DETERMINANTS OF WATER SOURCE CHOICE IN THE SLUMS OF KAMPALA: A SPATIAL AND INSTITUTIONAL ANALYSIS

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ABSTRACT

DETERMINANTS OF WATER SOURCE CHOICE IN THE SLUMS OF KAMPALA:
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Water is a non-substitutable human need. However, water scarcity is prevalent among 60% of the urban population living in the slums of Sub-Saharan Africa (SSA), partly due to ineffective resource distribution and governance. Globally, access to improved water sources is used as an indicator for water access; hence different stakeholders have invested in providing improved water sources. Utilities and NGOs have deemed pre-paid meter public standpoints (PPMs) the most successful available technology to extend pro-poor water services to the urban poor across SSA. In Kampala, Uganda, the national utility company (NWSC) adopted PPMs, not every water user in the slums chooses to use PPMs as their source for water. This research investigates the determinants of water source choice in Bwaise II, a slum in Kampala. I employed a mixed methods approach. First, I utilized GIS methods to present the spatial arrangement of the water system in the slum. Secondly, I utilized qualitative methods, namely interviews and focus group discussions with different water users, to answer questions investigating how, why, and when water users decide which sources to use. Results from this study present the changes in the water provision and access patterns in Bwaise II since the adoption of PPMs. They also present the perceptions different users have of different sources to specifically uncover the challenges users face when trying to access some of the components of the PPMs such as acquiring or recharging tokens. Findings from this study provide recommendations to improve the provision of the PPMs in slums to make them more accessible to the users.

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KEY TO ABBREVIATIONS

FGD	Focus Group Discussion
GIS	Geographic Information Systems
GPS	Global Positioning System
ID	Identification Card
KCCA	Kampala Capital City Authority
MoU	Memorandum of Understanding
NSDFU	National Slum Dwellers Federation - Uganda
NWSC	National Water and Sewerage Corporation
PPM	Pre-paid meter public standpoint
PSP	Post-payment public standpoint
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
UGX	Uganda Shillings
USD	US Dollar

INTRODUCTION

International treaties and national policies emphasize that water access is a basic human right and, therefore, should be made available to all (See Resolution A/RES/64/292. UN June 2010; African Union Agenda 2063 – Seven Aspirations). According to Pacheco-Vega (2019), even though the right to water has been declared as a norm that every country should follow, the applicability of the norm has many limitations. In fact, in 2017, over 844 million people in the world lacked access to improved and safely managed drinking water sources (WHO & UNICEF, 2017). Lack of access to reliable potable water compromises public health, economic activity, and overall wellbeing (Appelblad Fredby and Nilsson, 2013). Thus, it is not surprising that one of the Sustainable Development Goal (SDG) is to achieve universal and equitable access to safe and affordable drinking water for all by 2030 (United Nations SDG Knowledge Platform). According to authors such as Mehta (2014) and Parienté (2017), water scarcity in cities undergoing high rates of urbanization has little to do with volumetric measures and more to do with political and economic contexts that impact water management, which makes water scarcity in some parts of the cities a high concern.

In developing countries, urbanization is characterized by social, economic, environmental, and institutional challenges. These challenges include social inequalities, exclusion, pollution, an informal sector that employs many of the people living in the cities, and lack of basic infrastructure required for distribution and access to water, sanitation, and energy (You, 2007). “Rapid, unplanned urban population growth exerts pressure on different forms of infrastructure, weakens the urban governance systems and therefore leads to vulnerable urban environments” (Swapan et al., 2017, p 3). Urbanization has become virtually synonymous with slum formation in cities of

the developing world (Murungi, 2016). According to UN-Habitat World Cities Report (2016), as of 2014, about 359 million people in Sub Saharan Africa (SSA) lived in the urban areas, and 55.9% of them lived in slums. According to the UN/DESA (2015), the SSA urban population is projected to triple to 1.1 billion people by 2050. Currently in SSA, the rate of increase in service and infrastructure provision and access is not on par with the rate of increase in urban population (Parienté, 2017). Over half of the urban population lacks access to water due to resource distribution and allocation challenges, poor institutions, ineffective governance, and weak political will to address water scarcity (Dos Santos et al., 2017).

Globally, data on water access is often collected based on how many people have access to "improved" water sources, which implies that the source of water used is a fundamental indicator of water access (Adams, 2018). However, there are important indicators that determine access to these improved water access such as affordability, fetching time and distance from source, quantity of water available, quality of water at source, and reliability of source (Adams, Boateng, and Amoyaw, 2016; Devi and Bostoen, 2009; Majuru, Jagals, and Hunter, 2012; Nganyanyuka, Martinez, Wesselink, Lungo, and Georgiadou, 2014).

In 2017, 73% of the people living in SSA lacked access to improved and reliable on-premises water sources free of contamination (WHO/UNICEF JMP, 2019). The disparity in access to safely managed water infrastructure is dire among urban areas particularly in the slums where provision of water is poor (Adams, Boateng and Amoyaw, 2016; Adams and Smiley, 2019). Private household water connections are scarce among slum dwellers in African and Asian countries, so users utilize other water source options befitting of their social, economic, and political context

(Dagdeviren and Robertson, 2009). The options include public standpoints, (un) protected wells, water kiosks (vendors), rainwater harvesting and direct access from surface water sources (Le Banc, 2008; Adams, 2018).

In pursuit of the global goal of universal water access, national and international NGOs in SSA have devised and funded an array of policies and initiatives to increase safe water provision and access specifically for the urban poor (Kemendi and Tutusaus, 2018). This has enabled water utility companies to implement pro-poor services thereby extending water provision to under/un-served low-income communities (Boakye-Ansah et al., 2019). Pro-poor services require utility companies to extend service provision to vulnerable communities by designing service models that address specific challenges these groups have (Mason et al., 2016). Thus, utility companies have adopted appropriate technologies and structures to overcome conditions that prevent the slum dwellers from accessing water including lack of land tenure, inability to pay for water, inability to afford water infrastructure, and high connection fees (Boakye-Ansah et al., 2019, Berg and Mugisha, 2010, Schwartz et al., 2017).

In Kampala, Uganda, the national utility company called National Water and Sewerage Corporation (NWSC) adopted pre-paid meter public standpoints (PPMs) in 2008 aimed at improving water provision and access in the slums (Appelblad Fredby and Nilsson, 2013). PPMs are regarded as the best technology available to address water access challenges of the people living in the slums of SSA because they enable utility companies to meet the social objective of improving water access by providing infrastructure and water at subsidized prices, all while maintaining their financial viability (Berg and Mugisha, 2010; Heymans et al., 2014;

Schwartz et al., 2017). A few years after installation of the PPMs, water users in the slums of Kampala are reported to have convenient access to safe, affordable, and ample volumes of water, leading to an increase in water access from 26% to 84% (WSP Analysis Report, 2014; Heymans et al., 2014b; Berg and Mugisha, 2010).

Despite the local and regional popularity, PPMs do not come without challenges for users, such as unaffordability of tokens (the keycards needed to withdraw water from PPMs) (Heymans et al., 2014). Also, PPMs are capital intensive, which causes untimely or improper maintenance of infrastructure limiting their access (Von Schnitzler, 2008; Bond and Duggard, 2008; Schwartz et al., 2017). As a result, a significant number of people still do not or cannot use PPMs and opt for alternative sources such as wells and post-payment taps. Post-payment taps are associated with high water prices, but a token is not required to fetch water, while wells are mainly deemed unsafe (Murungi, 2016; Kayaga, 2007; Appelblad Fredby and Nilsson, 2013). In short, each source that users decide to use has associated benefits and challenges that either foster or compromise safe water access. It is therefore important to recognize the factors that influence users' decision-making vis a vis the different water sources available in the slums to better understand water needs, perceptions, and preferences among slum dwellers.

There are several studies on determinants of users' water source choice in the slums of SSA and the developing world; however, very few of them include PPMs (Adams, 2017; Pariente, 2017; Fotue and Sikod, 2012; Nketiah-Amponsah, Woedem, and Senadza, 2009; Briand et al., 2009; Hindman, 2007; Mu et al.,1990; Madanat and Humplick, 1993). Some of these studies suggest that water source choices are majorly influenced by the household's socioeconomic and

demographic characteristics and by the price of water (Fotue and Sikod, 2012). Some other common factors influencing choice include price of water, water fetching time and distance, quantity of water, and quality of water (Adams, Boateng, and Amoyaw, 2016; Devi and Bostoen, 2009; Majuru, Jagals, and Hunter, 2012; Nganyanyuka, Martinez, Wesselink, Lungo, and Georgiadou, 2014).

Isoke and van Dijk (2014) conducted a qualitative study using 200 in-depth interviews in the parishes of Bwaise II and Kisenyi II in Kampala, Uganda. The study aimed to determine users' choice for drinking water among four different piped water sources. These included public water points with conventional meters, household connections with conventional meters, pre-paid meter public standpoints (PPMs), and yard taps. The authors found that distance and time to get water from the source were the most important drivers of water source choice. In Bwaise II, reliability of water was the reason that came next, while in Kisenyi II cost was the next one. Overall, water users in Bwaise II preferred public standpoints with conventional meters to other sources of water because they are easy to operate and they are technically reliable as spare parts are readily available on the local market.

My study was also conducted in Bwaise II. Different from Isoke and van Dijk (2014), I look at all water sources available in the slum, and I do not focus only on drinking water. Since the study by Isoke and van Dijk (2014) was conducted shortly after PPMs were introduced in the slum, my study helps to understand what is happening with PPMs and other water sources over a decade after the installation of PPMs. I looked at all water sources available in Bwaise II, including sources that are free such as wells and springs. Studies on water source choice cite economic

reasons as key determinants for water source choice; therefore, I believe that considering both costly and free sources of water provides a more inclusive perspective of the determinants of users' choice. For purposes of this study, the water sources were categorized as follows: PPMs, post-payment taps (other piped water sources: household connections, yard taps and public water points) and other free sources (wells and springs).

This thesis aims to explore two research questions:

1. What is the spatial arrangement of water sources and other features of the water system in Bwaise II?
2. What are the determinants of water source choice in Bwaise II?

To address the first research question, a spatial arrangement of the water sources and other features of the water system in the slum is presented. It provides a visual guide of where all water sources such as wells, springs, post-payment taps and PPMs are, as well as other major features in the water system such as the pro-poor utility office, the local council office, and the service credit vending stations. The second research question is addressed through an investigation of the determinants of water source choice in Bwaise II based on interviews with users of different water sources (PPMs, wells, post-payment taps) to answer questions investigating how, why, and when they make decisions about the sources they use.

The results from this study present the factors that have fostered or compromised the choice of PPMs as a water source. This study found that most of the water users in Bwaise II prefer PPMs as their source of water. However, they face significant barriers to access which discourage the

use of PPMs, such as affordability of tokens and challenges in recharging them. These findings will be helpful to the utility company for making improvements to PPM provision and thereby sustaining convenient and affordable access to water among people living in the slums.

This document is organized as follows: (i) an overview of slums and of water access in SSA, (ii) a description of slums in Kampala and their current state of water access, (iii) a focus on water access in Bwaise II, the slum where this study was conducted, (iv) the theoretical framework on water governance with a focus on pro-poor water governance, the use of appropriate technologies and water user behavior, (v) the results from analysis of the data I collected to identify determinants of choice, and (vi) a discussion connecting the findings to present patterns and systems of access that influence choice of water sources in the slums.

AN OVERVIEW OF SLUMS

Originally, the term slum was used in Victorian times to refer to overcrowded, extremely dirty and unpleasant inner-city spaces in industrializing cities that arise due to poverty or neglect (Ward, 1976). In 1999, the UN reintroduced the word to mainstream and redefined it in the "Cities Without Slums" campaign (Fox, 2014; Gilbert, 2007).

Today in the context of Uganda, a slum refers to a heavily populated urban area that is characterized by substandard housing, social and economic isolation, irregular land ownership, low sanitation standards, and limited access to basic infrastructure and social services (Ministry of Land and Urban Development- Uganda, 2008). The UN-HABITAT Slum Almanac 2015-2016 defines a slum household as: "a living unit where the inhabitants suffer one or more of the following household deprivations: lack of access to an improved water source, lack of access to improved sanitation infrastructure, insufficient living area, lack of durable housing and security of tenure" (Slum Almanac, UN-HABITAT 2015/2016, 2).

Slums were regarded as part and parcel of the modernization or urbanization process of any developing country; they were deemed crucial as a starting place where poor migrating to the city would live while seeking employment opportunities (Frankenhoff, 1967; Fox, 2014). The belief was that people would work their way up the economic chain and eventually upgrade to standard living conditions with formal housing and better infrastructure outside of the slums (Fox, 2014). However, this myth has been debunked as slum formation has become more prevalent, especially in the developing world, mainly because the poor remain poor

and, therefore, lack the economic freedoms necessary to attain better standards of living or move out of the slum (Parienté, 2017; Fox, 2014; Turner, 1969).

In 2016, one in eight people worldwide lived in slums, amounting to a global slum population of one billion; about 881 million of these inhabited the slums in developing countries (Slum Almanac, UN-HABITAT 2015/2016; SDG 11 Progress Report, 2019). SSA accounts for approximately 22.8% of slum population in the developing world, and the slums are inhabited by approximately 56% of the region's urban population (Boakye-Ansah et al., 2019; HABITAT, WCR 2016). As in many other places, these slums have developed in spontaneous and unregulated ways, which makes it challenging for governments to plan, invest in, and develop infrastructures to enable access to basic services such as water (Boakye-Ansah et al., 2019; HABITAT, WCR 2016).

OVERVIEW OF WATER ACCESS IN SSA

Access to safe drinking water improves public health and overall well-being. As mentioned earlier, the term water access does not have a universal definition; it is rather a loaded term used to represent a set of factors or indicators necessary for an individual or household to get the water they need (Obeng-Odoom, 2012; Smiley, 2013). Most stakeholders measure water access based on how many people have access to "improved" water sources (Adams, 2018). However, a lot of criticism has been raised about potential under- or mis-reporting access because water sources classified as "improved" may end up being contaminated during transportation or water can become unsafe because of household storage practices (Boateng, Tia-Adeji &Adams 2013).

Over the years, the simplistic measure of water access based on improved water source has been criticized for not accounting for factors such as cost, availability, equity, and energy/time required for obtaining water (Adams, 2018). According to WHO/UNICEF JMP (2019), improved water sources have been further categorized into safely managed, basic, limited, and unimproved services for better assessment of Sustainable Development Goal six (SDG 6). Safely managed refers to sources located on premises, available when needed and free of contamination; basic refers to improved sources within 30 minutes round trip collection time; limited refers to improved sources beyond 30 minutes round trip collection time on foot (WHO/UNICEF JMP, 2019).

SDG 6 on management of water and sanitation contains targets and indicators that include economic and political factors (Adams, 2018). The first target of SDG 6 is to achieve universal and equitable access to safe and affordable drinking water for all by 2030. As of 2015, only 24% of the population in SSA used safely managed drinking water sources, while only 34% had access

to basic drinking water services (UN DESA n.d, JMP WHO/UNICEF JMP, 2017). Improved drinking water sources are scarce in SSA because there are few piped water connections inside the home or in the yard (Adams, 2018; Dos Santos and LeGrand 2006).

Service differentiation is the pro-poor service approach that utility companies in SSA have used to deliver appropriate technologies addressing the infrastructural and institutional barriers of access among the poor (van Ryneveld et al., 2003). This service takes into consideration the willingness and ability to pay for water services, as well as institutional inadequacies such as lack of land tenure rights (Gerlach and Franceys, 2010). Pro-poor service technology such as pre-paid meters (PPMs) has gradually increased coverage of improved water sources to the urban poor, thereby improving access (Berg and Mugisha, 2010). "A pro-poor service is a service that is designed and delivered to overcome common barriers of the poor around cost, information, regulation, and physical location that prevent poor people from accessing services" (Mason et al., 2016, 9).

Pro-poor service provision calls for a delicate balance between social and financial objectives (Schwartz et al., 2017, Marson and Savin, 2015). Some critics of pro-poor services argue that utility companies are too concerned about financial viability which fosters water commoditization, leading to lack of access for those that cannot afford to pay the subsidized prices (Boakye-Ansah et al., 2019, Mason et al., 2016). Therefore, differentiation of water delivery services compromises the goal of universal access to water (Schwartz et al., 2017). It has also fostered inequitable service provision as utility companies employ different levels of service for different consumers within the same water access system – which most likely leaves the urban poor with services not up to

the desirable standards (van Ryneveld et al., 2003). PPMs make money "prerequisite to access and access to water is cut off when consumers have used up their credit or when they do not have money to pay at water points" (Boakye-Ansah et al., 2019, 193). For this reason, "water access activists refer to PPMs as 'silent disconnections' that are neither acknowledged by the municipality nor afford space to negotiate or protest" (Von Schnitzler, A. 2008, 912). Nonetheless, if a consumer is able and willing to pay, the concept of pre-payment is not alien to the people living in the slums. Therefore, they are not concerned about the notion that PPMs require prepayment, rather they are concerned about the benefits they derive from the technology including convenience, affordability, and reliability (Heymans et al., 2014).

On the other hand, Marson and Savin (2015) explain that utility companies must focus on their financial objectives because cost recovery helps them maintain financial viability, which is a fundamental requirement to acquire loans from national and international finance organizations. Financial viability is also used by regulatory bodies as the basis for benchmarking regulation (Marson & Savin, 2015). Therefore, despite the apparent hardship in balancing financial and social goals, the technologies adopted need to be able to address both in the interest of the poor and marginalized; focusing on one over the other is not sustainable (Castro and Morel, 2008; Mehta, 2014, Schwartz et al., 2017).

As mentioned earlier, pre-paid meter technology has been adopted across SSA to improve water access for the poor. A pre-paid meter is a piece of technology that utilizes digital meters, fosters pre-payment at public water taps, and is used to replace conventional water meters which used a post-payment method. Users load service credit onto the token (re-chargeable key cards), which

they swipe through the pre-paid meter standpoint (PPM) to get water (Heymans et al., 2014). PPMs have been deemed the most successful pro-poor technology in water provision to the poor in SSA (Berg and Mugisha, 2010; Heymans et al., 2014; Schwartz et al., 2017). Although they are costly to acquire, install, and maintain, utility companies have recorded better cost recovery from volumetric water sales to the poor with pre-paid meters in place as compared to when conventional meters were being used; therefore, PPMs are referred to as the ultimate cost-recovery tool (Berg and Mugisha, 2010).

Studies cite that PPMs are capital intensive in terms of installation, and utility companies are reliant on external funding to acquire, install, and manage PPM provision, which limits coverage (Appelblad Fredby and Nilsson, 2013, Berg and Mugisha 2010, Heymans et al., 2014). Studies also suggest that maintenance of PPMs in SSA is inefficient because spare parts are not readily available within local markets: they are imported. The lengthy technology acquisition times limit reliability of access from PPMs as maintenance depends on the time and money available to acquire the spare parts (Dugard, 2008; Kumwenda, 2006; Heymans et al., 2014). Focus on financial viability, reliance on external funding, and technology acquisition challenges compromise scaling up of the pro-poor services, thereby weakening the level of service provision and leading to deterioration of access over time (van Ryneveld et al., 2003).

OVERVIEW OF THE SLUMS IN KAMPALA AND WATER ACCESS

Uganda has a total of 39 million people with 15.8% (approximately 6 million people) living in urban areas and 53.6% of the urban population living in slums (Slum Almanac, UN-HABITAT, 2015/2016). The Ministry of Lands, Housing and Urban Development was established in 2006 in response to rapid urbanization, and one of its main goals is to manage land and housing related challenges in the face of growing cities (Richmond et al., 2018). Kampala is the capital city and, since its formation in 1902, has had a spatial growth from 0.7 square kilometers to 839 square kilometers in 2018 (Richmond et al., 2018; Davis, 2007). In 2014, Kampala city was estimated to have a population of about 1.6 million people; 60% of these were estimated to inhabit its 57 slums spread across the city and live on less than 2 dollars a day (UBOS, 2014; Richmond et al., 2018).

Water is one of the key drivers of vulnerability for Kampala slums (Richmond et al., 2018). Prior to the introduction of pro-poor programs in 2006, only 17% of the population living in the slums was reported to have access to improved drinking water services (Water and Sanitation Sector Performance Report (WSPR), 2006). This was attributed to the absence of water distribution networks within the slums, and, where they existed, connection to on premise water sources was too expensive (Appelblad Fredby and Nilsson, 2013). Slum households in Kampala are characterized by low incomes ranging from UGX 10,000 to UGX 285, 000 per month (USD 6 – USD 166); thus they are unable to obtain and maintain in-house piped water connections (African Water Facility report, Kagugube Parish, 2010; Kayaga and Franceys 2007).

The complexity of land tenure in the slums arises because of the interaction between formal and informal rights that yield complex ownership claims over the land. Most of the people living in the slums do not have land titles - formal tenure security. However, they have somewhat secure informal property rights that in some instances play the role of a formal title, but not in all instances (Parienté, 2017; Lanjouw and Levy, 2002). Most of the slums in Kampala are established on Mailo land, customarily owned by the Buganda Kingdom (Kampala Slum Profiles, NSDFU 2014; Bryceson and Potts, 2006). Customary land rights could fall in the category of formal rights and, depending on the context, they can be absolute or overruled by federal land rights (Payne, 2001). In Kampala, slum dwellers often suffer eviction or live under a threat of eviction by third parties such as the city and national government or other private individuals (Irumba 2015; Kampala Slum Profiles, NSDFU 2014). The possibility of eviction creates un-certainty about the timeframe of both social and financial returns from infrastructure and service provision which dis-incentivizes NWSC from extending services to slums (GBOPA Commitment report, 2008). In addition to the uncertainty for the utility companies, some authors find that without some form of land tenure, people do not have the incentives to invest in infrastructure on the land they occupy (Nyametso, 2012; Parienté, 2017). A final concern with extending water services to the slums is the fear that installing somewhat permanent infrastructure like water mains (pipes) underground in areas that do not have tenure may seem like legitimizing the occupancy of that land and inadvertently encouraging faster slum growth (Water Utility Partnership, 2003).

There are three types of water sources in the slums of Kampala: public, private, and shared private. Public water points include (un) protected boreholes/wells, springs, and some piped water sources such as post-payment public stand points (PSPs/Kiosks), yard taps, and pre-paid public standpoints

(PPMs). Wells and springs are open access resources; they can be accessed by anyone and have no assigned caretaker or manager. However, wells and springs in the slums have increasingly been reported and considered contaminated by the Ministry of Health-Uganda among other scientific organizations and have been deemed unsafe for consumption. Specifically, these organizations caution that the water from these sources is contaminated with E. coli bacteria infiltrating into ground water from human waste due to lack of proper sanitation infrastructure (WSPR, 2006).

Piped water sources can be public, private, or shared private. Private and shared private piped water sources are yard taps that operate under the owner's rules. The ones where the owner sells water are called shared private. They all operate with conventional water meters that use the post-payment method. Public piped water sources such as PPMs are used by community members but are managed by one individual or household. All piped water sources (regardless of the property) are regarded as improved water sources.

The processes of acquiring post-payment piped water sources was both unaffordable and procedurally marginalizing the slum dwellers. Slum dwellers live in absolute poverty and could not afford to pay the required consumption fee deposits in addition to the already high connection fees of 150,000 UGX (about USD 58). Also, most of the slum dwellers do not own the land they live on and, therefore, could not present the proof of land ownership that was required to be connected to the water system (Murungi, 2016; Kayaga 2007).

NWSC created the pro-poor unit in 2006 and devised a program to subsidize the installation of public stand points (PSPs) with a differentiated rate structure (GBOPA Commitment report, 2008).

Water affordability at the PSPs became a major barrier to access as the public was paying an average price between 50-100UGX per 20L jerry can; yet the NWSC differentiated rate was at 17UGX per 20L jerry can (WSP Analysis Report, 2014). Furthermore, water shutoffs at PSPs became prevalent due to non-payment. Given the economic hardships, slum dwellers spend as they earn so PSP owners could not pay off cumulative monthly bills to sustain the water supply. (GBOPA Commitment report, 2008; Kayaga, 2007; Fredby et al., 2013). Provision of PSPs increased connections to the improved water system but not necessarily access to water from the source because only 26% (was 17% prior to program) of the population reported having access to it (GBOPA Commitment report, 2008; WSP Analysis Report, 2016). Resultantly, slum dwellers continued to rely on alternative sources, namely wells and springs.

In 2008, NWSC adopted the pre-paid meter technology as a tool to address barriers to access such as affordability, lack of infrastructure, lack of land tenure, dominance of middlemen, and the monthly payment structure (Appelblad Fredy and Nilsson 2013; WSP Analysis Report, 2014). NWSC installed three different kinds of pre-paid water points in different slums of Kampala: pre-paid public stand points (PPMs), pre-paid yard taps, and pre-paid domestic connections (NWSC Report, 2013; WaterAid, 2016). The pilot project began in 2008 in two slums, Kisenyi II and Ndeeba, funded by the German government under the KfW project (GPOBA Commitment Paper, 2008). Since then, NWSC has expanded the provision of pre-paid public stand points (most successful type among all three types of PPMs) to Kagugube and Bwaise II slums with funding from other international organizations like the African Water Facility, the World Bank, and the Coca Cola Foundation (African Water Facility report, Kagugube Parish, 2010).

Initially, the utility company faced a challenge when attempting to acquire land to install the PPMs. Some landlords rejected the installation for fear that installing this infrastructure would lead to the government taking over their land (GBOPA Commitment report, 2008; Heymans et al., 2014b). However, by 2013, a total of 1613 PPMs were installed in 16 out of 25 slums and were serving an estimated 900,000 slum dwellers (about 84% of the slum dweller population). Each standpoint served 15-30 households (African Water Facility report, Kagugube Parish 2010; Murungi, 2016).

Murungi (2016) notes that "slum dwellers have good and continuous access to affordable water supply for as long as there is no breakdown or if so, repair or replacement is undertaken within a reasonable time frame" (p.206). Therefore, the reported level of service is might be misreporting the reality on the ground where functionality and maintenance of PPMs are major challenges (Berg and Mugisha, 2010). Figure 1 shows the status of PPMs in the slums of Kampala (Heymans et al., 2014b)

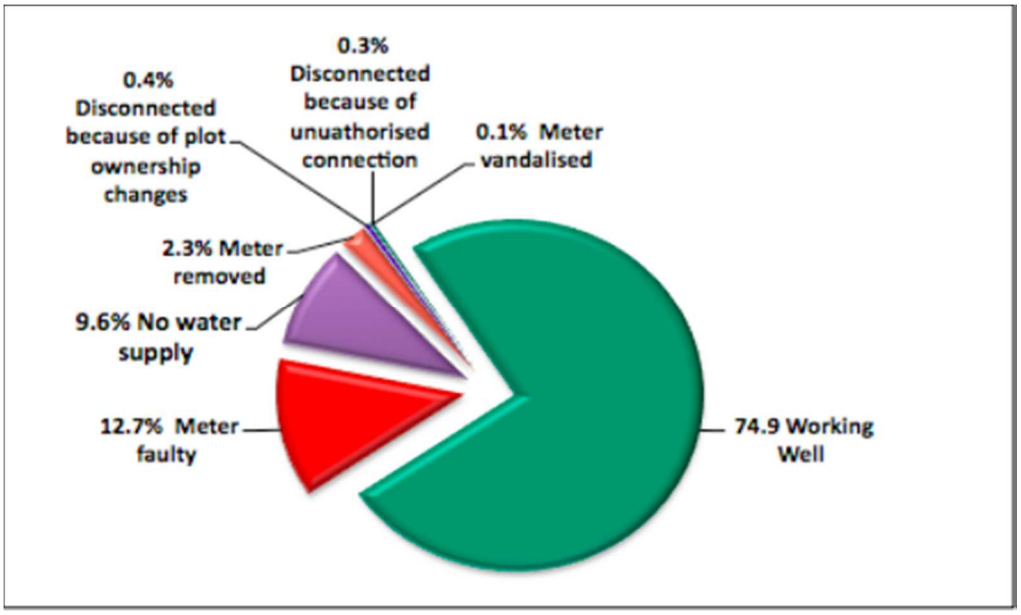

Figure 1. Status of PPMs in the slums of Kampala (February 2014 report)

Figure 1 shows the status of PPMs in 2014. Approximately 12.8% of the meters in the slums did not function due to maintenance or replacement challenges (Heymans et al., 2014b). As mentioned earlier, reliability of PPMs is one of the biggest challenges in the slums of Kampala where the infrastructure has been installed (Murungi, 2016; Appelblad Fredby & Nilsson 2013). A total of 3.1% of the PPMs were either disconnected or the meters were removed partly due to land ownership issues. Landlords who offer their land for PPMs sign an MoU to have the infrastructure for 20 years. However, the utility cannot effectively enforce this contract when landlords decide to sell their property to another owner or when they decide they no longer want the PPM on their land. Sometimes the landlords assume ownership of PPMs and deny/limit public access to the PPM, which forces the utility to seize the meter (African Water Facility report, Kagugube Parish – 2010; Heymans et al., 2014).

THEORETICAL FRAMEWORK

> *Water governance refers to the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society.*
>
> (Rogers and Hall, 2003, 7).

Water governance in cities

Provision of and access to adequate water is a fundamental requirement for building inclusive cities (Sutherland et al., 2015). However, a combination of climate change and rapid urbanization renders the current infrastructure and systems in cities unable to provide sufficient levels of water supply, making them prone to more water scarcity challenges. The extent of these challenges is dependent on how efficiently water is governed (Romano et al., 2019). Therefore, cities need to adopt and implement governance frameworks that encompass a holistic understanding of what needs to be done, how and by whom, and at which government level in order to effectively cope with the current challenges and uncertainties around water provision and access (Biswas and Tortajada, 2010).

Good governance responds to place-based needs; therefore, good water governance requires a holistic understanding of water users' demand for both domestic and productive water uses (Whittington et al., 1998). However, it is impossible to develop all-encompassing water governance indicators because different types of water uses have different governance requirements (Biswas and Tortajada 2010). For example, urban water governance requires different types of institutions and approaches as compared to irrigation water governance because the structures and functions of the institutions responsible for these two water use types are

different (Molden et al., 2010). The OECD Water Governance Initiative has the most comprehensive set of studies related to water governance, and it developed principles structured around the fact that governance should contribute to the definition and implementation of goals (effectiveness), at the lowest possible cost to society (efficiency), while ensuring inclusiveness of stakeholders (trust and engagement) (Romano et al., 2019; Berg, 2016). It is on these principles that water governance approaches can be assessed (Meene et al., 2011)

The hierarchical governance approach heavily involves centralized public authorities and little stakeholder participation in decision-making or designing and implementing water supply systems and, therefore, is incapable of adapting to the ever-changing water landscape in cities (Pahl-Wostl, 2007, Romano et al., 2019, Meene et al., 2011). Particularly, perspectives on water governance in the slums have increasingly changed from favoring state-led approaches to encouraging market-based or private-sector oriented governance solutions that are more adaptive to the ever changing and dominantly informal landscape in the slums (McGranahan and Satterthwaite, 2006; Dagdeviren & Robertson, 2011).

The market-based water governance approach was introduced into urban water management with the goals of allocating resources more efficiently and increasing engagement of different stakeholder other than national, city and municipal governments participation in water management through asset ownership (Pierre and Peters, 2000; Romano et al., 2019). Ownership is operationalized in the form of contracts between private and municipal entities, creating corporatization and competition in water provision (Bakker, 2002). Even if recent water reforms like PPM provision incorporate a market model of governance, different scholars have criticized

it for increasing the number of independent (private) actors with "self-serving" motives that lead to commodifying of water. This marginalizes the urban poor by limiting access to water resources that users could access freely before (Bakker, 2003; Saleth and Dinar, 2005, Meene et al., 2011). Therefore, it is important to emphasize the role of state-led water governance approaches such as investment in public infrastructure, implementation, and monitoring of supply systems in the case of developing countries where 30% of the urban population is living in the slums and experience affordability issues (Dagdeviren & Robertson, 2011). Such state-led government intervention has been very instrumental in alleviating access in Bwaise II slum where NWSC, a public utility following a mandate from the national government has committed to providing pro-poor water programs since 2006 with the goal to extend to extend safe and affordable water access the poorest water user that the market-based water provisions were marginalizing (Appelblad Fredby & Nilson, 2013; Berg and Mugisha, 2010).

Pro-poor water governance and institutions

Pro-poor is a specification of the intended outcome for water governance, which is to deliver, manage, and sustain water access for the poorest level of society using differentiated social, political, and economic systems (Connors 2005). As presented earlier, water governance is not one size fits all; it requires different governance approaches for different contexts, namely rural vs urban, rich vs poor (Molden et al., 2010). In the context of provision and access for the urban poor, "water can be regarded as an item of private consumption, but its provision can be categorized as an *essential community service*, which governments need to prioritize and that poverty reduction budgets need to allocate for" (Gutierrez, 2007, .892)

Water access in the slums is negotiated through mechanisms of water governance including institutions, social structures, right and entitlements, and financial resources operating at both formal and informal levels of society (Clever and Boesten, 2005). According to Ostrom (1990) and North (1990), social groups create institutions to shape interactions among individuals, in this case interactions to provide and access water. In principle, government bodies and utility companies devise formal rules of water provision and access in line with their obligatory extent and legal framework (Pacheco-Vega, 2019). These are created, communicated, and enforced through official channels; however, formal arrangements of provision are often insufficient in extending water services to the urban poor. They are not adaptable to the ever-changing water access landscape in the case of informal settlements like slums (Helmke & Levitsky, 2004; Meene et al., 2011). As a result, water users improvise mechanisms to ensure continued access when government provisions fail, and an informal water provision and access system emerges (Pacheco-Vega, 2019). The informal water system is mediated through socially transmitted information and adopted through social networks and political organizations that emerge in non-linear and complex ways (Rogers & Hall, 2003; Helmke & Levitsky, 2004).

Pro-poor water service provision utilizes appropriate technologies or physical infrastructure as the critical and most resource used to mediate affordable, manageable, and adaptive water services designed for the urban poor (Clever and Boesten, 2015). However, because of the existence of different water sources /infrastructures in the slums, there are different modes of governance and institutions already in place that prescribe water user behavior and choice of water sources (Bakker 2010; Schlager and Ostrom 1992). Therefore, effective pro-poor governance systems need to be put in place to facilitate the functionality of pro-poor technologies like PPMs and water user choice

for these appropriate technologies in order for the specific pro-poor goals to be actualized (Levin and Milgrom, 2004). Designing, using, and managing any form of technology involves both mechanical and socio-political systems through which water access is negotiated among actors following both formal and informal institutional arrangements (Clever and Boesten, 2003). There are different stakeholders within a singular water system in the slums that hold different bundles of rights which affect their incentives, actions, and, therefore, the outcomes they pursue with regards to access to water (Rogers & Hall 2003; Ostrom 2009). Therefore, adopting and fostering choice of PPMs in the slums requires drawing relationships between the allocation of the PPMs, the social structures within the water access system in the slums and the rules mediating the rights associated with water sources and who makes those rules (Frank and Cleaver, 2007).

Technology impacts power relations as it influences who controls the technology and by extension who controls the resource (Frank and Cleaver, 2007). Distinctions of this nature can be complicated within the slums because property rights are sourced from a complex intersection of both formal and informal institutions (distributed governance) that sometimes complicates understanding of individual/community behaviors and outcomes (Ostrom 1990). When pro-poor technology is introduced into the urban poor spaces, rights and access to other resources linked to it are negotiated through claims of ownership of the pro-poor technology because they can change the operational rules (Schlager and Ostrom 1992; Clever and Boesten, 2005; Frank and Cleaver, 2007). Claims of ownership to water infrastructure in Bwaise II must be understood because using the PPM system for example - the introduction of PPMs that utilize tokens an additional means of access to water from PPMs has introduced two technological requirements who ownership

together or separately is likely to influence the rights to access water in ways that either foster or compromise access for the water user.

METHODS

Study Area

This study was conducted in the parish of Bwaise II, a slum located in Kampala. Kampala is divided into five administrative units called divisions which are further divided into parishes. The city has a total population of 1,507,080 people (UBOS, 2014). The city has a total of 57 slums inhabited by 60% of the total city population, with 31% living in Kawempe division.

Bwaise II is one of the three slums where PPMs have been extensively added in the city, together with Kisenyi II and Ndeeba. Given the fact that Kisenyi II and Ndeeba were the first slums to have these infrastructures installed between 2006 and 2008, a lot of case studies have been conducted studying those two areas. When I was discussing with the utility company pro-poor project manager about places where we should conduct the research, I was advised not to go to those slums because residents have expressed that they have research fatigue. Additionally, the utility company (NWSC) was interested in learning more about the PPM users' perceptions in Bwaise II because not much research has been done in this area on PPMs. I followed NWSC's request since I want this research to both contribute to the literature on determinants of water source choice in a slum and provide policy recommendations about ways to improve water provision in the slum. Since the utility company is an essential actor in the system, I followed their request.

Bwaise II slum is one of the 15 slums located within Kawempe division. It was founded in 1986 following a subdivision of Bwaise into three parishes namely Bwaise I, II and III (Kampala Slum Profiles (NSDFU), 2014). Bwaise II parish houses the Kampala Capital City Authority (city

government) headquarters for Kawempe Division. Bwaise II is divided further into 8 administrative zones including Nakamiro, Tebuyoleka, Nabukalu, Jambula, Mukalazi, Lufula, Katale and Mugowa (KCCA Division Grades). The slum is divided into low-income and high-income communities. In relation to zones, low income communities are in Nakamiro, Jambula, Katale and Nabukalu zones in the drainage belt of the Nakamiro channel.

Bwaise II slum covers a total area of 190 acres of land owned customarily under Buganda Kingdom and residents are accountable to the Buganda Land (Kampala Slum Profiles (NSDFU) 2014). As in many slums, most buildings are unplanned, and land occupation does not have formal approval from the government central planning offices which puts the people living in Bwaise II slum under the threat of eviction. Bwaise II has a total population of 42,000 people living in 7,000 households; 75% of them are tenants that do not own the land they live on. The majority (59%) of the structures in the slum are only residential, 23% are used only for business, 12% are used for both residential and business and 6% are used for other purposes such as places of worship and government buildings (Bwaise II Neighborhood Profile, 2018; Kampala Slums Profile (NSDFU), 2014). Due to time and budgetary constraints, I could not collect data in all zones in the parish, so I selected one zone to do the research. I decided to do the research in Nakamiro zone because it seemed the best zone within the slum to explore the research questions. As presented in literature on water source choice – distance, income, and presence of alternative water sources are some of the key determinants for users' decisions (Hindman, 2007; Mu et al., 1990; Madanat and Humplick, 1993). Spatially, Nakamiro inhabitants have access to multiple water sources, namely PPMs, wells, and post-payment taps. Moreover, Nakamiro is one of the zones with the lowest income within Bwaise parish which means that they likely use fewer private

connections such as post-payment taps than in other zones and are more likely to use PPMs and wells (Isoke and van Dijk, 2014; Fotue and Sikod, 2012). From the initial visits to the slum, I established that Nakamiro had a total of fifteen PPMs installed, ten of those were functional and five were not working.

Map of Bwaise II slum showing selected study site.

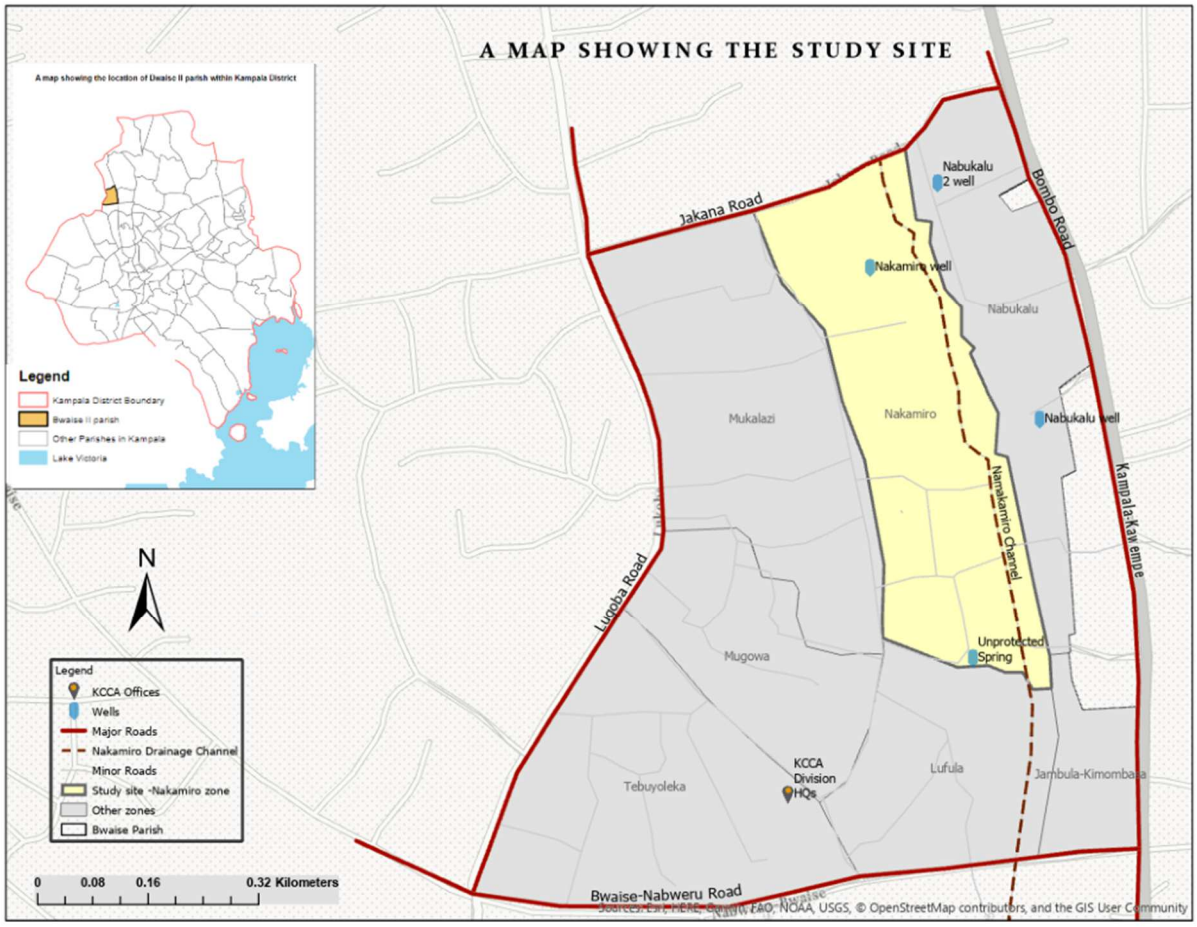

Figure 2. Map of Bwaise II parish showing selected study site, Nakamiro zone.
Created by Nanteza Rachel using ArcGIS. Location data for main water features collected by Nanteza Rachel using an app called GPS Tracks.

Study design

I used a case study design to carry out a specific descriptive investigation and gain in-depth understanding about the patterns of access and the determinants of water source choice in Bwaise II (Flyvbjerg, 2006; Yin, 2009). I used a mixed methods approach to collect different types of data and bring to bear the different dimensions of the water access system in one of the zones in Bwaise II parish (Creswell 1999; Tashakkori & Creswell, 2007). I used quantitative methods including geographical information systems (GIS) mapping and analysis to answer the first research question seeks to present the spatial distribution of the different components of the water system in the slum. The system includes the different sources of water available, namely wells, springs, PPMs, and post-payment taps, and other features such as service credit vending stations, utility company offices, and local council offices. I used different qualitative methods such as field notes, semi-structured interviews, and a focus group discussion with water users to answer the second research question exploring the determinants of water source choice in Bwaise II (Denzin and Lincoln, 2000). I triangulated the information and findings from each method (both qualitative and quantitative approaches) to present the overall interpretation of the determinants of choice in Bwaise II and provide a better understanding of the realities of water users in the slum (Tashakkori and Teddlie, 1998).

IRB approval

Before my departure to Uganda, I obtained Institutional Review Board (IRB) approval from Michigan State University to conduct my research. Additionally, once in Uganda I also had to get IRB approval from the Makerere University School of Health Sciences, and then I had to get a research permit issued by the Uganda National Council of Science and Technology. Finally, I also

got a clearance stamp from the Town Clerk of Kawempe Division to conduct research in Bwaise II slum.

Data collection methods

Data was collected during 7 weeks from June 2019 through August 2019 using the following methods: observation, GIS mapping, semi-structured interviews, and focus groups. I conducted the data collection with a research assistant who had extensive knowledge of and contacts in the slums of Kampala, particularly Bwaise II slum. In the following paragraphs, I explain each of the methods.

Observations

During the first two weeks of my fieldwork, I collected out observational field notes in the entire Bwaise II parish. My research assistant and I did a guided field tour around the parish with one of the youth leaders, who introduced us to local leaders, local organizations and different water users in the area who are gatekeepers within different zones of Bwaise II, and are knowledgeable about issues of water access in the zone. We canvassed the area to observe and familiarize ourselves with the community, engaged in conversation with people fetching water from different sources including post-payment taps, wells, springs, and PPMs to learn about water user behavior in relation to the different features relevant to the water access system in Bwaise II.

During the guided tour we identified and I took notes on the composition of the water system in Bwaise II, characteristics of different water sources identified, and stakeholders in the system, including water users, service credit vendor, and local leaders present in Bwaise II. I took notes

on the dynamics of how users access water from PPMs, how they purchased and re-charged tokens, what containers they used to fetch water in, peak-hours of water collection, and the gender and age of people fetching water and buying service credit from the only service credit seller.

These observations were crucial for my research because they allowed me to gain an experiential understanding of the water access system, which is imperative for conducting qualitative studies (Patton, 2015). I used the field notes and experience from these observations and engagements with community members to refine the protocols of the semi-structured interviews and focus group discussion (See appendix A of this thesis for the different interview protocols in English and appendix B for the focus group protocol in English). Then, my research assistant translated the protocols from English to Luganda, which is the dominant local language used in Kampala.

Spatial Data collection and GIS mapping

Spatial data is also known as geographic information about the location of features and their descriptive characteristics. I used the mobile phone app called GPS Tracks to collect GPS locations of water sources within the water access system, namely eighty-seven pre-paid meters' taps, three wells, one spring, and eight shared post-payment taps throughout Bwaise II parish. I also used the app to collect GPS location data for other key features in the system, including the service credit vending station, and utility company offices. Along with collecting spatial data for each feature, I observed and recorded descriptive data about all the features. The descriptive data contained information such as whether the water source was working or not, how busy the source was at specific times, and the zone in which the source was located (see Appendix C for GIS mapping guide used in this study).

Once I collected all the data, I created an Excel spreadsheet for all spatial features located with GPS, and I included all the descriptive data. I then used this data to create field maps that I used during the interviews. During the triangulation phase of my research, I used relevant data from semi-structured interviews and focus groups to supplement the descriptive data I initially gathered.

GIS mapping enables integration of multiple layers of spatial data and information (both quantitative and qualitative) to derive causal relationships between attributes within a system (Hiscock et al., 1995). I imported the Excel sheet into ArcGIS, a software used to analyze spatial data, and created maps to visualize the spatial distribution of the water access system within Bwaise II. I used these maps during the semi-structured interviews.

Semi structured interviews

For this study, I conducted a total of 35 semi-structured interviews with different stakeholders in the water access system of Nakamiro zone. 29 of those interviews were with water users and 6 were with other key informants who are knowledgeable about the water system because of their jobs and leadership positions within Bwaise II.

Interviews with water users in the slum

I categorized the users into two groups. The PPM users group includes people who used PPMs in some capacity. The non-PPM users group did not use PPMs at all. I created these user groups centered around PPM usage because my initial interest was around determinants of the users'

decisions to use or not use PPMs in Bwaise II. Then, I created different interview protocols for the two user groups to ensure that I elicited user experiences specific to each group. The questionnaires contained questions about water source used, water price, PPM infrastructure, rules of access, and other questions. All interviews with water users were conducted in Luganda. The interviews lasted between 20 and 45 minutes and were audio recorded with oral consent from the interviewee prior to the beginning of the interview.

All interviewees were purposefully selected using a snowball strategy guided by the maps I created (Patton, 2015). A guided approach to sampling was very important for this study because I learned from the observation and mapping methods that the spatial distribution of water features in the north and south differed, so water access likely varied across the zone. Therefore, I used the map as a spatial guide to strategically spread interviews throughout the zone, ensure maximum variation in data collected, and capture the likely heterogeneity within the water access system.

To start, I randomly chose a post-payment tap within Nakamiro on the map and approached the people living in the household where the water source was installed with the intention of interviewing the owner, landlord, or caretaker of the water source. I interviewed the landlord or caretaker at that PPM, and then I randomly approached people fetching water at that PPM to interview them. Then I asked them for a recommendation of someone who does not use PPMs in their area. I interviewed water users until I got a satisfactory spread of interviews across the zone and I was not hearing any new data (reached saturation) from the responses from the different water user groups I had identified during the interviews. These groups were non-PPM users at

wells and post-payment taps, PPM users including landlords of PPMs, token owners, and non-token owners. Some of these categories emerged from the research process.

In total, I conducted 29 interviews with water users; 25 were women and 4 were men. Four out of the 29 primarily used post-payment taps, two used only wells, eight used primarily PPMs (six of these were landlords), and 15 used a mix of pre-paid meters and wells. Out of the entire sample, 13 water users owned tokens (including landlords). The interviews were conducted either at the water source, at the home of the water user, or at their workplace, depending on where we found them.

Interviews with other key informants

I interviewed the NWSC representative who is part of the team that oversees the pro-poor provision in Kampala, therefore in Bwaise II, to get insight into the provision of piped water sources in Nakamiro. I also interviewed the only service credit vendor available in Bwaise II parish to understand the service credit vending system from a seller's perspective. In addition, I talked to two local leaders within Nakamiro zone l who were instrumental in the planning of the PPM program and its introduction to water users in Nakamiro. These interviews allowed me to understand the engagement aspect of water provision. Finally, I interviewed two NGO personnel who are part of an organization that conducted community education on PPMs prior to their introduction in Nakamiro. This NGO has also led projects to provide water infrastructure in different slums across Kampala.

I used the same interview protocol for all interviews and asked questions about the informant's role in the system, any form of collaboration with other stakeholders and water users, rules of

access, their perceptions of water access in Bwaise II, and other questions. The interviews lasted between 60 and 90 minutes and were audio recorded with oral consent from the interviewee prior to the beginning of the interview.

Focus group discussion (FGD)

In addition to the semi-structured interviews, I conducted one FGD with six PPM users (2 women and 4 men) who did not participate in the semi-structured interviews to gather other ideas about determinants of choice among the different sources of water available. In addition, I asked about the benefits and challenges that they face with each of the sources of water (Natasha, 2011). I ensured that these water users were diverse, in the sense that some only used PPMs (3) and some used PPMs and other source of water available in Nakamiro (3) zone, to elicit both divergent and convergent PPM user experiences. I worked with a youth leader in Bwaise II to do the recruitment for the FGD. I collaborated with this youth leader because, given his positionality in the community, he knew the users in the zone.

I used the translated FGD protocol (See Appendix B) to guide the discussion among participants in Luganda. I used the guide to prompt participants to name and explain their experiences in the form of benefits and challenges regarding the PPM system. This list created by all participants was meant to depict divergence in PPM user experiences. The FGD last for two and a half hours and was audio recorded with oral consent from the participants at the beginning of the discussion.

I used a convergence triangulation model to compare data on PPM user experience in the interviews and in the FGD. I used the data in the FGD to confirm and corroborate the data from the semi-structured interviews on water user experiences with a focus on PPM user experiences.

Data Analysis methods

Spatial (GIS) Analysis

I did the GIS analysis using ArcGIS with the spatial and non-spatial data I collected. I used the ArcGIS geo-processing tools to calculate the distance of PPMs from other key features in the water system, including the service credit vending station and NWSC offices. Having these quantitative measures allowed me to triangulate the qualitative narratives around some of the determinants of choice such as convenience and presence of alternative water sources (Hiscock et al., 1995).

Qualitative Analysis

Writing Analytic Memos

The analysis of data collected in this study was iterative as it started in the field with me writing analytic reflections of my observations and interactions with the participants for every interview and after the FGD.

Developing a code book

Post fieldwork, I developed a codebook in English (see Appendix D) with themes and codes that were derived from the theory of water access/choice and water governance. Other themes and codes were derived from the raw data collected in the field (DeCuir-Gunby, 2011; Guest and MacQueen, 1998). I performed an inter-coding exercise to make sure the codebook was clear and reliable. I asked a Luganda speaker to code three interviews that I had already coded and ran a coding comparison query in Nvivo using her coding and mine; this resulted in a Kappa coding co-efficient of 0.43. According to Landis and Koch (1997), this co-efficient reflects a moderate inter-coding reliability for this study's coding exercise. Many factors may explain that result First, the

other coder is not familiar with the research topic and so we analyzed data based on different contextual units for example in some instances where I coded a paragraph or couple of sentences to capture the entire meaning of some codes, she used a few words within a sentences. Therefore, with a moderate score and based on some comments I received from her, I modified some of the codes and their definitions to get the final codebook. I used this codebook to code all the interviews in Luganda after which I wrote code summaries and analytic memos for each code following Miles and Huberman (1994). I did the summaries and analytic memos in English.

After coding and memoing

I employed a technic called folk taxonomy (Miles and Huberman, 1994). A folk taxonomy is a set of categories (themes) organized based on single semantic relationships of if-then. These categories show the relationship between codes, so I used them to visualize the determinants and processes of water provision, access, and management identified in the primary data collected from interviews, field notes, GIS mapping, and focus groups along with data from analytic memos. I used the folk taxonomy to create visual flows that guided further systemic analytic interpretations of the similarities and differences between situated and categorical experiences for subgroups among water user groups (Miles and Huberman, 1994; Saldana, 2013). These interpretations were guided by a combination of primary data and literature on water source choice, pro-poor services, institutions, and water governance.

WATER ACCESS IN BWAISE II

According to the residents of Bwaise II, prior to 2008, water access in the parish was challenging because water infrastructure coverage was insufficient. There were few post-payment taps including kiosks, yard-taps, and PSPs; however, water from these sources was unaffordable. Most of the residents used to get their water from the wells and/or springs or use rainwater harvested in small containers. As can be seen in Figure 2, Bwaise II slum dwellers have access to three water wells, including Nabukalu well, which is considered the biggest water well in Kawempe division that could provide water to the entire division in case of a piped water shortage. However, due to lack of proper sanitation infrastructure, water from the wells and springs has been increasingly considered unsafe for drinking (WSPR, 2006).

A total of 100 PPM public stand points were installed in Bwaise II between 2011 and 2013 under the Water and Sanitation Project for the Urban Poor (WATSAN) spearheaded by NWSC and funded under Replenish Africa Initiative (RAIN) project by the Coca-Cola Foundation (Coca-Cola 2010; NWSC Report, 2013; Isoke and Peter van Dijk, 2014). A survey done jointly by the Kampala City Council and ACTogether Uganda in 2018 found that 50% of the households in Bwaise II used community taps (public stand points), 34% used shared private taps, 8% used their own private tap, and 8% used protected springs as their drinking water sources (Bwaise II Neighborhood Profile, 2018).

According to a qualitative study done by Isoke and Peter van Dijk (2014) on 200 interviews of water users throughout Bwaise II parish, the following determinants influenced users' choice among piped drinking water source: access distance and time (60.9%), reliability (23.9%), quality

(9.8%), and cost of the water (5.4) %. The study inquired about the technology users use the most: 38.3% used public water points with conventional meter (PSPs/Kiosks); 28.7% used public water points with pre-paid meter (PPMs); 18.1% used yard taps (shared private connections); and14. 9% used household connections.

RESULTS

In this section, I present the spatial distribution of these main features using the maps that I created followed by a description of each of the main features I identified as relevant to the water system in Nakamiro zone. Then I follow that up with findings from the semi-structured interviews about the determinants of water source choice with a description of water user perceptions of those determinants and how those perceptions and relationships users have with the determinants influence their water source choice.

Spatial distribution (maps) of main features identified in Nakamiro

The water features used in Nakamiro zone are spatially distributed within Bwaise II and neighboring parishes (See Figures 3 and 4. The features included the types of water sources used in Nakamiro categorized as i) protected wells, ii) an unprotected spring, iii) pre-paid meter standpoints (PPMs) and iv) post-payment taps. Other structures shown include Nakamiro drainage channel, the service credit vending location located in Lufula zone, the Nakamiro Local Council Office, and the main roads. Some other important features are located very far apart from the water users within Nakamiro zone as shown on Figure 3. The PPM utility office (Pro-poor utility office) is located in Kisenyi II parish, and the post-payment utility office which is also called the NWSC local office is located in Bwaise III parish.

Maps showing the spatial distribution of the water system in Nakamiro zone

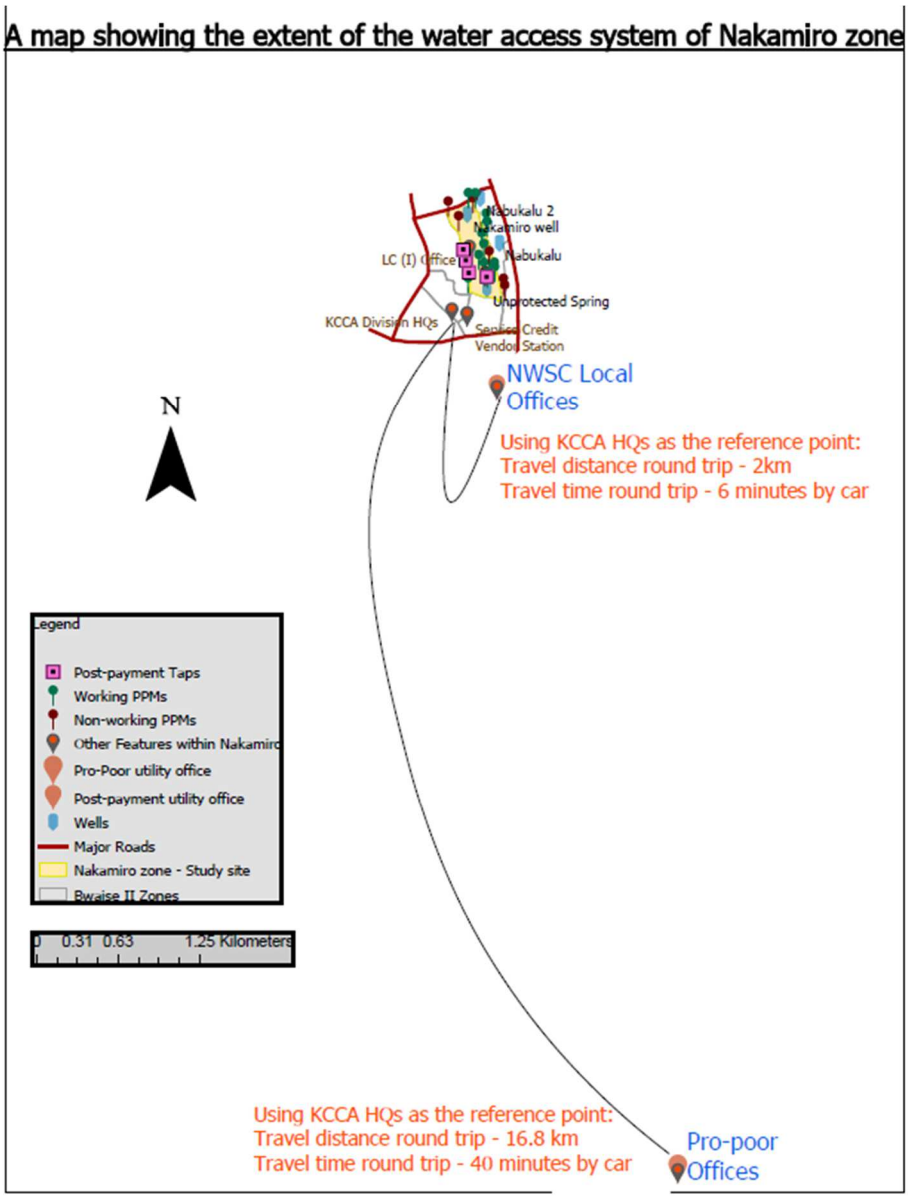

Figure 3. Map of full extent of water access system in Nakamiro zone

Shows distance references for features outside of Bwaise II parish including NWSC pro-poor offices and the NWSC Post-payment offices. Location data for main water features collected by Nanteza Rachel using an app called GPS Tracks. Created by Nanteza Rachel using ArcGIS.

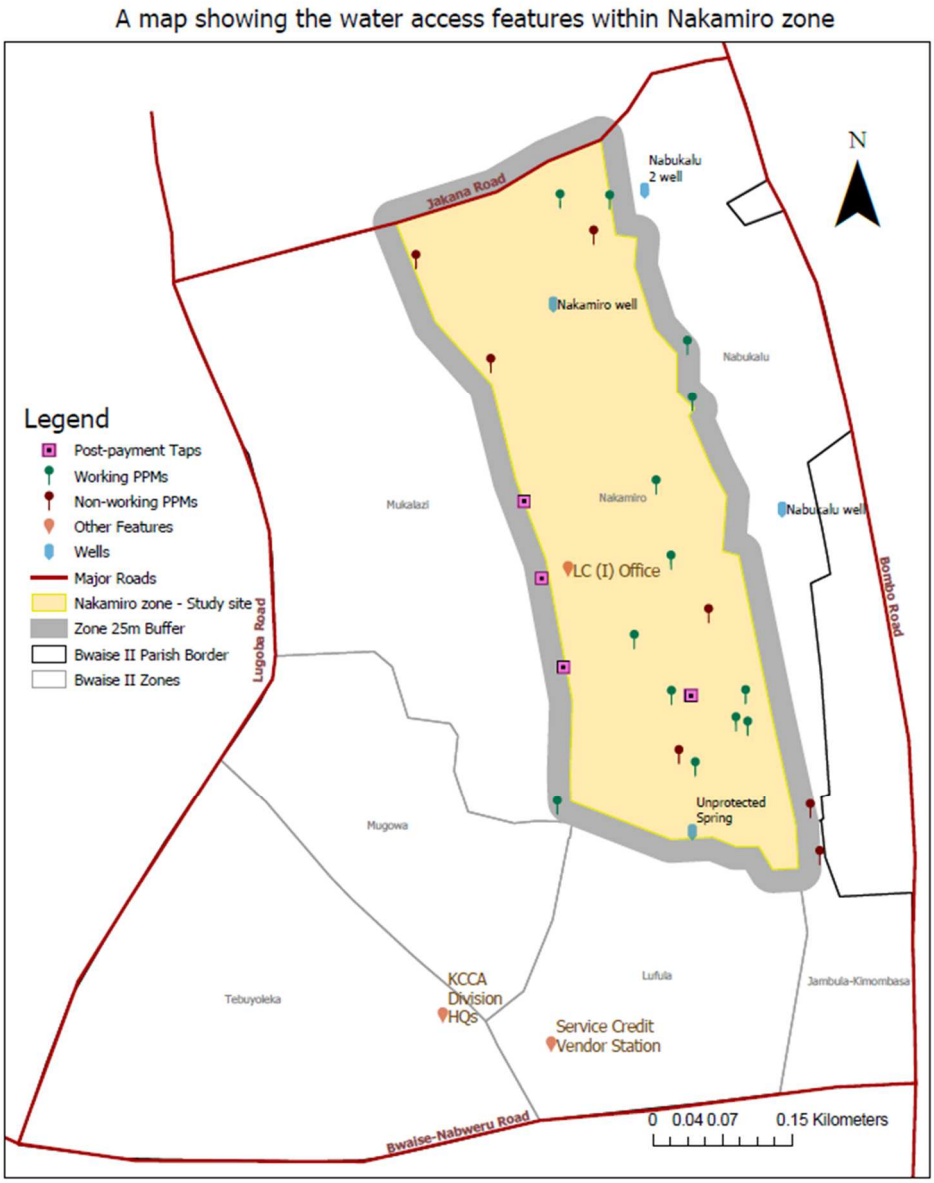

Figure 4. Map showing the distribution of water features within Nakamiro.
Location data for main water features collected by Nanteza Rachel using GPS Tracks App. Created by Nanteza Rachel using ArcGIS.

Description of the main features in the Nakamiro water system

Wells and a spring

There are three protected wells (see figure 4) used by people of Nakamiro zone: Nabukalu, Nakamiro, and Nabukalu 2. A protected well is one with infrastructure built around the water

channel with a concrete cover, a protected water outlet that acts as a well faucet, and a drainage channel. All these features are meant to prevent water from surface contamination at the source. Some people also use an unprotected spring that is on the border of Nakamiro and Lufula zone. Unprotected means a source without any infrastructure protecting it from surface contamination. Nabukalu well is located east of Nakamiro in Nabukalu zone and is used by most of the water users interviewed in this study. It is considered the biggest well within Kawempe division and serves people beyond Bwaise II parish. It has six outlets - unlike other wells with two outlets- and supplies water at a consistent flow regardless of the season of the year (wet or dry). Nabukalu 2 well is located north east of Nakamiro zone in Nabukalu zone, and Nakamiro well is located in the northern part of Nakamiro zone.

Post-payment taps

For this study, I mapped the four post-payment taps in Nakamiro zone that interviewees indicated they use. Post-payment taps were the first piped water sources to be introduced in Nakamiro zone but their coverage in the slum was limited because of the connection requirements and investment. Post-payment taps became even less popular after the introduction of PPM standpoints, and users mentioned that they had fewer post-payment taps than before because most of them were shut off due to a composite of unpaid bills and the fact that people had the option to access water more cheaply at the PPMs.

PPMs

All the PPMs in Bwaise II parish are public standpoints that were provided for free by NWSC with funding from the Coca-Cola Foundation. A public standpoint is piped water infrastructure serving

all households in its vicinity, and users are supposed to have a token with service in order to fetch water. With the help of water users, I identified 15 PPMs within Nakamiro zone; 10 of those had some level of functionality and 5 were non-functional. Of the 15 PPMs mapped in this study, 10 are located in the southern part of the Nakamiro zone. Only 5 are located in the northern area where Nakamiro well is located. PPM users along the borders of Nakamiro also use PPMs in other zones. Therefore, I used ArcGIS to create a 25m buffer zone along the border of Nakamiro in order to include those PPMs. I used a 25m buffer because it was the shortest distance between PPMs within Nakamiro as informed by the GPS data collection exercise. Thus, in total I mapped 20 PPMs used by water users in Nakamiro; 13 had some level of functionality and 7 were non-functional (see Figure 4).

Service credit vending station

This is the only place where token owners can have their tokens recharged with credit in the entire Bwaise II parish. This vending station is located in Lufula zone (see Figure 4) at an average distance of 0.54km from working PPMs (calculated using the near tool in ArcGIS, range is 0.25km-0.91km). This means that PPM users in Nakamiro zone travel an average distance of 1 km each time they need to recharge their tokens. In the past, water users could buy tokens and recharge them from mobile service credit vendors; however, those are no longer in service since registration of tokens was introduced in mid-2017.

NWSC (utility company) offices

NWSC has different offices for post-payment taps and for PPMs. Utility offices are the locations where users go to make complaints and inquiries. Post-payment owners can also access these services via phone. The utility company has two field personnel designated for Bwaise II PPM

service who are in charge of receiving complaints and work orders for mechanical services. PPM users must go in person to the pro-poor utility office to access services such as purchasing and registering their tokens, blocking lost tokens, or have their tokens examined in case they stop working. Using KCCA Division Headquarters as a reference point: the post-payment utility office is located 1km away from Nakamiro zone in Bwaise III parish, while the pro-poor (PPM) utility office is located 8.4km away from Nakamiro zone in Kisenyi II parish (see Figure 3).

Nakamiro Local Council Office

This is office the local administrative unit where residents of Nakamiro can officially meet their local leader for administrative inquiries and services. This office and the chairperson are very important to the water system in Nakamiro zone because the chairperson gives water users the letter to prove residence in Nakamiro, which is required by the utility for water users to be able to connect to the piped water system. Also, the chairperson acted as a collaborator with NWSC and NGOs during the introduction and adoption of post-payment taps and PPMs (see Figure 4).

Determinants of choice

In the following section, I present the attributes of the water system as gathered from semi-structured interviews and the focus group data that I identified as determinants of water source choice among water users. First, I present how water users access different water sources - wells, post-payment taps, and PPMs. Then, I present water user perceptions and relationships with the identified determinants: level of water access at source, reliability and maintenance of water source, the tokens (access, use, and re-charge), water quality, convenience as a composite of fetching distance, time, energy and wait times, and water prices.

Level of access to the different water sources

Access to wells and springs

All wells and the spring are public water sources and people can use them free of charge. They are open access and can be used by anyone who gets there. In addition, there are no limits to how much water someone can collect from them.

It is important to note that all water users in the area have access to and always use wells when there is a general water cuts/shortage at the piped water sources or when there is an infrastructure failure at either the PPMs or post-payment taps that they use. This is illustrated by one interviewee who explained:

> *"…we have our Nabukalu well, it always comes in handy because there are times when this [PPM] tap dies, which leads us to using the well…that well helps us a lot and for that reason we don't want it to be blocked. Even in the event of water cuts, people come all the way from Kawempe with cars to fetch from this well…"*
>
> (Interview 9~Mixed source user. July 2019)

Access to post-payment taps

In order to own a post-payment tap one needs to pay for the tap infrastructure, connection fees, and cash deposit and present proof of ownership of land. Some post-payment taps owners got the taps as part of NGO initiatives to improve water access in the slum. A few of the people in Nakamiro zone were able to pay for and acquire post-payment water taps in their yards. Only one out of four of the taps mapped in Nakamiro zone was paid for by the owner, while the other three were acquired through the NGO.

Access to post-payment taps is unlimited for the owners of the infrastructure unless the owner does not pay their bill or there are water shortages that occur when the utility company turns off water

supply for a certain period of time for maintenance. All post-payment taps mapped operate as private shared connections, meaning that owners choose to "share"/sell the source with other community members. The owners set the rules of access and these vary from across owners. For non-owners, post payment taps in Nakamiro zone operate on limited access dependent on when tap owners want to sell water or is available to sell water to people outside of his/her household. Except for the four post-payment tap owners, none of the other water users interviewed in this study used post-payment taps.

A common rule at these taps is that people must pay before they fetch. Post-payment tap owners are charged directly by the utility company; therefore, when they sell water, users buy the water from them. They often charge a markup price that is 3-5 times higher than the domestic water rate they are charged.

Access to PPMs

PPMs landlords are key stakeholders in the PPM system because they are the owners of the land where PPMs are installed, and they act as the managers or caretakers of the PPM infrastructure. Formally, all PPMs must be open to the public. Every PPM installed in Nakamiro entails a MoU between the landlord and the utility company stipulating that landlords must allow everyone with a token to access and withdrawal water from the PPM.

However, in practice some landlords set rules limiting access to PPMs. PPM users in the FGD ranked this second among the top three challenges that PPM users face that prevent them from using PPMs at a given time. The utility company urges people to report these landlords with the consequence of seizing the PPM, but in practice people do not report them to avoid conflict.

Although all landlords interviewed said they allow children to use their PPMs, two of the users reported that some landlords do not allow children to fetch water because they claim children will spoil PPMs. This is important because 23 out of 29 interviewees reported that their children par take in water fetching duties in their households. In addition, other landlords deny people access to PPMs when they insist that PPM users must use the landlord's token, instead of their own. They do this because they are making profit from "sharing" the token as explained by this interviewee:

> *"…The PPM is over there ahead; she doesn't allow you to fetch water just because she wants to sell. It is a real struggle and using that PPM is uncomfortable, the only times she is pleasant and personable to you when accessing the PPM is when you pay her to use her token."*
>
> (Interview 10~Mixed source user. July 2019)

Also evident in the quote above, all 17 PPM users interviewed (not landlords) reported that the emotional exchange or requirement with the landlords of where the PPMs are located (comfortable or uncomfortable) influence which PPM they used among the PPMs. Additionally, four out of 23 PPM users interviewed do not use the PPMs closest to them near to them because the water user does not get along with the landlords as a result of a misunderstanding unrelated to PPMs.

Despite water users citing restricted access from some PPMs, no landlord admitted to limiting access. However, all six of the landlords interviewed explained that the circumstances of use of PPMs can potentially push them to limit access specially to offset the PPM management costs they sometimes incur as illustrated in the quote below

> *""…I always pay out of pocket for fixes on this PPM that the utility does not cover. I no longer ask people that use this PPM to contribute because they do not bother to do so...they [PPM users] claim that it is my [landlord's] responsibility since the PPM is in my yard, some say they should not be paying because PPMs are provided by the government. I, however, do not mind fixing the PPM because I sell water from it and get money to buy food…"*
>
> (Interview 28~PPM Landlord. July 2019)

Maintenance costs incurred by landlords will be elaborated on in the reliability and maintenance section. However, the bottom line is that if PPM users do not cooperate in practice to maintain PPMs, as they formally should, all landlords reported that they are most likely to limit access as a way of getting returns for their time and mostly money that they invest in this public resource.

Landlords mostly use the PPM in their land, therefore only contribute to maintenance of that PPM which has yielded a norm that landlords do not use other PPMs when the ones in the land break. Five out of six PPM landlords interviewed followed that norm.

> *"…landlords of the PPMs usually do not like it when you [fellow landlord of a PPM] fetch from their PPM. So, when my PPM dies, I just go to Nabukalu well."*
>
> (Interview 26~PPM landlord. July 2019)

Reliability and maintenance of water source

Wells

Wells were reported as the most reliable source in terms of availability of water at the source, and Nabukalu well was reported as the most reliable amongst all three wells because of the consistency in water pressure regardless of the season of the year (wet or dry). Since no one person is responsible for maintenance of wells, community leaders enforce occasional well cleaning days. On these days, everyone who needs water must do some aspect of cleaning in order to fetch water. Cleaning the well entails activities such as picking up litter, weeding, unclogging the water way, etc. Some cleaning days are organized routinely by community leaders, while others happen randomly when need arises. Since people are usually reluctant to clean the well, therefore times when there are piped water cuts/shortages become prime opportunities for the well to get cleaned as people do not have other water source options.

Post-payment taps

Post-payment taps were reported to be reliable unless there is a water cut, which does not happen that frequently anymore. Users of post-payment taps reported that reliability used to be an issue in the past when water cuts would last as long as a week and happen about twice a month, but today they are shortened to less than 2 days once a month. Water users, NGOs and local leaders interviewed attribute reliability of piped water to the fact that there are more piped water sources in the area.

> *"...now that there are more taps in the area and more people are using the taps, the utility does not cut off our water flow as much as it used to"*
>
> (Interview Local leader – Bwaise II. July 2019)

> *"...even if there is more work that needs to be done by both the government and national water (NWSC); National water has become more intentional about supplying the poor people in the slums with water over the last couple of years..."*
>
> (Interview NGO personnel. July 2019)

According to the utility personnel interviewed, the fewer water cuts are a result of the expansion of the water treatment plant and distribution network for Kampala district.

PPMs

PPMs were reported to be unreliable because they broke down often and maintenance was not done in a timely manner as illustrated by this PPM landlord:

> *"…For some reason - sometimes the PPMs are not fixed for long periods of time, sometimes they fix them first. The first time it (PPM) died it took six months for them (NWSC personnel) to come fix it…"*
>
> (Interview 29~PPM Caretaker. July 2019)

In the focus group discussion ranking exercise, frequent break down and untimely maintenance were ranked as the main challenges PPM users face that hinder them from using PPMs. Of the 20 PPMs I mapped in Nakamiro, only half (10) were functioning properly, and seven were completely nonfunctional – no water had been available from them for at least three months. Additionally, three were dysfunctional: water could be obtained from the PPM but either the meter was over

charging or the tap was leaking. Water users reported that leaking uses the battery of the PPM and it eventually dies.

Formally, as stipulated by NWSC, mechanical fixes can only be done by the utility personnel for free, so the PPM users have to wait for them to show up. It is the responsibility of the landlord to call the utility service personnel when the PPM breaks. The utility service personnel are not local to Nakamiro, and they take between a week and six months to show up and repair (if possible) the PPMs. PPM users reported that the lack of repairs disrupted their water access and forced them to fetch water from the wells.

> *"in terms of recommendation, I would like to recommend that they (NWSC) improve their level of service when we call them to fix the PPM. There are so many PPMs in here that are not working and that is a big challenge for us"*
>
> (Interview 26~PPM landlord. July 2019)

PPM users reported that giving the NWSC service personnel tips to incentivize them to show up quickly is common and is tending into the norm. Some PPM landlords incur these financial costs to fix PPMs while others are lucky to have PPM users chip in as a collective effort under the mobilization of the landlord.

> *"…when our PPM dies, the guy that does our fixes comes fast because we usually work as a group to get him some money for transport – as a matter of fact he says get me some gas money and I'll be there. Usually we collect between 15,000-30,000UGX (4.06-8.13USD)."*
>
> (Interview 14~Mixed source user. July 2019)

Four out of six landlords reported that a few NWSC service personnel ask them for money (different from a tip), an average of 20,000UGX (5.17USD) under the claim that the battery (which is usually what is dead) costs money. Some users reported that they have paid this money but a new battery was not delivered.

Other maintenance duties are fulfilled by PPM users include replacing fetching pipes, renovating PPM water catchment areas, and unclogging the water drains.

> *"…In case that PPM dies…., it is my responsibility as a caretaker to ensure that it is fixed. I have to call the utility personnel to fix it, they will not know it needs fixing unless someone calls. But if it is fixes the utility does not cover, we have to do them ourselves [the PPM users]. So, it is my responsibility to mobilize people who use this PPM to contribute money"*
>
> (Interview 29~PPM caretaker. July 2019)

All PPM landlords reported that they face challenges with day-to-day maintenance of the PPMs.

"As a landlord, I find it hard to ensure that people fetching water from the tap leave it clean. Some people even find my grandkids cleaning it, but after they fetch – sometimes they leave the PPM muddy. They do not care; they keep saying after all the PPMs are free. I bet there are some PPMs you have come across that are either dead or very dirty. That is partly because the landlords and the people don't bother to clean. When I tell them to clean up after themselves, they don't"

(Interview 25~PPM landlord. July 2019)

Lack of proper channels to communicate maintenance roles such as keeping the PPM clean, unclogging water drains, replacing fetching tubes, or fixing PPM catchment area to different PPM users places a maintenance burden on landlords who in turn limit access to compensate themselves for the time and monetary costs they sometimes incur which in turn influences choice of PPMs as a water source choice.

Tokens

Tokens are required to be able to withdrawal water from PPMs at a pro-poor rate and only token owners have access to this rate. Among the 23 PPMs users interviewed, 13 users (including 5 PPM landlords) owned tokens at the time of interview.

Access to tokens

When PPMs were installed, the utility company distributed one token for free per household for every five households nearest to each PPM installed. All landlords were guaranteed a token; however, the majority of PPM users interviewed report that token distribution was not based on household proximity to the PPM. Three out of 23 PPM users reported that they managed to get more than one token for their household.

> *"…when they had just introduced PPMs, they would give out tokens for free right after installing the PPM. The utility personnel, after installation, called all of us around here and gave us tokens, whoever came was handed a token and then their names were written down"*
>
> (Interview 22~ PPM landlord)

After the initial token distribution cycle, other water users that wanted tokens bought tokens from mobile token vendors. Mobile token vendors were people who sold tokens door to door to water users in Nakamiro. According to the utility personnel interviewed, tokens were purchased from the utility office by anyone who could and then later on sold within Bwaise II as a business; most of the mobile token vendors also doubled as service credit vendors. They sold tokens initially at a price of 5000UGX (1.36USD) and later increased it to a range of 10,000 – 15,000UGX (2.71-4.06USD).

According to the utility service personnel and water users, selling tokens became a new business that people profited from which led to a rampant habit of stealing each other's tokens for resale. As a result, all token owners became very vigilant about how they use or share their tokens.

> *"...People no longer have tokens because they have been stolen...You have to wear that token like a necklace, you cannot just place it anywhere because it will be stolen – especially by the kids who pretend to come visit and play. They are aware the tokens have credit (recharged) so they still them and take them to their parents..."* (Interview 12~Mixed source user. July 2019)

In this study, six out of the 10 of the non-token owners PPM users reported that their tokens were stolen. According to the all PPM users interviewed, theft of tokens reduced tokens available to use which made a lot of prior token owners depend on other people to use their tokens which impacted whether they chose PPMs or wells.

Token registration

In 2017, NWSC introduced a token registration policy as an attempt to prevent theft of tokens. NWSC carried out the token registration process for two weeks. All token owners had to register their tokens, and each user could have only one token registered under his/her name. To register, water users were required to present their national identification (National ID) cards to verify name and residence in Bwaise II parish. This presented a challenge since some users did not have national identification cards.

> *"…we registered our tokens at a registration camp that they [NWSC] set up near the Division Headquarters. There was not a process as such, except for waiting in long lines with your national ID - the only requirement was that the token had to be registered in your name. It took about two weeks and people were still waiting in line to register because the people registering were very few compared to those that need to register tokens"*
>
> (Interview 14~Mixed source user)

Users who missed the two-week window, after which the policy that unregistered tokens would not work in PPMs took effect, had to go to the pro-poor office in Kisenyi II with their National IDs to register their tokens. These PPM users that depended on registered tokens (both owners and non-owners) to use PPMs in the meantime as they figured out how to get their tokens registers. Registering tokens has impacted the use of PPMs. According to three out of the 10 non-token owners interviewed said that they faced challenges with registering their tokens namely – two did not have national IDs and the people they entrusted to register their tokens claimed they lost them

while the other missed out on the token registration window within Bwaise, failed to get time to go to the utility office in Kisenyi and ended up losing the token. As a result, these users transitioned into mixed source users using both PPM (using other people's tokens) and wells.

Price of tokens

Registration of tokens reduced theft of tokens; however, it has led to a scarcity in the supply of tokens within Bwaise II because presently users can only get tokens from the pro-poor office in Kisenyi II. Since token registration took effect, tokens have become unaffordable as reported by all water users. Today, tokens are sold at 25,000UGX (6.77 USD).

> *"…Tokens are scarce and expensive at 15,000UGX (4.06USD) and we can only get them at that price from I think Kisenyi or Kazo [two other slums], I am not really sure. So, someone cannot leave here if they do not have money even more so if they do not know where to go to get a token at 15,000UGX... They [NWSC] should bring for us tokens on promotion at like 5000UGX…"*
>
> (Interview 12~Mixed source user. July 2019)

All water users interviewed in this study reported that PPMs are expensive despite the fact that twenty of them reported willingness to pay for a token if provided at an affordable price. 11 out of 23 PPM users interviewed said they cannot afford to buy tokens at their current price.

How non-token owners access PPMs – the process of sharing tokens

10 of 23 PPM users interviewed did not own tokens. Six out of those 10 (including 1 landlord) had their tokens either lost or stolen, while four had never owned a token before. These categories are important to distinguish as they represent distinct PPM user experiences.

Nine of 10 PPM users who do not own tokens pay a markup price to use another person's token. The remaining person has an arrangement to co-recharge her neighbor's token so she could fetch

water at the NWSC pro-poor rate. PPM users reported that this arrangement is unpopular because it increases the risk of losing the token as it moves from one household to another; also, different households have different demands for water so the re-charge arrangement could lead to social tension. A handful of people occasionally use other people's tokens for free, but that was also very uncommon.

> *"In some rare cases one of my tenants can come and request that you help them with some water because they do not have money to buy or they have failed to find a middleman to fetch water for them, and because we have a good relationship, I help them out and give them the token to fetch a jerrycan or two free of charge"*
>
> (Interview 12~Mixed source user. July 2019)

Each token owner sets their own rules on how the token should be shared/used. Out of the 13 token owners I interviewed, one does not share her token with anyone except people in her household, and four of the 13 limit sharing their tokens to people within their extended family or to close friends. They claim that handling of the token by multiple people will lead to tokens malfunctioning or being stolen, broken, or lost. The other eight did not limit who uses their tokens. However, because of the likelihood of token theft, they do not hand their tokens to people they are not very familiar with. Thus, the token owners or their kids walk with the stranger to the PPM, insert the token for them, and wait until they finished fetching.

> *"…My token has never died [malfunctioned] because I used it alone. I do not share it, never! Even for my neighbor who is also the landlord of where the PPM is, her token was stolen so once in a while when I am fetching water for myself, I might fetch for her a jerrycan or two. I never hand her my token."*
>
> (Interview 27~Mixed source user. July 2019)

Recharging tokens - Maintaining tokens as a means of withdrawal from the PPMs

According to the utility personnel, mobile service credit vendors were business owners that invested in the service credit vending machine and were trained by the utility company to provide

the token recharging service. This service was supplemented by two stationery vendors within the parish. However, over the years, mobile service credit vendors have been put out of business and ceased service.

> *"…But the challenge we have with these taps [PPMs] is that they gave us few service credit vendors. There used to be mobile vendors who used to pass through uploading credit for us but they don't exist anymore. When Salongo died a few years ago, we are now left with one lady she lives in Lufula zone, she makes us suffer"*
>
> (Interview 26~ PPM landlord. July 2019)

Currently, the closest place to recharge a token for Nakamiro toke owners is in Lufula zone which is a 1km round trip from the closest PPM in Nakamiro and has compromised use of PPMs because of unreliable token recharging services

> *"Sometimes you get there, and she takes your money and says she is uploading credit, but when you come back home to use the token – it reads zero balance. Then you have to go all the way back only for her to say, oh I had forgotten"*
>
> (Interview 24~PPM primary user. July 2019)

As a result, majority of the PPM users mentioned that because of the lack of options for service credit vending stations, they are forced to use other water sources because their tokens are not serviced.

When users load credit, they recharge the tokens with any amount of credit they can. On average token owners who do not share their tokens load between 2000-3000UGX (0.54-0.81USD), which lasts about a month. Token owners "sharing" tokens as a business load credit as needed depending on how much their token is used. They report significant profits.

> *"...selling water at PPMs is now a business for us landlords with tokens. You feel me! If the PPM is functional one can make up to 10,000UGX on a good day or at least 5,000UGX on a bad day."*
>
> (Interview 22~PPM landlord. July 2019)

Perception of water quality

The topic of water quality in the different water sources is controversial. Water users chose a water source based on their perception of the water quality at source which is influenced by different indicators including taste, appearance of water, normative water uses, knowledge about contamination and processes involved in making water drinkable. On the other hand, the local leaders, NGO personnel and the pro-poor manager reported confidently that water from the wells is contaminated by *E.coli* and therefore unsafe for drinking, and framed water piped water (both PPMs and post-payment pipes) as the only safe water source for human consumption.

From the interviews, I learnt that the water from the well is pumped directly from groundwater while piped water comes from Lake Victoria and it is treated before it is transported to the slum.

The first and most commonly mentioned indicator was the taste of water. Users referred to the *taste* of water from PPMs and post-payment pipes with different adjectives such as "chlorinated", "hard", or "salty". For example, one user explained: *"…. okay the water from the well tastes very good if you are using it to drink for example tea, but this one from the PPM sometimes it is not so good because of the chemicals they put, it does not have the best taste when you drink it, it does smell bad sometimes"* (Interview 25~PPM landlord. July 2019).

As this quote highlights descriptions of taste were explained in connection to a differentiation in the intended use of water. Two of the interviewees owned refreshment selling businesses and they said their customers prefer the taste of well water. This is further illustrated by another user who explained: *"Piped water does not taste good, but I am not saying they should remove the piped*

water sources because we get water from them for doing laundry, showering among other house chores". (Interview 9~Mixed source user. July 2019).

In short, while taste was an important indicator, it was not used to determine choice because most of the interviewees prioritized distance, fetching time and fetching energy required to get water from the source over their perception of the water quality.

The *appearance of the water* was a second indicator mentioned by users. They described the water from PPMs and post-payment pipes as "foamy" and "muddy". In contrast water from wells described as "clear". The appearance of water was taken as an indicator of potential quality problems as illustrated by one of the interviewees who explained: *"...the quality of water from these taps [PPMs] is doubtable because sometimes it forms foam as you collect it and it is unclear with a little smell. Otherwise it does not have a problem.* (Interview 10~Mixed source user. July 2019)

The third indicator for perception of water quality is the precautions that water users take before drinking water from source and these contradict each other even among water users of the same source. For example, one well user confidently reports that: "*...water in our well flows and circulates really well, we found those underground water wells here and have used them all our lives, whether boiled or unboiled."* (Interview 9~Mixed source user). Ten out of 27 users perceive water from the well as safe; therefore, they never boil it before they drink it. These water users said that they have drunk water from the well all their lives and they have not had any problems with it. On the contrary, another mixed source user reports that *"...the quality of water at the PPMs*

and from the well is all the same because it doesn't matter where you get your water from – you cannot drink it without boiling it first" (Interview 25~PPM Landlord. July 2019)

This indicator is also sometimes influenced by the public health awareness that different water users have or the degree to which they accept this awareness about the quality of water at the source from the health officials and utility company advisory as illustrated in the quote below:

> *"…so they [local health officials] told us that water from Nabukalu is contaminated, although we have grown up using that water, we used to drink it [unboiled] and not get sick. But now they say that doctors tested it and it had a lot of contaminants slipping through into it because of the activities people do on the land – the market is very near the well. But they say that the water from the post-payment taps is treated and free of contaminants. I think that is the difference there is in quality from both sources"*
>
> (Interview 3~Post-payment owner. July 2019)

Regardless of what indicator is used to report perception of water quality, all water users reported that if water is perceived as unsafe is used for household chores rather than drinking unless it is boiled first.

Convenience of access from water source

Convenience refers to the ease with which people can get water. All users report components of convenience such as **fetching distance/time, required energy and wait times at source.** They mentioned these components separately but every interview mentioned the word convenience in regards to either of those three components and they are closely related to one another.

Fetching distance

Distance was reported as one of the main determinants of water source choice. Water users used words explicit as far, near close to reference distance but also frequently used references of fetching time and energy they need to get water from a source to cite how far, close or near a

water source is and why they chose it. All PPM users have attributed convenience to the distribution of PPMs within Bwaise II as illustrated in the quote below:

> *"Bringing all these PPMs has brought water very close to us because we do not have post-payment taps in this area. We have a well not so far from here, but you find people waiting at this PPM to get water, yet they could go to the well. However, now that the PPMs are everywhere, we have saved trips to the well."*
>
> (Interview 20~Mixed source user. July 2019)

Interviewees mentioned that Nakamiro zone in general did not get a lot of post-payment taps from NGO initiatives, or PPMs compared to other zones like Tebuyoleka, Lufula and Mukalazi. Majority of the PPM users interviewed attributed the difference in distribution to the location and proximity of Nakamiro to the three wells on the parish.

The two NGO personnel interviewed reported that their understanding of the location of PPMs was that they were supposed to be installed at a distance of 50m apart. According to the NWSC personnel interviewed, the minimum distance in between PPMs was supposed to be 50m and maximum was 100m. However, he reported that distance between PPMs was just one of the criteria for installation, in addition to population in the area as well as physical attributes of the area.

> "*We had a criterion we are supposed to use but that criteria are not cast in stone. There are three factors we considered, one the distance from one to another, the minimum we used to talk of minimum distance between the two is 50m that is if you are using distance. Then we have another factor, population. Because one meter serves a certain number so you cannot just put one when the population there is very big…….Three is accessibility. There are places where there is a drainage channel. People find it difficult to cross from here to there with their jerry cans…. Now the other factor which is not outside the normal is acceptance. Other people will say I don't want, then where you feel it's the right place according to distance according to whatever the person says no, then another one offers. So sometimes you find that you have to ignore this distance criteria"*
>
> (Interview NWSC Personnel. July 2019)

All water users interviewed reported that distance influences where they fetch their water. All PPM users explained that they choose the closest PPM to their household and that PPMs have significantly reduced the fetching time and energy requirement in comparison to when they used the wells. Because PPMs are closer, users can go more often and they can carry less water per trip as compared to wells which are further away and so users are forced to carry water in large volumes per trip to lessen the fetching time.

For some mixed source users, distance and the time of the day influence whether they use wells or PPMs. For example, they go to the well at times of the day when the users' schedule is not busy and to PPMs when they are very busy.

> *"...yes, water from the well is always available but there are some days when you just do not have the energy to carry water, but with the PPMs close to us you can make multiple fetching trips using 5-liter jerrycans to fit your energy level. But because the well is far, it forces you to carry water in larger volumes to get the water for your needs in the shortest time possible, otherwise 5-liter trips at the well will take you forever."*
>
> (Interview 8~Mixed source user.July 2019)

> *"...sometimes I come back from work late at night and I do not want to go all the way to the well to get water, so PPMs are very helpful that way. Otherwise, if I am at home all day, I go to Nabukalu because it is free"*
>
> (Interview 11~Mixed source user. July 2019)

Distance also dictates whether water users use middlemen to fetch water for them, especially those that did not have children or did not want their children or themselves to carry water over long distances. Participants in the FGD ranked distance as the second highest reason for people to choose PPMs over other sources.

Waiting times at source

All water users interviewed in this study reported significantly longer waiting times at the wells than at PPMs or post-payment taps, especially in the evenings, when children who fetch water are

back from school. Afternoon waiting times are shorter because it is usually hot and unconducive for people to carry water over long distances and most people are at work during the day.

> *"...before PPMs came, there used to be so many people at the well. You would send a child to fetch water and sometimes you would think they are playing instead of bringing water home, but they would be there standing in long lines waiting for their turn to fetch"*
> *(Interview 22~PPM Landlord. July 2019*)

For the case of piped water, and specifically PPMs, users did not report a significant time investment, and they attributed this to the fact that PPMs are near their homes and the fetching windows presented above do not apply so people can fetch water at any time they need it which reduces crowding at the source as one person explained contrasting fetching water from the PPM to doing it before from the well "*...by the time you make the trip to the well, wait in line – here you just insert you token and in a minute, you have the water you need"* (Interview 25~PPM Landlord. July 2019). Also having more PPMs distributed within the area has increased convenience of access by reducing the wait time for service from middlemen at both the well and post-payment taps as described in this quote:

> *"... It is even more convenient using a PPM than a middleman because sometimes you have to wait for the middleman to show up after you have requested him, but with PPMs it is swift, there is no waiting at the source as you would at the well waiting for everyone else to finish fetching. You just get there, fetch your water and go."*
>
> (Interview 18~Mixed source user. July 2019)

In the event of a piped water shortage, waiting times are significantly longer at the wells because everyone has to use them; in those cases, users reported wait times ranging from one to six hours.

> *"...in the event of a water cut, people at the well are so many, it serves the entire division so you will really have to wait to get that water, especially if you go in the morning or evening, the afternoons are the best times to go because people are at work"*
> *(Interview 24*~PPM (primary) user. July 2019)

Water Prices

Water price is the amount of money water users spend to get water and that influences which source users choose. Water prices in Nakamiro zone vary depending on the water source, whether there is a shortage, and who fetches the water.

Prices at wells

As mentioned earlier, water from the well is free and people can withdrawal as much as they can whenever they want.

Prices at post-payment taps

All the four post-payment tap owners interviewed pay a NWSC domestic water rate of 83UGX per 20L jerrycan. They sell water from their taps at 200-300UGX per 20L jerrycan. In the event of water shortages, the water price increases to as much as 700UGX as decided by the owner. NWSC has no regulations in place for water pricing at post-payment taps. All interviewees considered post-payment water prices expensive and said high water prices are the reason why post-payment taps are no longer popular within Nakamiro zone.

> *"…there are now very few functional post-payment taps in this zone because the water at those taps is so expensive, and when PPMs were introduced, we got a cheap option …., for that reason, people abandoned using them [post-payment taps]."*
>
> (Interview 10~Mixed source user. July 2019)

Prices at PPMs

Token owners get water at the NWSC pro-poor rate of 30-40UGX per 20L jerrycan. NWSC officially stipulated that token owners could sell water to non-token owners at 50UGX/20L jerrycan. However, according to the NWSC personnel interviewed and some of the PPM users,

that currency unit is reported to no longer have purchasing power for anything on the market. Therefore, in practice, token owners sell water at 100UGX/jerrycan (which is the next unit of currency after 50). The 10 out of 23 PPM users who did not own tokens mentioned that they paid token owners 100 to 200UGX for every 20L per jerrycan they withdrew from the PPM using their token.

> *"…I am not really sure why the price of water varies among token owners because it was announced [by NWSC] that a jerrycan should be sold at 50 and that we should report to them [NWSC] anyone that charges more than that… but 50UGX doesn't buy anything today people have ended up selling PPM water at 100UGX because…okay legally I am not sure what the unit price of water at a PPM when bought directly from the utility for token owners costs but at this point in this country people no longer care for one another but for themselves so it could be partially because of that that they hike the price. However, we are still grateful to them for selling at 100UGX because there are people who sell as high as 200UGX."*
>
> (Interview 14~Mixed source user. July 2019)

All PPM users reported that getting water from PPMs with your own token is the cheapest water source option. However, users explained that tokens are considered expensive. In addition, participants in the focus group discussion ranked cost as the most significant reason they choose PPMs over other sources. Even though water at the well is free, 18 of the 23 PPM users reported willingness to pay either the NWSC rate or the marked-up price because of the convenience (close, no wait times, and less fetching energy required) of PPM access.

Middlemen

Middlemen are important stakeholders in the water access system in Nakamiro. According to NWSC personnel, middlemen are infrastructure owners who sell water to end users. However, in this study I refer to these as owners. I found another type of middlemen - people in the business of fetching water from any source for households for a fee. The prices they charge depend on the distance from the household to the water source the middleman uses and variables such as the

number of middlemen in area and whether households have children who are available to fetch or not. Water users noted that unless the household requests otherwise, middlemen get the water from the well since it is free, and they charge in between 200 and 300UGXper 20L jerrycan. In the event of a water cut/shortage, the price range increases to 500-1000UGX for all water sources. If sourced from a PPM, middlemen charge a 100UGX delivery fee if using the token of the person requesting the service.

> *"…I use PPM, the well and sometimes middlemen when I or my husband cannot go to the well to fetch water for ourselves. So if you calculate six jerrycans using a middleman that would be 1800UGX, just for six jerry cans yet if I just add 200UGX to that I can service my token at 2000UGX and use that money for up to a month getting water from the PPM…. PPMs mean deducting costs of water but getting more quantity"*
>
> (Interview 18~Mixed source user. July 2019)

Table 1 summarizes the water prices at the different sources. Regular price ranges are paid when no extraordinary events are occurring. Conditional price range refers to the price range charged in the event of water cuts/shortages. Users mentioned that post-payment tap owners, middlemen, and token owners set prices based on at least two factors. The first one is the relationship between the seller and the buyer. Therefore, family and friends are likely to get a special rate.

> *"…we used to share our token with our neighbors that were friends with my mum, some we used to charge money for using the token others we never charged at all. But most of them we charged 100UGX/jerrycan, and then we used that money to recharge the token"*
>
> (Interview 2~Well (only) user. July 2019

> *"…for me I sell water at 100-200UGX. The price differs depending on whether I know the person or not, for people I don't know I charge them 200ugx and I cannot hand them the token, I have to go with them to the PPM, insert it and wait for them to finish fetching, I can't risk them leaving with my token"*
>
> (Interview 29~PPM caretaker. July 2019)

The second factor is the reliability of water sources around the area where they are located. Owners and middlemen set prices taking into consideration what others around them are charging or if other water sources are open, functional, and accessible.

"…in the event of a piped water cut, Nabukalu is flooded with people to the extent that the police intervene to create order sometimes. No one calls them, they just show up because people are fighting to get water. In cases like that, the strong youth can make money off of us the elderly by charging us up to 1000UGX to help you fetch water at the well. Usually you give up that amount willingly because you need water. I'm so glad we have those PPMs now, if you stock up on water, it can take you for a couple of days – we [elderly] can no longer fetch water"

(Interview 27~Mixed source user. July 2019)

Table 1. Water prices at different sources for different water user groups

Source	**User group**	**Regular Price range per 20L jerrycan (UGX)**		**Conditional range**	
		In-person Fetching	Using middlemen	In-person Fetching	Using middlemen
Well	Everyone	Free (0)	200-300	Free (0)	500-1000
PPMs	Own token	30-40	Price of Water + 100	-	-
	Do not own token	100-200	200-300	-	-
Post-payment Taps	Own tap	83	-	-	-
	Do not own tap	200-300	300-500	-	-

I found six determinants of water source choice in Nakamiro. The section above explains how water users perceive and relate with each determinant which in turn influences how they make decisions for what water source to use. Table 2 presents a summary of all the six determinants and the water user relationships as derived from triangulating findings from all qualitative and quantitative methods used in this study.

Table 2. Determinants of water access among different water user groups of different water sources in Nakamiro zone

Determinants	Source of water				
	Wells	PPMs		Post-payment taps	
		Own Token	No tokens	Owners	Non-owners
Level of access	Open access	Limited	Limited	Limited	Limited
Regular price with no water cuts (UGX/20L jerrycan)	Free	30-40	100-200	83	200-300
Convenience (distance, time, and energy requirements)	Low	High	Medium	High	Low
Water quality (user perception)	Drinkable	Boil to drink	Boil to drink	Boil to drink	Boil to drink
Reliability/maintenance source	Reliable	Irregular	Irregular	Reliable	Reliable
Cost of Infrastructure (user perception)	None	Expensive	Expensive	Expensive	Expensive

DISCUSSION

In this study, PPMs were reported as the best available source of water over wells and post-payment taps, all determinants considered. This is contrary to what Isoke and van Dijk 2014 found that the people of Bwaise II preferred the post-payment taps over PPMs. The difference in result can be attributed to how much time has passed between when Isoke and van Dijk did their study in 2014 and when I did mine seven years after PPMs were installed, and what had occurred with the water services in the meantime. Also, it is important to note that their study was conducted in the entire parish of Bwaise II and Kisenyi II and mine was conducted only in Nakamiro zone within Bwaise II. Back in 2014, the PPMs had only been in Bwaise II for one year. From what I learned, PPMs provide water cheaply per 20L jerry can, and they are closer to most people's households than post-payment taps, especially people who do not own post-payment taps. Consequently, post-payment taps are becoming less popular. It is important to note that this finding might vary across Bwaise II because of socio-economic and spatial variability across the eight zones in terms of ownership of post-payment taps, availability of PPMs, ownership of tokens, and relative distribution and location of water sources (Brown 2003; Fotheringham and Brunsdon, 2010).

Convenience, distribution, and choice of water sources

Convenience, as a composite of fetching distance, time (including waiting time at the source), and energy, was reported as a significant determinant of water source choice in Bwaise II. This resonates with findings from diverse studies in urban areas across SSA Africa that have found distance to be the most significant determinant of water source choice (Briand et al., 2009; Isoke and van Dijk 2014; Mu et al, 1990; Nketiah-Amponsah, Woedem, and Senadza, 2009). 23 out of

29 participants cited convenience as one of the reasons they chose to use PPMs over other water sources. However, findings in this study show that convenience is contingent upon the distribution of water sources; therefore, knowing the location of water features in the water access system and how people relate to them is very important in helping understand water user behavior. Even if a water source is close, if it is serving a lot of people there will be long wait times– access from the source would not be ideal (Brown, 2003). Understanding how one determinant is closely connected to the other can inform better planning and allocation of infrastructure and the development of supporting systems for adoption, maintenance, and sustainability of water access from PPMs or any water source (Gutierrez, 2007; Adams, 2018).

Additionally, in the case of PPMs, the overlap between convenience and distribution not only applies to water sources but also supporting infrastructure and services such as service credit vending stations and places to get tokens. Using technical interventions like PPMs as a mechanism to actualize the goals of pro-poor water governance is very common; however, that needs to be supported by system services that foster choice of these interventions (Romano et al, 2019). In the case of Bwaise II, PPM users interviewed reported that the lack of reliable and conveniently located service credit vending stations reduced the choice of PPMs because users were unable to readily re-charge their tokens to access water whenever they would like. Challenges of accessing service credit vending services may discourage investment in owning tokens, which further compromises access to affordable water for the people living in the slums. In addition, users also mentioned that the lack of proper maintenance of PPMs and the delays up to six months to fix them when they are broken prevents them from accessing PPMs and from a reliable service.

Ownership of infrastructure, level of access, and choice of PPMs

Access to water is enabled through ownership of water infrastructure and the rights it accords; with regards to pro-poor service in Bwaise II, infrastructure ownership refers to PPMs and tokens (Ginger et al., 2012; Adams, 2018). PPMs and tokens are the technologies used to mediate access to affordable water in the slums; therefore, it is important to understand the relationship between ownership of this infrastructure and access to water in the slums. This is because the rights of access and withdrawal from PPMs are "negotiated through" overlapping "claims of ownership" between PPMs and tokens and are partially mediated by rules set by NWSC (Cleaver, Franks and Boesten, 2005, 7; Frank and Cleaver, 2007). By virtue of extension of land-property rights, landlords, even if they do not technically own PPMs, have some level of entitlement over PPMs to set the operational rules of access and employ management strategies for the PPMs on their land (Schlager & Ostrom, 1992, Rogers and Hall 2003). These rules can be exclusive and compromise choice of PPMs, especially when not in alignment with the public access rationale of PPMs. Studies have found that landlords deny access to water users at PPMs because they want to sell them water (acting as middlemen) or because of social tensions (Schwartz et al., 2017, Heymans et al., 2014, Murungi, 2016). This is true for the case in Bwaise II. Landlords interviewed in this study communicated an understanding and appreciation of PPMs as a pro-poor service provision and showed interest in complying with the MoU they signed with the utility agreeing that PPMs on their land would operate as public infrastructure. However, they said their compliance is subject to change when stakeholders, including utility personnel and other PPM users, fail to follow their formally and informally set duties as providers and users, respectively, of this public resource. Landlords reported that lack of formally communicated ways for them to fulfill their managerial duties makes maintenance of PPMs on their land challenging to the point

that they bear maintenance costs themselves in the absence of cooperation from other PPM users. Some landlords respond to this challenge by limiting access to PPMs. Some that own tokens sell water and compensate themselves for maintenance costs. This need for compensation spurs landlords to violate the MoU requiring public access and effect their exclusionary property rights with the goal of making profit (Rampa, 2011). Therefore, non-compliance of PPM water users with their duties to contribute to maintenance of PPMs can trigger a potential change in their level of access as well as the price they pay to access water, especially when users are prohibited from using their own tokens and the landlord insists that they must pay the mark up price to use his/her token to access the PPM. Users who own tokens and could use them in PPMs have unlimited access to affordable water at pro-poor rate of 30-40UGX per 20L jerry can, as long as their tokens are charged and the PPMs are working.

PPMs may have reduced the dominance of landlords (older version of middlemen) over the water market in the slums, but they have certainly fostered the culture of selling water in Bwaise II; the water selling is one of the main criticisms of pro-poor services in the literature (Boakye-Ansah et al., 2019, Mason et al., 2016). Shortages of tokens benefits users who own tokens (one of the newest kind of middlemen in system) because they can overcharge for the water as they "share" their tokens at a markup price of 100-200UGX per 20L jerry can. Even if non-token owners are paying significantly less for water at PPMs than they would at post-payment taps and to middlemen accessing wells (100UGX vs 200-300UGX), they are still not getting water at the pro-poor rate. For this reason, I argue that affordability of water is still a prevalent challenge among the water users in the slums. Despite the existence of PPMs, non-token owners are still paying more for their water than other water users in higher income areas accessing the same piped

water system. This finding substantiates a similar conclusion of van Reynolds et al. (2013). This makes ownership of tokens imperative for providing affordable water to the people living in the slums. The utility company should do something to help with the distribution of tokens.

Cost of water

For water users in Bwaise II, cost of water is a composite of the unit price of water, the cost of the water infrastructure (tokens), and the transaction costs of accessing water. Water users acknowledged that wells are free. However, acquiring that free water takes considerable time and energy; therefore, users prefer to pay for water from PPMs if they have the money and time to either service their tokens (in the case of token owners) or pay per fetch (in the case of non -token owners). However, the extent of willingness to pay is constrained by the users' ability to pay; understanding this relationship is very important in devising infrastructure and supporting services that will encourage choice of pro-poor services like PPMs (Raje et al., 2002, Gerlach & Franceys, 2010). Studies done in different cities, namely Lilongwe, Kampala, and Kisumu, found that slum dwellers will only spend so much of their income to pay for water or water infrastructure, especially if they have alternative sources that are cheaper or free (Berg and Mugisha, 2010; Schwartz et al., 2017, Adams 2018).

The results on willingness to pay in this study are in alignment with findings from a study done by Heymans et al. (2014) on PPMs across SSA; water users in Nakamiro have a high willingness to pay for water per fetch. Additionally, as presented in the results of this study, water users in the slum possess an understanding that piped water infrastructure is a service and therefore comes at cost. Literature on pro-poor service provision calls for a balance of both the financial and social objectives of water provision among the urban poor (Castro and Morel, 2008; Schwartz et al.,

2017). That people in the slums of Kampala perceive of piped water access as a service and accept the pre-payment process means conditions are in place that can foster the success of PPMs as a pro-poor technology. On the other hand, the culture of pre-payment coupled with perception of access to piped water as a service incentivizes the behavior of selling water at inflated prices through middlemen and other water user behavior that could compromise choice of PPMs as a water source. Therefore, fostering equitable access to PPMs will require that PPM provision is accompanied by pro-poor water governance mechanisms that mediate the existing culture and rules of access.

PPMs were mechanically designed to use tokens as a tool to intervene and alter the culture of selling water at inflated prices, enabling water users to access water directly from the PPM at a pro-poor rate and reducing the dominance of middlemen in the water access system. However, this goal is hindered by the challenges of token accessibility. Case studies conducted in Kampala on PPMs (Berg and Mugisha, 2010; Appelblad and Fredy, 2013; Murungi, 2016; Heymans et al., 2014b) revealed that access to tokens was a challenge, but reports of unaffordability of tokens as a barrier to access from the PPMs have escalated. Tokens are currently priced at 250,000UGX (6.77USD) 82% of the water users interviewed in this study viewed this as expensive and unaffordable, despite their stated willingness to buy one. The price of tokens increased 40% from 15,000UGX in 2017 to 25,000UGX at the time of this study, water users indicate they are unable or barely able to buy or replace tokens.

Additionally, transaction costs of acquiring a token have increased significantly since registration of tokens was introduced in 2017. The registration requirement left people of Bwaise II with only

one place to buy tokens – the only available pro-poor office in Kisenyi II serving all slums with PPMs in Kampala. Water users interviewed for this study reported that accessing this office is inconvenient and costly in terms of time and transport fees. Also, the processes of acquisition of tokens was reported as lengthy, expensive, and inconvenient by the water users interviewed for this study. This is because purchase and registration of tokens requires the buyer to have a national identification card (ID). Meene et al. (2011) present this as one shortcoming of pro-poor water governance: when service providers adopt formal procedures that create additional barriers to access and further marginalize the urban poor. In the case of Bwaise II, making access to tokens, a required means of access to water, contingent upon legal documents like national IDs (an extreme case is land-tenure requirements for post-payment taps) for people living in informal settlements limits access to affordable water from PPMs at an NWSC rate.

Even if the cost of acquiring a token is relatively cheaper than that of acquiring the conventional water infrastructure (post-payment taps), affordability is still a challenge given the people in the slums live on less than two dollars a day (UBOS, 2014). This means that the challenge of unaffordability of water prevalent with post-payment infrastructure has been transferred to the PPMs system in form of unaffordability of tokens, where unaffordability is a composite of token price and the additional costs of time, transport fees, and registration requirements. Furthermore, these challenges discourage investment in buying tokens because the people living in the slums are transient; PPMs are not installed in every slum or in other parts of the city, so people might be discouraged from investing in a token if they are likely to move. A combination of all these token acquisition challenges forces more water users to rely on middlemen, fellow water users with tokens who sell water at prices three times higher than the pro-poor rate. Consequently,

unaffordability of tokens has led to the prevalence of middlemen and hindered access to affordable water, which jeopardizes the fundamental goals of why the PPM intervention was introduced in the slums. This reinforces criticism of pro-poor water service provision for its failure to provide long term improvements in access to water (van Reynolds et al., 2003, Mason et al., 2016).

Reliability, perception of water quality and choice of PPMs

Water users reported their choice of PPMs as a water source was contingent upon the reliability of water supply at the source, which affirms Murungi (2016)'s statement that the proclaimed benefits of PPMs are real only when PPMs are working. Poor maintenance of PPMs by the utility service personnel has compounded the challenge of PPMs frequently breaking down. The reliability challenge is reported as a significant barrier to PPM use across SSA (Heymans et al., 2014). Maintenance failures are not entirely internal to the water system of Bwaise II; they are also influenced by external factors such as the ability of NWSC to acquire spare parts. Studies on efficiency and status of PPMs in the slums across cities in SSA have found that PPM provision is largely funded by International organizations. Yet, the infrastructure is capital intensive, and utility companies do not have the financial flexibility to invest in expensive spare parts when needed. Additionally, as learned from the interview I conducted with the utility personnel, NWSC lacks sufficient funds which has crippled the utility's ability to invest in supportive services such as extending pro-poor offices to other slums and interventions such as increasing service credit vending stations and enforcing the consequences for landlords who violate the MoU.

Determinants of choice are temporal and can vary among water users in the system (Mu et al., 1990). In this study, reliability was not as much of a concern for post-payment tap owners as it

was for PPM users, which contrasts with the findings of Isoke & van Dijk (2014) that reliability of water supply at the source was the second most important determinant of water source choice among piped water source users. The difference in results arises from the fact that water supply at piped water sources today is more reliable, with a few water cuts per month that users did not find bothersome enough to report as high. In this study, reliability of water source supply was more significant for PPM users than for post-payment users because PPMs break down frequently and take a long time to be fixed, not because of inconsistent supply from the water mains. Also, non-token owners' reports of reliability was a composite of availability of water at the source and willingness of token owners to "share" their tokens.

Access to safe water is a primary reason for extension of PPMs to the slums of Bwaise II and is cited as a determinant of water source choice among a few participants in this study. The results related to perception of water quality are contradictor among the water users but not among the six key informants interviewed, which raises questions about how water safety information is communicated formally and informally within the slum. Similar to other studies on perception of water quality (Francis et al., 2015; Miguel de Franca Doria, 2010; Canter et al., 1992), water users in this study reported that they judge water quality based on taste, appearance of water color, knowledge of contaminants, and source of water at source. Further analysis of the contradictory results on perception of water quality among water users is needed, since even those that use the same water source reported different quality perceptions. According to the utility company, piped water sources such as PPMs and post-payment taps are reported as the safe water sources and wells are regarded as unsafe. However, all piped water source users reported that they boiled piped water before drinking it; some perceive it as unsafe while others are following the public health advisory

from the utility which notes that piped water could be contaminated during transportation. Considerations of safety or processes involved in making water safe after fetching it were reported to influence choice of water source. However, they were overridden by considerations of distance and cost of water.

CONCLUSION

PPMs have been reported to make convenient and affordable water available to the people of Bwaise II slums. However, they do not come without challenges. The decision to use one water source over another is not straight forward and is dependent upon a water user's situational assessment of determinants of choice. There may be many determinants of choice, but in practice water users actively consider only two to three determinants at a time. The primary requirement for water access is presence of a working source; all other determinants are contingent upon a water source being available and in a working condition. Therefore, it is very important to know where water sources are located to better understand water user behavior. Hence a spatial analysis was a crucial component in this study.

Distance and price of water emerged as the main determinants of water source choice in this study; therefore, PPMs are the best water source in Bwaise II. PPMs allow more water users in Bwaise II to conveniently access water at a pro-poor rate for token owners and at the cheapest price per 20L jerry can for non-token owners. Water users in Bwaise II place a high value on convenience. I make this conclusion because, even if wells are free, most water users in this study preferred to pay for water at PPMs when they were closer. However, they are not able to pay for convenient access if water is too expensive. Access to convenient and affordable water from PPMs is dependent on compliance of landlords and token owners with the rules in place for access and pricing of water from PPMs, especially because the utility does not have the capacity to enforce the rules or implement the consequences. Therefore, for PPMs to operate successfully, water users must have an appreciation of the technology as a public provision and act in ways that do not exclude others from accessing affordable water.

Access to convenient and affordable water from PPMs is lower than when PPMs were first introduced because of inadequate maintenance of PPMs by the utility, lack of convenient and reliable access to service credit vending stations, and unaffordability and unavailability of tokens. These challenges have left water users in the slums stuck in a state of poor and unaffordable access to water services.

Tokens are the means of access to water from PPMs, which makes access to serviced (charged) tokens an essential determinant of access to affordable water within Bwaise II. Challenges of unaffordable tokens, inconvenient and unreliable token re-charging services, and high transaction costs of access to tokens and service credit limit the choice of PPMs as a source of water. Tokens decentralize ownership of water access infrastructure from landowners to slum dwellers without land tenure; this reduces the need to buy water from middlemen and extends access to affordable water. Choice of PPMs as a water source is compromised unless water users can easily acquire tokens and easily recharge them to maintain them as a means of access to the PPMs. Therefore, NWSC support for PPM infrastructure with provision of services that make accessibility to PPMs easier is essential. Recommendations include providing more service credit vending stations, providing a location within the parish where water users can buy tokens, providing tokens at a lower or pro-poor rate, and substituting the formal national ID requirement with an informal requirement to ensure that those without IDs are not marginalized.

Day-to-day water access in the slums is predominantly mediated by informal institutions since water users must devise ways to access water besides the formal provisions of piped water.

Analyzing how power relations within the system affect access illustrates that users of the same infrastructure have different constraints of access depending on their level of ownership of the water infrastructure being used. Therefore, different users within the same system are likely to describe varying degrees of influence of different determinants on water source choice. PPM landlords, token owners, non-token owners, and post-payment tap owners all hold different rights to water access infrastructure which influences how they relate with one another to actualize access. Understanding these differences is very important for designing and implementing inclusive water access systems that benefit the poorest and least powerful water users and identifying leverage points to enhance overall access within the system.

PPMs have altered the structure of water access by extending access to water at NWSC pro-poor rates to water users who do not own land, and these rates have been a major determinant of choosing PPMs as a water source. Considering that over 75% of the population does not own land and is transient, installing public water infrastructure with decentralized means of access like tokens enables more people can access a single water point with some level of ownership. Of course, some landlords deny water users access to PPMs, but I found that if landlords understand the essence of pro-poor provision, they are more likely to comply with this nature of provision. However, this compliance can be withdrawn depending on a number of factors, and a particularly important one is the degree to which PPM users hold up their end of the bargain by working with landlords to maintain the PPMs. Therefore, continued education of both the landlords and users is imperative for maintaining the desired level of access to PPMs.

PPM landlords will always have some level of exclusionary rights to PPMs because of land-property rights. The extent to which these rights can be exercised depends on the existence and effectiveness of formal and/or informal accountability systems (Rampa 2011). Therefore, the effectiveness of pro-poor services depends upon giving the poorest user more ownership and power over their state of access, especially in slums where most people do not have formal property rights and are susceptible to exclusion (Cleaver, Franks and Boesten 2005; Roger & Hall, 2003). In the case of Bwaise II, this means making tokens more accessible and affordable and making service credit vending services more convenient and reliable. Also, since compliance of landlords is erratic, which threatens access for token owners, the utility should incentivize landlords to maintain PPM availability as envisioned in the MOUs. Merely relying on the good will of landlords threatens sustainable access, especially in a culture that reinforces buying and selling water.

Sustainability of access from PPMs is threatened by NWSC's over-reliance on external funding from international organizations for continued provision of PPMs and their related services. One of the prominent challenges within the PPM system is unreliability of infrastructure because it breaks down too often and mechanical fixes take a long time to occur. In part, this is due to inefficient service by utility service personnel. But the primary problem is that spare parts are expensive and funds are limited.

Distribution of water sources and water access supporting services influences the key determinants of choice: distance and cost. As mentioned earlier, zones in Bwaise II are not homogenous in either respect. Therefore, I would recommend further research exploring water user behavior in relation

to spatial variability in distribution of PPMs across the different zones (smallest administrative units and therefore smallest possible unit of service provision) in Bwaise II. This will help explain the context of equitable distribution of PPMs in Bwaise II. Having an understanding of where PPMs are or have been removed and why will inform allocation of water resources within the slum at an administrative level.

I would also recommend a comparative study of the status and determinants of choice of PPMs in different slums across SSA with a focus on understanding the institutions that foster or compromise access. Such research would highlight the heterogeneity of water access in the slums. Existing research has studied water access grouping water users in socio-demographic and economic groups. I would recommend that future research delve into how determinants of choice vary among water users with varying levels of ownership of infrastructure within the same water system. In particular, such research should be conducted using a bigger sample size and applying qualitative and quantitative methods (both statistical and spatial methods), especially in areas like slums where access to water is predominantly run by informal systems.

I would also recommend future participatory action research (PAR) involving the urban poor. Research on PPMs, and pro-poor services in general, needs to go beyond studying water users' behavior work to co-create solutions with pertinent stakeholders, especially with the water users. This is uncharted territory in terms of water access among the urban poor. Even though it is likely to be financially demanding, I believe it is worthwhile to conduct PAR on pro-poor water services from an asset-based angle. This will foster grass roots engagement of local water users in the creation of knowledge on water user engagement and on infrastructural and service development

to enhance the design, implementation, and maintenance of pro-poor service arrangements like PPMs. There is a wealth of talent and experiential knowledge among residents of the slums, especially the youth, that can be tapped to design infrastructure and support programs to augment infrastructure already in place.

APPENDICES

APPENDIX A: Interview Guides

In-Depth interview guide for PPM users

Introduction:

Thank you for accepting to take out 60 minutes of your time to sit down with me and share your water access experiences. My name is Rachel Nanteza; I am doing research to understand water user perceptions on whether PPMs have improved access to water in Bwaise II. I will be doing various activities including mapping and interviews with other locals to learn more about the system. I look forward to hearing about your experiences and learning from them.

READ THE CONSENT FORM

Present map to participant

This is a map of the Bwaise II water access system that I have done. It includes features such as: shared pre-paid meters, boreholes, NWSC offices, service credit vendors, major streets and buildings, water kiosks among other features.

Spatial Distribution

1. By looking at this map – are you able to approximate the location of your household?
2. <If yes>, please mark it on the map.
3. Do you draw your water from different locations?
4. Could you indicate on the map the places where you frequently draw your water? (Probe: Include all source namely PPMs, boreholes, springs, water kiosks, other sources for your households)
5. <if the person marked multiple sources of water on the map>, why do you get water from different places?
6. Is there one you use more often than the others?
7. How do you choose what PPM to go to?
8. How long do you have to walk to get to the PPM?
9. How long do you usually wait before you can withdrawal water from the PPMs you access? (Probe: Are the wait times significantly different at the PPMs you marked? Are you able to assign wait times to some of the PPMs marked?)
10. What challenges do you face from using pre-paid meters (Probe: do they differ from meter to meter, talk about property rights – landlords, on/off, public Vs private)

Tokens

11. Does your household own at least one token?
12. <If yes >: Where did you buy your token? (Probe: How much)

a. Do you share your token with other people? If so, what is the sharing arrangement?

b. Do you use the same token on all the PPMs that you use?

c. <if no> why you need more than one?

13. <If no>: why?

a. how do you get access to PPMs? (Probe: do you have access to the token from another household? Or do you have to use a middleman? What is the arrangement?)

14. Have you heard of people sharing tokens? (Probe: do you know how do they do that?)

15. Have you ever lost of a token?

16. How did that alter the way you access and withdrawal water?

17. Did you get a new one?

18. <if yes>: How much was it?

a. After how long

b. Did you access PPMs between losing a token and getting a new one? What did you do during the time you didn't have one? (Probe: How do the experiences of having/not having a token differ)

c. Why didn't you just continue accessing PPMs like that?

19. <if no >: Why?

a. How do you get water now? (Probe: how do you access PPMs now?)

b. What challenges have you faced in getting water since you lost the token?

20. Has your token ever become un functional? (Probe: what happened)

21. What did you do about it?

22. Do you know some people that do not use PPMs? Why they do not use PPMs?

Service Credit:

23. Where do you load service credit? (Probe: are the payment avenues accessible?)

24. How much is a jerry can of water (20L) from the PPMs?

25. How does the price change depending on how you acquire a token?

26. How does the price compare to prices from other water sources?

27. You mentioned using a kiosk sometimes, isn't that more expensive than using a PPM? (Probe: if yes, why do you do it anyway?)

28. How is the involvement of middlemen in the PPM system different from their involvement with kiosks?

29. Do you have any thoughts on the involvement of middlemen in the provision and access of water from PPMs (benefits and barriers they present to access)?

30. What kinds of things/provisions do you think enable someone to be able to access water?

31. What is an affordable price in your opinion? (Probe: and what price would be affordable for you (and your household to pay?)

Water access and withdrawal

32. For how long have you lived in Bwaise II?

33. Roughly, when did you start using PPMs?

34. How has water access change over the last couple of years (length of stay or 5 years)
35. How have water prices changed in the past5 years? (Probe: Has affordability changed)
36. Is accessing water more convenient now than it was 5 years ago? Why?

PPMS

37. When did you start using PPMs?
38. Why did you start using them?
39. Where did you fetch water from before you started using PPMs? (Probe: Wasn't there tap water?)
40. <if there was tap water>: Why didn't you use it?
41. For what purposes do you use the water that you draw from the PPM?
42. How is the quality of water that you draw from the PPMs? (Probe: How does it compare to other sources?)
43. In general, who in your family fetches the water?

Maintenance

44. Who is in charge of the PPMs you use?
45. Who is in charge of reporting non-functional PPMs? (Where do they report)
46. Who is in charge of fixing the PPMs if they break?
47. Who pays for the repair?
48. Have you ever reported a broken PPMs?
49. How long does it take to get a PPM repaired?
50. Where do you get your water as you wait?

Perceptions

51. What were the major challenges in terms of water access that you and your family faced before the introduction of PPM?
52. What are the challenges that you and your family face as you try to fetch water from the PPMs?
53. Could you tell me the benefits that fetching water from the PPM has brought you and your family (and your household)?
54. Do you think PPMs have improved access to water in the slums? (Probe: how do they compare to other options, Comment on quality)
55. If yes – in what ways?
56. If not – why not?

In-Depth interview guide for Non-PPM users

Introduction:
Thank you for accepting to take out 60 minutes of your time to sit down with me and share your water access experiences. My name is Rachel Nanteza; I am doing research to understand water user perceptions on whether PPMs have improved access to water in Bwaise II. I will be doing various activities including mapping and interviews with other locals to learn more about the system. I look forward to hearing about your experiences and learning from them.

READ THE CONSENT FORM

Present map to participant
This is a map of the Bwaise II water access system that I have done. It includes features such as: shared pre-paid meters, boreholes, NWSC offices, service credit vendors, major streets and buildings, water kiosks among other features.

Spatial Distribution and Access

1. By looking at this map – are you able to approximate the location of your household?
2. <If yes>, please mark it on the map.
3. Could you indicate on the map the places where you frequently draw your water? (Probe: Include all sources namely PPMs, boreholes, springs, water kiosks, other sources for your households)
4. <if the person marked multiple sources of water on the map>, why do you get water from different places?
5. Is there one source you use more often than the others? (Probe: Please mark it, why)
6. For how long have you been using this water?
7. How do you choose which one to go to?
8. I noticed that you did not mark PPMs on the map; are you familiar with PPMs? (Probe: does that mean you don't use them?)
9. <if yes>: Have you ever used PPMs in the past, when?

a. <if yes>: please mark which PPMs you used?
b. Why did you stop using them?
c. Would you like to continue using them? (But/why?)
d. <if no>: would you like to use it? (But/why)

10. <if no>: would you like to learn about them? (move to definitions)
11. Have you heard of the sharing tokens?
12. <if yes>: what is the arrangement (Probe: talk about the role of different stakeholders)
13. Would you like to use any of the arrangements mentioned above? (Probe: But/why)
14. <If no>: would you like to learn about these arrangements? (Probe: But/why)

15. if you were using PPMs today, which ones would you be using and why?

16. Who fetches water in your household?

Definitions

17. What kinds o things/provisions do you think enable someone to be able to access water.
18. What is an affordable price in your opinion? (Probe: and what price would be affordable for you to pay?)
19. For how long have you lived in Bwaise II?
20. Has water access change over the last couple of years (length of stay or 5 years) - how
21. Do you know other people that do not use PPMs? Why don't they use PPMs?
22. What is the quality of water that you draw from the sources that you use? (Probe: How does it compare to other sources?

Price

23. How much is a 20L jerry can of water?
24. Who decides the price of the water at the sources you use?
25. Do you think the price of water you are charged is fair?
26. How does that compare to the price of 20 L of water from the PPM?
27. <If more expensive than PPM>: why do you use those sources anyway?
28. Have water prices changed over the last couple of years

Perception

29. What are your perceptions of the PPMs system?
30. Has the introduction of PPMs in any way altered access from the sources that you use? – How?
31. Do you think PPMs have improved access to water in the slums? (Probe: how do they compare to other options, Comment on quality)
32. If yes – in what ways?
33. If not – why not?

APPENDIX B: FGD Guide

Focus Group Discussion Guide
Eligibility:
5-8 participants with experience using pre-paid meters

Introduce my research assistant and myself:
Hello, my name is Rachel Nanteza. I am the one going to facilitate this focus group. I am a student at Michigan State University doing my masters in Community Sustainability. Part of the requirement to complete my masters is to complete a research project. I am doing a study to understand user's perception of pre-paid meters. I am here with my assistant; his name is XXXXX. He will be listening to our discussions and he will be taking notes of some of the points you make.

Read and explain the consent form.

Guidelines for the Focus groups

- The opinion of everybody in this group is important.
- There are no right or wrong answers. Rather, I am looking to hear about your personal and shared experiences as people that have use pre-paid meters.
- You do not have to always agree with one another, as each of you has had their own unique experience.
- Every person will have the opportunity to talk if they want to.
- I will interrupt when two or more people are speaking to make sure everyone gets a chance to be heard.
- Your identity will be confidential. I will not share your names, with any one.
- Please keep your cell phones on silent or vibration and if you need to take a call, please quietly step outside to do so.
- Moving in and out of the focus group for whatever other reason is at your discretion, but please do it quietly.
- The focus group will take one hour and my assistant and I will highly appreciate it if you could stay for the entire session.

Introductions (5 minutes)
Now, we are going to spend sometime getting to know one another.
Let's go around the room and introduce our-selves. Please tell us your name, the neighborhood where you live, and for how long you have lived in Kisenyi II.

Pre- activity discussion: (30 minutes)

We will begin our discussion with each one of you sharing your experience of how you access water. I will ask the following questions and any of you feel free to share your experience or compliment another person's response

1. How do you define access?
2. How has water access changed in Kisenyi II over the past XX years?
3. Is water more affordable now than it was XX years ago? Why?
4. Is accessing water more convenient now that it was XX Years ago? Why?
5. Is water safer now than it was XX years ago? Why?
6. How did you get water before PPMs were introduced in the slums?
7. What benefits do you enjoy by accessing water from PPPMs?

Now, we will make a list of the benefits you enjoy from the pre-paid meters. As we list the benefits – we will define each one of them to make sure the listed benefit means the same thing to all of us.

8. What barriers to access water existed before PPMS?
9. What barriers to access water exist now?

Now, we will make a list for the challenges or barriers you encounter as you attempt to access the PPMs. We will also define each one of the challenges to make sure we have the same understanding of each listed challenge

Ranking activity: (15 minutes)

10. I am now going to hand you stickers each and request that you come and put on sticker on each of the top three benefits you and your family enjoy the most.

11. Now, I will hand you three red stickers and request that you come up and put one sticker on each of the top three challenges/barriers that you and your family face the most.

<for the ranking activity, if somebody wants to put all the stickers in the same challenge/ benefit that is okay>.

Post activity discussion (30 minutes)

We will now discuss the ranking outcomes

You have ranked these as your top three /two benefits. Could we talk more about these benefits.

12. Why do you value these benefits so high? (why these are on top on your list)
13. Do stakeholders help in the provision of these benefits?
14. What factors and processes make the benefits accessible?

Now we will move on to the challenges.

15. You have ranked these as the top three/two challenges you face. Could we talk more about these challenges. (why these are on top on your list), do they make your life more difficult)

16. Have you devised any strategies to address these challenges?
17. Have other stakeholders devised any strategies to address these challenges?
18. What do you need from other stakeholders to address these challenges?
19. What factors and processes foster these challenges?

20. What recommendations do you have for NWSC that can enhance the benefits/improve challenges you are getting from PPMs?

De-brief about focus group

21. Do you have anything else you would like to add to all we have discussed today, do you feel like there is something we have missed or did not discuss in depth, as we should have?

Closing

That will be all for today. Thank you so much for your time. And in celebration of all the sharing and learning we have done today – we will have a meal. Please queue by the food table for a plate of food and a drink. Feel free to hang around for conversation and find me to talk about anything else you might like to share.

Have a lovely day!

APPENDIX C: GIS Mapping Guide

Observation for GIS Mapping - Guide
I will use this guide to organize the filed notes that I will take during the first two weeks of direct observation, identification and mapping of the features within the water access system

Feature:

Location (GIS coordinates):

Year installed/opened:

Date of observation:

Hour of observation:

Hours open/ accessible:

Circle characteristic applicable to feature
On public land/ on private land
Landlord on site / Landlord offsite

Condition: Working / Not Working
Reason:

Other notable characteristics about feature:

Water user behavior
Which genders are fetching water?

Which ages are fetching water?

How big are the containers where they fetch water?

Is there a line/ queue to fetch the water? If not explain.

What is the payment dynamic (Cash, free, token,)?

To whom is the cash payment being made?

Other notable behaviors

Reflection on observation

APPENDIX D: Codebook

Table 3. Codebook developed and used for this study

RQ1: How does the spatial distribution of the water access system influence water user decision within the slum? **RQ2: What are the determinants of water user decisions in the water system in the slums of Kampala?**				
THEME	**CODE**	**DEFINITION**	**RULE**	**EXAMPLE**
Water Source	Source of water	The type of water the household uses or where the household fetches/used to fetch water	Use this code for places where the user gets water. If uses middlemen, code it as a source too.	"I fetch my water from the well but sometimes I use the PPM too..."
	Awareness of other sources	Any mention of knowledge of other water sources that they do not use for example names or attributes like location and price of water from them.	Use this code irrespective of whether they know where the alternative source is located or not	"...the other PPM is somewhere there, if you go a little bit forward you will see it...
	Who fetches the water	The person who fetches the water in the household Any text indirectly referencing who fetches water under conditional/rare circumstances.	Use this code for the person who draws water from the source (known or unknown) to the household. Include when and where if they use different sources and people	...we would have loved to use the taps but we do not have anyone to/middleman to fetch the water for us... (Interview 10) ...I use middlemen to fetch water for me from the well when there is a water cut on the PPMs" (Interview 8)

				...there are long lines when kids come back from school
	Quality of water	This includes statements about: the taste of water, color/appearance of water.	Use this code if person mentions aesthetic characteristics of water or the effects of drinking water from any named source	"…the PPM and tap water have a misty color in them I think it is because of the chemicals"
	Use of water	Different uses/purposes of water for the case of people who use more than one source (mixed users), and a mention of the processes undertaken to make water from any source drinkable.	Use this code for any text on separating uses of water dependent on source or awareness of such separation. Also for any treatment that is given to water before it can be used.	"...I use PPM water to cook and wash cloths but I must go to the well every day to fetch water for drinking, that one whether boiled or un boiled it is still good to drink…" (Interview 9)
	Wait period/Fetching Time	How long the fetcher has to wait at the source before they are able to collect water in their container per single fetch or during block periods like morning, afternoon, evening. How much time it takes to get water from the source to the house	Use this code for statements about waiting at source and/or statements about one way or round trip fetching time estimates and inferences to distances such as far, not as near.	"...there is usually no wait time at the PPMs, you can just go fetch the instance you need the water unlike at the well which is far and even when you get there you have to wait for people who got there before you to fetch..." (Interview 10)
	Other characteristics of source	This includes texts about spatial, social, or mechanical (water availability	Use this code for statements about distance and social relationships as determinants of source of water. Use this code for any text that directly	"...I fetch water from this PPM because I already have a token, have money (service credit on it) and it also happens

		at source)conditions that influence how water users decide which source to get their water from.	explains/supports the choice or no choice of any given water source.	to be the nearest to me…" (Interview 13) "...I only use that other PPM when the one nearest to me is not working"
Water Prices	Amount	The amount (number/range) of money in UGX that water users pay or source/infrastructure owners charge to warrant water collection in any amount from any source be it per single fetch/ per week/ per month	Use this code when someone mentions an exact amount or range (anything numbers) of money they pay for any given unit of water of water from source or delivered to their household. Use this code when someone mentions how much they pay if they do not have a token, or how much they charge those they share their token with. Use this code for amount of service credit (the amount of money token load on a token) to be able to collect water from PPMs.	"...Before PPMs, a jerrycan costed 100 UGX but the taps are no where close to me anymore (rare); at PPMs it is at 30 UGX per jerrycan if you have your own token but I borrow from my neighbors and I pay 200 UGX PER JERRYCAN..." (Interview 11) "...we used to get 4 jerrycans for 1000UGX of service credit but now they have reduced to three"
	Determinants of Price	The factors that influence how prices of water are set	Use this code conditions and costs put into consideration when prices of water are being set at anyone given source.	"...I buy water at 100 - 200 UGX from the PPMs, but most of the times it is 200 UGX. Well sometimes it depends on your relationship with the owner of the token". (Interview 15).
	Willingness to Pay	The desire to pay the asked price for water, a token or other related infrastructure and	Use this code for statements on whether users mind or do not mind paying the asked price	"...Nowadays there is few people with tokens because most of them lost them, for someone to pay 15,000 UGX in one

		services in order to get water		go to get a token again seems like a lot of money" (Interview 12).
	Ability to pay	If a user can or can not pay for the asked price of water, or a token, or other related infrastructure that make water access possible for them	Use this code if user hints on capability to pay or not the asked price. Willingness is a non-factor because some users are able but are not willing to pay.	"…I offered him 15,000 UGX but he insisted that I give him 20,000UGX, and that is too much money that I did not have so I just gave up on getting a token"
	Affordability	Statements that speak to the fairness of the asked price for water, tokens, and other infrastructure necessary for water access.	Use code if a price is stated in comparison with another price or in relation to the economic status/income of user. Use this code if amount of resource collected/required for any given price at one source is compared with that from another Do not use this code if statement does not compare or in the very least hint at it.	"...In my opinion if you consider and care about the living conditions and the poverty we live in, a jerry can of water should have been sold at 50 UGX" (Interview-13)
PPM Infrastructure	Get a Token	Includes text about the process the user went through to acquire and/or replace a token; who/where they got it from. It also includes text about the perception of the process of	Do not use this code if text it is about sharing a token.	"…I got my first token for free when they installed the installed the PPM here., but they steal them. I think I have bought over ten of them. When you buy it from the utility office in Kisenyi, they give you a form to fill, then you go to the bank and pay money then you go back and they give you the token"

	acquiring/replacing a token user acquired their toke n		(Interview 25) |"...after sometime, they started requiring that we register our tokens under your name and telephone number and if you dont it will not work past the grace period" (Interview 13)
Price of Token	The amount (number) of money in UGX that water users to get a token regardless on where they get the token	Use this code when there is a mention of the exact amount or range of money paid to acquire and own a token. It also includes text on awareness or lack there of how much a token costs.	"I thought it was at 10,000 UGX but the middleman asked for 20,000 UGX. I offered him 15,000 UGX and he refused"
Reaction/Impact to token	Include text on the perception and impact of tokens as a means of access to PPMs. Also includes text on the affordability of the price of the token and the users' willingness and/or ability to own a token	Use this code for any text expressing opinion on anything tokens related.	"…15,000 UGX is a lot of money to pay in one go just for a token"
Sharing a token	Text about how people who do not own tokens access PPMs. It also includes text on the perception and impact of sharing tokens (benefits and	Use this code for experiences of both the token owner and the person who does not own a token (texts about selling and/or buying water at PPMs and the transaction costs and risks of the process of and sharing a token.	|"...actually that whole registration thing has not helped us, they told us if we register them to reduce them being stolen it will work like how you register a phone but still, people steal them... that is why I don't share my token" (Interview 25)

	challenges/disadvantages)		
Service Credit	This includes text about where users load money onto their tokens and details about the process of loading tokens. It also includes texts on the significance or impacts of service credit in getting water.	Only use this code for mention of who, where, how, why, when and how much about loading money unto tokens. Use this code for text of how much and how and the amount of service cred Do not use this code if text is about unit price of water for token owners	"...Sometimes Namegembe (lady who sells service credit) is not available, and then we suffer because our tokens have no money."
PPM acquisition	This includes text on the process of how PPMs were introduced to water users as well as the process that led up to their installation or transfer of management.	Use this code for texts on how users learned/or not about PPMs, and how they got them installed, uninstalled or switched from one place to another. Use this code for when someone speaks explicitly that they lack knowledge of the process	"…they found me here and asked me if I wanted to Install a PPM on my land. But they put the agreement in my husband's name because he is the owner of the land. And they asked for proof of ownership of land and passport photos. The chairman came and told my husband, then he told me to tell my husband to bring the photos and if we agree to put a PPM for us then they put it..."
Benefits of PPMs	The positive changes noticed within the water access process and lifestyle of water users within the Bwaise II after the introduction of PPMs.	Use this code for any form of changes in water access stated as positive whether in direct reference to PPMs or indirectly, by stating water access challenges with other sources that they do not have to deal with anymore.	"…in my opinion PPMs have improved access because if I want six jerrycans of water, I used to be under pressure /stress to find the money to buy all those jerrycans but if I get that 1200 UGX and add like 400 UGX then I make 2000

				UGX, then I can fetch water for like a month from the PPM". (Interview 18)
	Challenges of PPMs	The limitations that water users face(d) when using PPMs; negative impacts noticed within the water access process and lifestyle of water users within the Bwaise II after the introduction of PPMs.	Use this code for conditions and rules (official and unofficial) explicitly stated as limitations/negative impacts of access Use this code for text that report no challenges in response to a direct question about them. Use this code for text about lack of information on certain aspects of PPMs under her	" We have encountered a number of challenges especially when the PPM dies, that is quite a problem. Also sometimes Namagembe (the lady who loads service credit on tokens) is nowadays not there when you need her which makes it very challenging to top up /reload the token to be able to withdrawal water". (Interview 25)
	Benefits of other sources	The Positive impact of any of the other sources other than PPMs	Use this code for text that mentions the perks of having other sources in addition or despite of PPMs Use this code for text that mentions any other source as a solution to the challenges of PPMs	"…see that well over there, we are always guaranteed to get water despite the water cuts at the taps"
Impact of water sources	Challenges of other sources	The limitations associated with any of the other sources other than PPMs.	Use this code for text that mentions the limitations or negative impacts of other sources on water access. Use this code for text that compares the before and after the introduction of PPMs by passively speaking what they do not have to do now that PPMs are in place.	"…access to water has improved so much, now we do not have to go so far to get water and I can even fetch water anytime I get home from work"
Rules	Formal	The official rules, procedures for how and	Use this code for formal rules that were devised and communicated	"...As per NWSC, we accepted the owner of that plot there where we have

		when the rights of access to PPMs, management, and water withdrawal will be exercised.	through official channels like the local council, the utility company (NWSC)	put the PPM to sell water to those who do not have. Only that person is supposed to sell water from the PPM" (Interview NWSC). | "...I am not sure why the price of water is different at different PPMs despite the official announcement from NWSC that a jerry can should be sold at 50 UGX and if someone violates this, we should report them" (Interview 14).
	Informal	This includes text about the informal rules, for access to PPMs, management, and water withdrawal will be exercised	Use this code for informal rules devised by community members or PPMs owners and users such as landlords, PPM service personnel.	"…the utility company announced that each jerrycan should be sold at 50 UGX but people sell a jerry can at 100 UGX because fifty shillings is no longer that much in circulation and even the government refused to emphasize the use of 50 UGX so people also decided to abandon it".
	Access/Exclusion	Who is allowed (or not) to get to any water source. What are the rules that give this permission and who decides them, how and why.	Use this code for explicit mention of who can or cannot get to (access/exclude from) the water source and the prescriptions that determine that	‘‘ There are some PPM owners that do not want you to use your own token. They want us to pay them to use their tokens to get water from the PPM yet we were also given tokens for free to begin with. So you go to a PPM and the landlord gives you a hard time, I personally decided to give up on using PPMs (Interview 3)

Property rights	Withdrawal	Who can or is (not)allowed to fetch or collect water from any water source. What are the rules/requirements to fetch, who decides them and why.	Use this code for prescriptions of who is able to collect water from source how, when and with which requirements Use this code for who decides what infrastructural or social conditions/requirements determine if water can be collected	"Anyone with a token loaded with credit then can fetch water from the PPMs"
	Management	Who is responsible for installing, repairing and the day-to-day maintenance of any water source and What actions they undertake in their roles.	Use this text for text on who does or is expected do/provide what, how and when for people to be able to collect water from any given source.	"I am responsible for this particular PPM and my responsibility is that when it dies, I have to call the person who the utility assigned to fix it. I am also responsible for cleaning it and keeping it sanitary" (Interview 22)

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