

Follow the Water

Diving into the Politics of Water Losses in Nairobi, Kenya

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Summary

Access to water is a global challenge with 2,2 billion people lacking this service. In Nairobi, 64% of the residents have piped access to water, with major differences between the higher-income areas and the lower-income areas. It is assumed that in the latter area, around 80% of the residents get their water from other sources such as boreholes, legal and illegal water vendors and rivers. In contrast, 40% of the water is assumed to be lost by the water utility company as it is not being paid for to the utility company. However, to a large extent, this water flows from the governmental water distribution system into the informal water distribution system. As a crisis in water is often a crisis in water governance, this research took a the perspective of the politics of water governance to explore the flow of water from the governmental water distribution system to the informal water system. Through a policy document analysis and interviews with various experts in the water sector in Nairobi, the following research question was answered;

How does current water governance create water losses and how does this influence the access to water in the informal settlements in Nairobi, Kenya?

This research has shown that the access to water in the informal settlements is both dependent on the governmental water distribution system and the informal distribution system. The water that flows from the governmental system into the informal system influences the affordability and availability of the water in the informal settlements.

This research has contributed to debates on the access to water in the informal settlements, understanding the intertwining of the informal and formal water system and has shown that informality comes from necessity and commercial opportunities.

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List of abbreviations

AFD	Agence Française de Développement
AWWDA	Athi Water Works Development Agency
CBO	Community Based Organization
IWS	Intermittent Water Supply
KIWASH	Kenya Integrated Water, Sanitation and Hygiene project
KPWF	Kenya Pooled Water Fund
NCWSC	Nairobi City Water and Sewerage Company
NMS	Nairobi Metropolitan Services
NRW	Non-Revenue Water
SDG	Sustainable Development Goal
UfW	Unaccounted for Water
WAG	<i>Water Action Groups</i>
WASREB	Water Services Regulatory Board
WSUP	Water & Sanitation for the Urban Poor

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Introduction

Water deficits occur in many rapidly urbanizing cities around the world (Arfanuzzaman & Rahman, 2017). Even though the percentage of the global population that has access to safe drinking water has risen from 61% in 2000 to 71% in 2017, 2,2 billion people are still lacking access to safely managed drinking water (UN, 2017). The majority of those without access live in sub-Saharan Africa, especially in the urban informal settlements (Dos Santos et al., 2017), where 60% of the urban population of sub-Saharan Africa lives (UN Habitat, 2016). Even though the urban population is more likely to have piped water supply than the rural population (WHO/UNICEF, 2017), urban access to water has been stagnating for the past three decades (Dos Santos et al., 2017; WHO/UNICEF, 2015b).

Nairobi offers an interesting gaze into a rapidly growing city, both economically as with regards to population growth. While in many cities in developed countries population growth is connected with socio-economic development, this has not been the case for Nairobi (Mutisya & Yarime, 2011), as Nairobi is one of the most unequal cities in Africa (UN Habitat, 2010). For decades, Kenya and Nairobi have been dealing with water scarcity due to years of drought, poor management, population growth and water contamination (Marshall, 2011). Nairobi now deals with a water deficit of 25% (World Waternet, 2019; World Waternet, 2020), and deals with big intra-urban inequalities with regards to access to water (Ledant, 2013).

Many scholars find the solution to reduce the water deficit and inequalities in access in more efficient water management (e.g. van den Berg, 2015; González-Gómez, García-Rubio & Guardiola, 2011; Lai, Chan & Roy, 2017). They refer to the non-revenue water (NRW) as the indicator of inefficient water management. NRW is most commonly used within the water sector to describe the difference between the amount of water put into the formal distribution system and the amount of water that is billed to the customers (van den Berg, 2015; Farok, 2016; IWA Water Loss Task Force, 2003; Kankoudis et al., 2013; Lai, Chan & Roy, 2017; WASREB, 2014). According to González-Gómez, García-Rubio and Guardiola (2011), NRW constitutes out of three components; physical water loss, commercial water loss and authorized water loss.

While physical losses refer to actual water that disappears from the governmental water distribution system and is not used by any customer because of leakages or overfull tanks,

commercial losses refer to the water that is not paid for to the utility company and is thus often still reaches the residents. The commercial losses happen due to meter inaccuracies and illegal connections (González-Gómez, García-Rubio & Guardiola, 2011). The authorized losses also refer to water that is used but not paid for as it constitutes out of water that is given away for free to low-income citizens or used for cleaning out the pipes (González-Gómez, García-Rubio & Guardiola, 2011). Thus, commercial water losses and authorized losses, unlike physical water losses, are thus not completely lost, but are lost from the formal governmental water distribution system, and thus not paid for to the utility company. However, this says little about actual water losses that would limit the availability of water for the residents.

Better understanding in these flows of water can be found in water governance. According to the Organization for Economic Collaboration and Development (OECD, 2011) “the water crisis is a crisis of governance” (p.26). Hyden (2001) explains water governance as a concept that refers to the questions of ‘who gets what, when and how?’ and ‘who decides what, when and how?’. Even though, the concepts of water governance and water management are interrelated with one another, governance can be understood as the political, social, economic and administrative system in which water management takes place (Chan, Roy & Chaffin, 2016). The implementation of water policy plays an important role and is dependent on the actions of various actors. Besides the formal governmental actors that are involved in the water sector itself, water governance also includes the influence that private actors and civil society have on how water is distributed (Hyden, 2001). While distributions of water are often researched with the idea to improve the system, Zwarteveen and colleagues (2017) argue that water governance is filled with politics. Therefore, a better understanding is necessary on how water governance takes places now and what kind of system that current distributions represent.

Research aim and question

This research aims to explore the influence of water losses on the access to water in the informal settlements through the lens of the politics of water governance. Therefore, the following research question has been formulated;

How does current water governance create water losses and how does this influence the access to water in the informal settlements in Nairobi, Kenya?

Scientific relevance

Much of the literature on the water losses from the governmental water distribution system comes from the engineering perspective (Van den Berg, 2015) or focus on how the water losses can best be reduced (e.g. Biswas & Tortajada, 2010). This research represents the general lack of focus by scholars on the “actual workings of particular institutional, financial and organizational governance arrangements and processes. Even less systematically analyzes such practice-based descriptions in terms of how they reconfigure distributions of water” (Zwarteveen et al., p.8). This research will contribute to this lack of research by taking the perspective of the politics of water governance to understand the distributions of water. The research will be applied on the flow of water that moves from the governmental water distribution system into the informal water distribution system.

Societal relevance

This research is relevant as it is assumed that more than 90% of the global south will be living in urban areas in 2050 (UN, 2018), due to population growth and urbanization. Additionally, the pressure on water will rise due to agricultural use and industrial consumption (González-Gómez, García-Rubio & Guardiola, 2011; Krhoda, 2006). Furthermore, water insecurity has been leading to poor health among urban informal settlements (Subbaraman et al., 2013). Therefore it is important to understand the dynamics that go on in water distributions and access to be able to adhere to Sustainable Development Goal (SDG) 6, which ensures access and availability to water and sanitation (UN, 2015).

Outline of the thesis

The first section will highlight the scientific debates on access to water in informal settlements, urban informality, the politics of water governance, water losses, and the monetization of water.

The second section will discuss the methodology of this thesis. It will start off with a description of the study area and will continue with the operationalization of the concepts, the data collection methods and data analysis tools. This section will close off with a reflection of ethical issues and the positionality of the researcher.

The third section will encompass the results from the research. This section is divided into three parts; the governmental water distribution in the informal settlements, the informal

distribution of water in the informal settlements and an analysis on the effects of the different systems on the access of water for the residents of the informal settlements.

The fourth section will conclude the results from the case study on access to water in the informal settlements in Nairobi, Kenya, and will answer the main question of this research.

The fifth section will discuss the theoretical contributions of this thesis to the theoretical debates outlined in the first section. The main topics that it will focus on are the access to water in informal settlements, the intertwined relations between formality and informality and the idea of informality as resistance. Then the discussion will continue with some limitations and further research.

Theoretical framework

This chapter will highlight the most important debates on; access to water in the informal settlements, urban informality, the politics of water governance, the politics of water losses, and the monetization of water.

Access to water in informal settlements

No universal definition of 'access to water' exists yet (Adams, 2018b). In the SDGs, the UN measures access to water by looking at the proportion of the population that has 'improved' water coverage (UN, 2015). Water sources are considered to be improved when they are free of contamination. Examples of improved water sources are; piped water into dwelling or yard, public tap or standpipe, tubewell or borehole; protected well; protected spring; and rainwater. Example of unimproved water sources include; unprotected springs and dugwells, carts with tanks or drums; tanker trucks, surface water and bottled water (WHO/UNICEF, 2015a). However, Boateng, Tia-Adjei and Adams (2013), have shown that 'improved' water sources can also become contaminated during transportation or during storage.

In many cities in the Global South, 40% to 70% of the population is served by the governmental water utilities (Ahlers et al., 2014; based on Nickson, 2002 & Mwanza, 2005). Especially in the informal settlements, the access to water is low (Dos Santos et al., 2017). While the UN focuses on 'improved' sources of water, residents in the informal settlements often rely on 'unimproved' sources for their water supply (e.g. in Malawi (Adams, 2018b). The urban informal settlements have been getting less water policy and development in comparison to the core-urban centers (Biswas, 2006). Informal settlements are defined by the UN Human Settlements Programme as "residential areas where 1) inhabitants have no security of tenure vis-à-vis the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing, 2) the neighbourhoods usually lack, or are cut off from, basic services and city infrastructure, and 3) the housing may not comply with current planning and building regulations, and is often situated in geographically and environmentally hazardous areas" (UN-Habitat, 2015, p.1). Thus, by definition, informal settlements lack adequate water infrastructure. In the cases that the governmental water utilities do not supply water, water supply is often delivered by a large variety of small formal and informal agents (Matsinhe et al., 2008). Data from Dos Santos and colleagues (2017) suggests that residents of informal

settlement often rely on market solutions and community initiatives for their water supply, such as private water vendors and boreholes. These providers are often illegal, unregulated, unreliable, unsafe and more expensive (Dagdeviren & Robertson, 2009; Nganyanyuka et al., 2014; Subbaraman et al., 2013).

According to Smiley (2013), using coverage to describe access does not fully reflect the water insecurity in the informal settlements as it overlooks the intra-urban inequalities and irregularity of supply. Ribot and Peluso (2003) refer to access as “the ability to benefit from things – including material objects, persons, institutions, and symbols” (p.153-154), meaning that the coverage of water is just a small aspect and that being able to benefit from this available water is intertwined with many other issues. Many authors on water access agree that one simple number of coverage cannot fully state the level of water access, especially in informal settlements. Obeng-Odoom (2012) argues that issues in water access lie in the ‘deep access’ to water, which refers to the affordability, quality, distribution and reliability of water. Usher (2015) uses five determinants to describe access, namely; availability, accessibility, affordability, accommodation and acceptability. Thompson and colleagues (2000) only used three determinants; reliability, use and cost. During a resolution in 2010, the UN defined five different aspects of access to water. Water had to be “sufficient (between 50 and 100 l per day), safe (free of microorganisms), acceptable (culturally appropriate), physically accessible (minimum collection time of 30 min within a distance of 100 m), and affordable (cost less than 3% of household income)” (Adams, 2018a, p.36, based on UN, 2010). Adams (2018a) uses source, volume, time spent and affordability as variables of access.

Urban informality

Banks, Lombard and Mitlin (2020) argue for a deeper political economic analysis of urban informality. According to Banks, Lombard and Mitlin (2020), a focus on informality shows those people who are disadvantaged by their inability to fit into ‘formality’ and those who benefit from ‘informality’.

Urban informality is often seen through a dualist paradigm in which informality is seen as the problem and formality as the solution (Angiotti, 2013). The idea behind this paradigm is that transforming informal neighbourhoods into formal neighbourhoods will solve the issues in the

city. According to Roy (2005), the same message was presented in the work of De Soto in which he calls for legalization and formal recognition of the informal practices. This would lead to prosperity for all residents (Roy, 2005; based on De Soto, 1989; 2000). This duality between formality and informality enforces hierarchy and favours formality. Banks, Lombard and Mitlin (2002) mention the inadequate services provisions and evictions of the residents of the informal settlements to be examples of this hierarchy.

Roy (2005) therefore, takes a different approach and defines informality as “an organizing logic, a system of norms that governs the process of urban transformations itself” (p.148). She presents informality as “a series of transactions that connect different economies and spaces to one another” (Roy, 2005, p.148).

Another main topic within urban informality is the assumed separation between formality and informality (Banks, Lombard & Mitlin, 2020). For example, Hall and Pfeiffer (2000) have argued that informalities are formed outside of the control of the formal system. In contrast, according to Bromley (1978), formal and informal systems should not be looked at in duality but economic activities should be classified along a continuum where informality and formality are opposite poles from each other. Many economic activities will be able to fit in one of the two categories as it will have characteristics of both informality and formality (Bromley, 1978). McFarlane (2012) has also reconceptualized informality to show the fluidity between formality and informality. This is in line with Bromley’s (1978) argument that there is a ‘fluctuating state of interaction’, in which one system can be dominated or even created by the other system. The same duality is often portrayed on territories, households, neighbourhoods, labour activities and forms of organisations (Bromley, 1978; McFarlane, 2012), while a division in informal and formal is not applicable in many situations as some people will be engaged in the informal system while others are involved in the formal system, or in both (Bromley, 1978). Bromley (1978) stresses that the two systems do not function separately and independent from each other.

In a part of literature on Latin America, informality is explained as a form of resistance. Varley (2013) argues that the romanticization of urban informalities by perceiving it as resistance or reverse colonialism is at the expense of recognizing the constraints of the urban poor and how they are able to overcome these.

Bromley (1978) points out that the 'urban informal system' and the 'urban poor' are often used as synonyms of each other. However, he argues that "not all persons who work in the informal sector are poor and not all poor people work in the informal sector" (Bromley, 1978, p. 1035). Research by Wright Mills (1965) shows how informality is not only practiced by the 'poor' residents but also by political elites that govern the United States through the interconnection of informal political relations and formal functioning of the state.

Politics of water governance

Even though the term governance has become more popular in the past 20 years (Asaduzzaman & Virtanen, 2016), the scientific community hasn't yet agreed on one definition. Governance is often used as an umbrella term to cover a wide range of concepts and is used in various fields such as academia, politics and international development communities (Hyden, 2001). This has led to many different understandings in the academics on water governance.

Biswas and Tortajada (2010) looked at good governance while researching the water supply of Phnom Penh, Cambodia, which was able to reduce its NRW from 72% to only 6% in 15 years. The case was used as an example of good governance by analysing the changes in staff-attitude, corruption and centralization of management. Also in practice, institutions like the World Bank use the concept of 'good' governance as a goal within the water sector (World Bank, 1992).

According to Zwarteveen and colleagues (2017) the focus on 'good governance' portrays an image of what water governance is supposed to look like and leaves out the politics that is embedded in water distributions. They argue that it promotes the ideas of transparency, integrity and accountability, that is implicit to a political reform agenda that advocates for liberal democracy in which there is "the encouragement of competition and markets; the privatization of public enterprises; reforms of the civil service by reduced alleged over-staffing; the introduction of budgetary discipline; the decentralization of administration and the greater reliance on nongovernmental organizations." (p.2). One of their examples is the

introduction of water markets and water rights, as it would be assumed to improve water use productivity.

Therefore, scholars of politics of water governance argue for a different perspective on water governance in which the politics is embedded in the discussion in how water is distributed, by whom this water is governed and what kind of implications are behind decision-making processes (Zwarteveen, 2015; Zwarteveen et al., 2017).

How water flows is influenced by both the natural and social environment and the interactions that take place between them (Zwarteveen et al., 2017). Therefore, Zwarteveen and colleagues (2017) define water governance as “the practices of coordination and decision making between different actors around contested water distributions” (p.3). According to Zwarteveen (2015), these practices are full with culture and politics. Water governance is based on political choices deciding on the distribution of water, voice and authority, and expertise (Zwarteveen et al., 2017). Especially important is the process in which these decisions are steered through society, policy and interactions (Biswas & Tortajada, 2010; Chan, Roy & Chaffin, 2016). Changes in direction are caused by formal groups that have the power to change the policies and regulations through formal institutional structures (Hyden, 2001; Wilson et al., 2019), but also those that have the power in daily negotiations, conciliations and contestations around water between various actors that happen on the ground (Wilson et al., 2019). These practices are then again embedded in a broader political system (Wilson et al., 2019).

When water flows into one area, it will have implications for another area (Zwarteveen et al., 2017). Questions that come to the forth are then; what allowed this to happen? What larger interests do these changes promote? What are the rules of the game and who decides these? And in which context are these dynamics embedded? (Death, 2014; Wilson et al., 2019; Zwarteveen et al., 2017). These questions focus not only on the organization of decision making but also on creating social order through water distribution (Bridge & Perreault, 2009; Zwarteveen, 2015). Zwarteveen and colleagues (2017) encourage researchers to dive deeper into the politics of water governance by looking beyond the different actors and focus on how the society functions and how truth is established.

Zwarteveen and colleagues (2017) argue that equity should be incorporated better in discussions on water distributions. Often equity in water distribution is thought about afterwards or is assumed to happen alongside sustainability. However, according to Zwarteveen and colleagues (2017), equity should be “at the heart of water governance concerns” (p.2), because political structures are often based on ethnicity, race and gender (Zwarteveen et al., 2017).

Politics of water losses

Within the engineering literature, the difference between the system input volume and the billed consumption is referred to as NRW (van den Berg, 2015; Farok, 2016; IWA Water Loss Task Force, 2003; Kankoudis et al., 2013; Lai, Chan & Roy, 2017; WASREB, 2014). However using the term of NRW in the water sector to describe its functioning is implicit to the idea that water should be monetized. Unaccounted for Water is based on the idea that the water never reaches the customer (Kumar, 2010).

The commercial losses happen due to meter inaccuracies and illegal connections (González-Gómez, García-Rubio & Guardiola, 2011). The authorized losses also refer to water that is used but not paid for as it constitutes out of water that is given away for free to low-income citizens or used for cleaning out the pipes (González-Gómez, García-Rubio & Guardiola, 2011). Thus, commercial water losses and authorized losses, unlike physical water losses, are thus not completely lost, but are lost from the formal governmental water distribution system, and thus not paid for to the utility company. However, this says little about actual water losses that would limit the availability of water for the residents.

Meter inaccuracies or broken meters, leakages in pipes and illegal taps are some of the main reasons for high percentages of NRW (Farok, 2016). Inaccuracies or a broken meter can be caused by an Intermittent Water Supply (IWS), where water is only supplied for a small duration of the day (Kumpel & Nelson, 2016). First, the fact that there is no water in the pipes can cause the meters to record air volume that build up when you resume pumping (Schenk et al., 2020). Secondly, the pressure of water when the supply returns, referred to as a water hammer, can cause the meters and pipes to break (Schenk et al., 2020; WASREB, 2018a). A less technical cause of high NRW is a low level of water invoice index, which is the fraction of

the households that have enough income to pay their bills in comparison to the total number of households (González-Gómez, García-Rubio & Guardiola, 2011).

Monetization of water

Due to a rise in economic liberalization in the 1980s, market mechanisms started to play a bigger role in the distribution of water, while the government started to take a step back (Wissen & Naumann, 2006). Privatization of water is often justified due to a scarcity of water, making it an expensive product that needs to be regulated by the market (Wissen & Naumann, 2006). This trend has been highly contested as it goes against the idea of water as a basic human right (De Albuquerque & Winkler, 2010). The human right to water states that water should be affordable for everyone. What can be considered to be affordable is a matter of context and interpretations. What is affordable for high-income users might not be affordable for low-income users. Water itself might be free but the infrastructure, the purification and transport still costs money (De Albuquerque & Winkler, 2010). Those that are pro-monetization argue that commercial companies are better fit to make investments in the water system to extend their area of coverage. Besides, they argue that commercial companies are often able to provide water for lower prices and have a higher efficiency. However, several cases can be pointed out in which this has failed (De Albuquerque & Winkler, 2010).

Operationalization of concepts

The chapter above shows the different debates in academic literature. In order to understand what will be meant with different concepts throughout the research, the following section will present the operationalization of the concepts.

Access to water

This research will follow Peluso and Ribot's (2003) definition of access as "the ability to benefit from things – including material objects, persons, institutions, and symbols" (p.153-154). Besides, based on the different proposed determinants of access to water, the researcher has decided to focus on those that were deemed most important throughout the research; availability and affordability.

Informal settlements

This research will follow the definition by the UN Human Settlements Programme as "residential areas where 1) inhabitants have no security of tenure vis-à-vis the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing, 2) the neighbourhoods usually lack, or are cut off from, basic services and city infrastructure, and 3) the housing may not comply with current planning and building regulations, and is often situated in geographically and environmentally hazardous areas" (UN-Habitat, 2015, p.1).

Formality

While in the debates on urban informalities, the distinction is often made between formal and informal, this research will refer to the formal as the governmental water distribution system. In the case of Nairobi, this means that it looks at the water distribution system by the governmental actors of AWWDA, NCWSC, Nairobi city council or NMS. This decision has been made to make clear that this research does not focus on formal ways of supply by non-governmental organizations (NGOs)GOs or Community Based Organizations (CBOs), which are often also considered to be 'formal'.

Informality

Informality refers to those actions and systems outside of formality (Subbaraman et al., 2013), excluding the non-governmental sector. For this research, the focus lies on the flow of water

that moves out of the governmental water distribution system due to informal practices such as tampering with meters and illegal connections. It will also include water that was gained in a formal manner from the governmental distribution system, but is later re-distributed through informal practices.

Water governance

Water governance is looked at from the perspective of the politics of water governance and refers to “the practices of coordination and decision making between different actors around contested water distributions” (Zwarteveen et al., 2017, p.3). The concept is made up out of three key components based on Zwarteveen et al., (2017) and Wilson and colleagues (2019); formal institutional structures, daily negotiations and the political system.

Water loss

Due to the fact that both the concepts of NRW and UfW do not cover the water that this research is focusing on. This research will refer to ‘water loss’ when talking about the water that leaves the governmental water distribution system without being paid for. This includes water that then flows into informality and water that flows back to nature.

Research questions

The main question of this research is:

How does current water governance create water losses and how does this influence the access to water in the informal settlements in Nairobi, Kenya?

In order to answer this research question, the following sub-questions have been formulated based on the theoretical framework of the politics of water governance outline above.

1. What formal institutional structures of water governance are in place that influence water losses in Nairobi, Kenya?
2. What daily negotiations of water governance take place that influence water losses in Nairobi, Kenya?
3. What is the underlying political system that drives the formal institutional structures and daily negotiations in Nairobi, Kenya?
4. How do the formal and informal systems provide water access in the informal settlements in Nairobi, Kenya?

Explanation of Questions

Following the components of the politics of water governance, the first sub-question focuses on the formal institutional structure of water governance such as policies and regulations. Additionally, the roles and responsibilities of the governmental actors in the governmental water distribution system were analysed and looked into how they influence water losses. The second sub-question focuses on the daily negotiations over distribution of water. By focusing on both aspects, a holistic picture of formal and informal water governance is created.

Based on the first two questions, the political system that the formal institutional structures and daily negotiations represents is looked into. This question dives deeper into Wilson and colleagues' (2019) understanding of the socio-political context in which decision-making takes place.

Contextual framework

Study area: Nairobi, Kenya

Kenya is situated in the east of Africa in between south Sudan, Uganda, Tanzania, Somalia and Ethiopia. The country is connected to three bodies of water, the Indian Ocean, Lake Victoria and Lake Turkana.

Its capitol city, Nairobi, can be found in the southern part of the country.

The city is currently home to almost 5 million people is predicted to grow exponentially to 8,5 million in 2035 (World Population Review, 2021) and 14 million in 2050 (WSUP, 2018).



FIGURE 1. MAP OF KENYA (ONGOMA, GITAU & MUTHAMA, 2013)

Informal settlements in Nairobi

Most of the informal settlements date back to the colonial period. For example, the largest informal settlement, Kibera, finds its origins in 1912 when it was a settlement in the forest outside of the city. After World War I, the colonial government of British Kenya opened its gates as a home to Nubian soldiers that returned home (Mutisya & Yarime, 2011). Other informal settlements found their origin due to the fact that most Africans were excluded from the city as it was only available for Asians and Europeans (Mutisya & Yarime, 2011). Those who were able to move to the city to search for work were forced to create informal residential settlements. These created settlements were not acknowledged by the colonial government (Amnesty International, 2009). In 1948, the city created urban development plans that ignored the informal settlements (Mutisya & Yarime, 2011). In 1963, the first government after independence deemed the informal settlement of Kibera to be illegal (Mutisya & Yarime, 2011). Because of this, the city never invested in services, such as water, or roads to the areas

(Mitullah, 2003). Despite the ignorance of the government and the status of illegality, the informal settlements in Nairobi continued to grow in a steady pace of 5% annually (UNDP, 2007). Currently, it is estimated that 60% of the population lives in informal settlements (Ledant, 2013), but it only occupies 5% of Nairobi's surface area (World Bank, 2016). It is assumed that the informal settlements will continue to grow as new people will most likely settle in these because it is cheap to live (Blomkvist et al., 2020).

Due to its informality, there is no clear indication of the number of people that live in the informal settlements of Nairobi. In the case of Kibera, the government statistics suggest that around 200,000 people lived in the area in 2009 (KNBS, 2010), while UN-Habitat estimates the total population at 350,000 to one million and other experts suggest 800,000 people (Mutisya & Yarime, 2011). This discrepancy between the estimations of the population and the number of population that are registered by the government suggests that not all inhabitants of the informal settlements are registered.

The residents in the informal settlements of Nairobi lack clean water supply and sanitation, housing, waste management, schools, energy provision and hospitals (UN, 2006; Centre on housing rights and evictions, 2008). Additionally, the informal settlements deal with high levels of unemployment.

Figure 2 shows the location of the informal settlements in Nairobi.

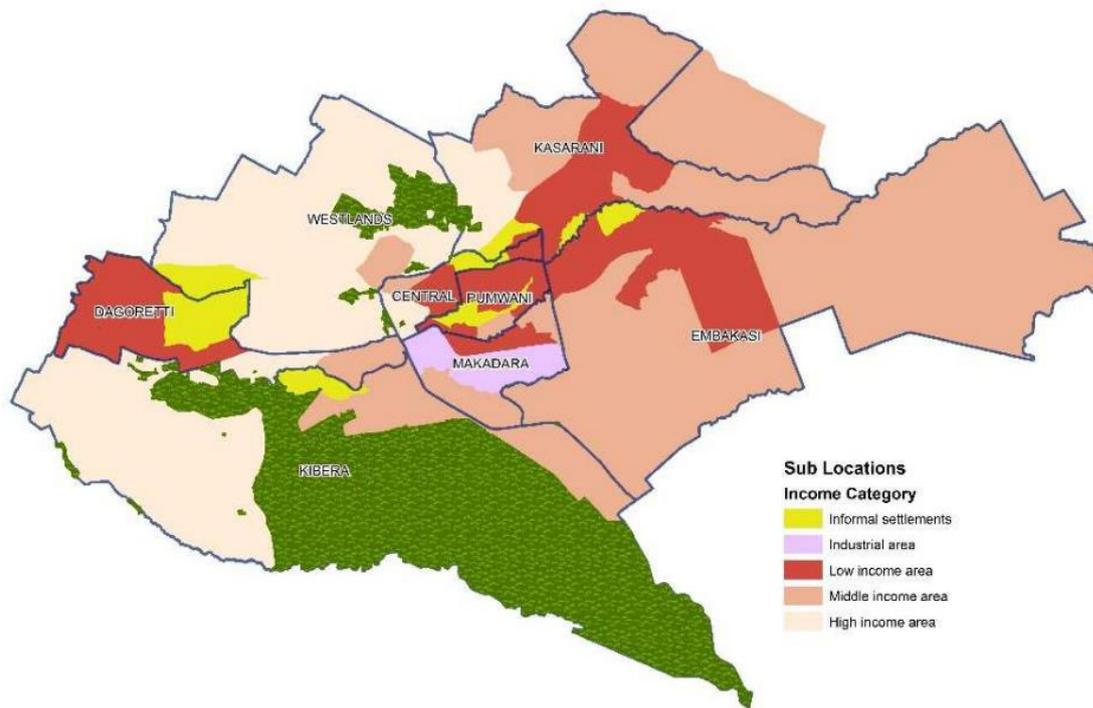


FIGURE 2. INCOME LEVELS PER SUB-LOCATION IN 2015 (SEURECA, 2017, FIGURE 58)

Governmental water supply in Nairobi and its informal settlements

The Nairobi City Water and Sewerage Company (NCWSC) is responsible for the water provision in the city. The water that NCWSC supplies comes mainly from four sources: the Thika Dam, Sasumua Dam, Ruiru Dam and Kikuyu springs (Figure 3). Additionally, some boreholes supply water to the city which are operated by NCWSC. However, these do not have a significant impact on the total supply of water (Seureca, 2017).

While Ledant (2013) and the World Bank (2016) talk only about the piped water supply, WSUP (2016) estimates that in the informal settlements 80% of the residents have to get their water from standpipes, kiosks and vendors, and transport that water to their property (WSUP, 2016). Water vending, defined as the “formal or informal reselling or onward distribution of utility water or water from other sources by small vendors for domestic use” (WASREB, 2020, p.21), is the most common mode of water provision by the largely underserved customers. These water vendors play an important role in the water provision in these areas and fill in the demand deficit that the governmental structures of water provision leave. The main concern is that the quality of this water is relatively low (Sarkar, 2020). Not only does it take three-times more time to collect water than when you are non-poor (Gulyani, Talukdar & Kariuki, 2005), the private water vendors charge up to 25 times more than the NCWSC-tariff (WSUP, 2016). Lower-income households are bound to this low-quality, time-intensive and high-cost water because they are not able to pay the initial payments to build an in-house connection or lump-sum billing that is required by the utility (Sakar, 2020). Other sources of water are boreholes, rainwater, broken pipes or water provided by NGOs and CBOs (Mutisya & Yarime, 2011).

Despite the fact that NCWSC has a special department that is focusing on providing water to the informal settlements (WSUP, 2018), the provision of water in high-income areas is prioritized (Ledant, 2013), so these inequalities in access are not likely to change soon.

Water Losses in Nairobi

As in many other developing cities, Nairobi’s water provision is influenced by water that goes unaccounted for in the formal water distribution system. There is no clear idea of the amount of water that leaves the formal system as different parties document different percentages. Currently, NCWSC (2019) states that 36% of the water that is pumped into their system is paid for. World Waternet (2020) puts this percentage at 39% and Water Services Regulatory Board (WASREB) of Kenya (2018) at 50%. Nevertheless, as the numbers do not divert too far from each other, it is safe to say that around 40% of the water that is provided by NCWSC leaves the system without being paid for. According to Tanui (2017), the commercial losses constitute the major losses in the formal system, as 75% of the losses were due to meter errors, under registration of connected meters, water theft and illegal connections, and water accounting errors (WASREB, 2014).

Data from NCWSC on water losses are divided into the different commercial zones. Due to this, they have an idea of in which areas water is not paid for. According to these numbers, in August 2020, three-quarters of the water was not paid for to NCWSC in the informal settlements. However, when put into perspective by looking at the actual volume of water, in the month of August 2020, the informal settlements were only responsible for 10% of the water losses, while the formal residential areas were responsible for the other 90% of the water losses (NCWSC, n.d.-c). These numbers suggest that that even though in percentages, much water is not accounted for in the informal settlements, due to their relatively low use of water, the bigger amount of water that goes unaccounted for can be found in the residential areas that only make up 40% of the residents in Nairobi. This can be partly explained by the fact that high income residents consume 10 times the amount of water that low-income residents consume (Ledant, 2013).

Methodology

This chapter will elaborate on the steps that have been taken to collect and analyze data to answer the main research question. First, the host organization will be described. Second, the operationalization of the theory and concepts will be explained. Third, the data collection process will be highlighted, followed by more details on the data analysis. Lastly, considerations of ethics and the positionality of the researchers will be clarified.

Host organization

This research has taken place in collaboration with World Waternet. World Waternet is a subsidiary of Waternet, a water service provider in the region of Amsterdam, the Netherlands. By linking experts from Waternet to public water utilities in developing areas, World Waternet aims to increase sustainable access to water and sanitation facilities. In 2017, World Waternet has entered into a Water Operator Partnership, through the WaterworX program with NCWSC (World Waternet, n.d.). The WaterWorX program aims to achieve sustainable access by strengthening the sustainability of the water companies and the enabling environment in terms of policies, laws, regulations and financing (World Waternet, 2020) Twice a year, the project group visits Nairobi and has an intense week of exchanging knowledge with the staff of NCWSC.

In this research, World Waternet provided a supervisor with whom was met every three to four weeks to discuss the advancement of the research. World Waternet has arranged a contact person within the NRW department of NCWSC which has helped the researcher find contacts within NCWSC and the city of Nairobi. Besides this, relevant data and literature was made available through SharePoint.

Operationalization of theory and concepts

For this research, the politics of water governance was used as a theoretical lens to describe the governmental and informal water distribution system in Nairobi. It was chosen to focus on the city rather than a neighborhood because the flow of water in one area has implications for the flow of water in other areas (Zwarteveen et al., 2017). This politics of water governance

can be used on many different analytical levels. In this research, it was chosen to look at the politics at the institutional level. For this, the concept of water governance was separated into three different aspects; the formal institutional structure which includes the policies and institutions that operate in the governmental water distribution system, the daily negotiations that refer to the 'everyday' interactions between the both governmental and informal actors on the ground, and political system that is represented in the daily negotiations and formal institutional structures and the decisions are based on.

Drawn from the operationalization of the theory of politics of water governance, topic lists were created for the two different groups of respondents, which can be found in Appendix 1 and 2. The formal institutional structures were operationalized by looking into the roles and responsibilities of the governmental actors in the governmental water distribution system. The daily negotiations were operationalized by discussing the relations between the various actors and dive deeper into the reasons as to why the water is leaving the governmental water distribution system without begin paid for. The political system was operationalized by looking at the aims and goals of the various actor to understand the reasoning behind their actions.

Specific questions, based on the desk research or previous interviews, were add to the interview guide in a later stage.

Data collection

Data collection has taken place in the months of March, April and May in 2021. Due to the corona pandemic, the data has been collected from the Netherlands using online tools as explained below. Various qualitative data collections methods were used to answer the research questions. Qualitative data collections methods are more appropriate as they are able to get a deep understanding of a phenomenon and the context in which it takes place, such as experiences and social relations.

Desk Research

The research started with an analysis of various policy documents of the involved governmental institutions in water distribution and management in Nairobi. These actors entail Nairobi City Water and Sewerage Company (NCWSC), Water Services Regulatory Board

(WASREB), the Kenyan ministry of water and sanitation and Athi Water Works Development Agency (AWWDA). These documents were used to gain a better understanding of how the government supplies water in Nairobi and which actors decide on where water from the governmental supply flows. The documents from the NCWSC were the strategic plans of the company for the years 2014/15-2018/19 and 2019/20-2023/24. These plans were used for general information on the way in which the company supplies to the city. Both the annual impact report and strategic plan of WASREB were used for data on the water losses in Nairobi and for understanding the functioning of the governmental water distribution system in Kenya. Especially the non-revenue water audit of WSP's by WASREB was useful for getting insides of how the water flows away from the governmental distribution system. Three documents were analysed from the Kenyan ministry of water, sanitation and irrigation; the non-revenue management annual report of 2017-2018, Standards NRW management and the national water master plan 2030. While the first two documents provided information on the water losses from the governmental water distribution system, the last document showed insights on the governmental water distribution system of Kenya. Furthermore, the strategic plan 2018-2022 of AWWDA was analysed, which was also used for the information on the water losses from the governmental water distribution system and its understanding of the functioning of the governmental water distribution system and its different actors. Lastly, the bi-annual report from the Water Action Groups (WAG) Nairobi, the volunteer group, belonging to WASREB, that protect customers rights and function between the customers and other the governmental actors, included points of reflection of the first half of the year 2021. This report gave insights on customer relations and functioning of NCWSC.

Secondly, reports from actors that are not governmental institutions were analysed. Four reports were analysed from the French development bank (Agence Française de Développement (AFD)), the Water and Sanitation for the Urban Poor (WSUP), Seureca, and the Kenya Integrated Water, Sanitation and Hygiene project (KIWASH). These reports all reflected on the water distribution and management in Nairobi. The AFD report focused specifically on NRW management and capacity building. The WSUP report focused mainly on providing water in the informal settlements. The purpose of the Seureca report was to create a water master plan for the city of Nairobi. Seureca is a consultancy company that was hired by AWWDA to write the report. AFD was also involved in the writing of the report. Lastly, the

KIWASH report was based on the whole of Kenya in which it discussed KIWASH's efforts of the year 2018.

These reports were used to give a reflection on the current management and distribution by the governmental actors. Desk research has been used to understand the known context and build the interview questions on. Additionally, the desk research was used to then later put the data collected from the interview into context. Equally important, data from the desk research has been used to answer the first sub-question regarding the formal institutional structure that are in place that affect the water losses. Especially formal policy documents on the national and local level have been used for this aspect.

Code	Name Document	Organization
D2	Impact Report no.12	WASREB
D3	Strategic plan 2014/15-2018/19	NCWSC
D4	Strategic plan 2018/19-2023/24	NCWSC
D5	Non-Revenue Water Management annual report 2017-2018	Ministry of Water, Sanitation and Irrigation Kenya
D6	Strategic Plan 2018-2022	AWWDA
D7	Strategic Plan 2018-2022	WASREB
D10	Standards NRW Management	Ministry of Water, Sanitation and Irrigation Kenya
D11	Non-Revenue Water Audit of WSPs 2018	WASREB
D12	National Water Master Plan 2030	Ministry of Water, Sanitation and Irrigation Kenya
D14	Bi-annual report	WAG

D1	A Journey of Institutional Change	WSUP
D8	Proposal for Non-Revenue Water Interventions	AFD
D9	Consultancy Services for Preparation of Nairobi City Water Distribution Master plan up to 2035	Seureca
D13	Annual report	KIWASH

TABLE 1. LIST OF ANALYZED DOCUMENTS

Semi-Structured Interviews

The main source of data has been the semi-structured interviews with various respondents. These interviews aimed to get an understanding of the situation that happens on the ground. Respondents were targeted because of their expert knowledge on the water distribution in Nairobi. Due to the fact that interviews have to be done from a distance, the focus will be on speaking to representatives of organizations. In the end, 12 semi-structured interviews were held with 10 different respondents. Two of the respondents were asked for a follow-up interview after a quick analysis of the data and the realization that some more question were necessary to be answered. All the respondents received a follow-up email with the notes of the interview and some follow-up question if these were necessary. An overview of the different respondents can be found in **Error! Reference source not found.** It was intended to speak with more respondents but due to non-response, this was not possible. Semi-structured interviews were held because they give room for the respondent to bring in other information (Bernard, 2011). Open-ended questions will give the respondent the ability to express their own opinion and perspective (Reja et al., 2003).

Besides the semi-structured interviews, two informal conversations were held within the host organization in the beginning of the research to get a first impression of the situation in Nairobi.

Code	Name Organization	Type of Organization
I3	Water Services Regulatory Board (WASREB)	Water Regulator
I4/I12	Nairobi City Water and Sewerage Company (NCWSC) – NRW department	Water Utility
I6/I11	WAG Nairobi	CBO (part of WASREB)
I8	Nairobi City Water and Sewerage Company (NCWSC) – Production department	Water Utility
I9	Nairobi City Water and Sewerage Company (NCWSC) – NRW department, technical team	Water Utility
I10	Athi Water Works Development Agency (AWWDA)	Water Agency
I1	Kenya Pooled Water Fund (KPWF)	Fund
I2	KIWASH – USAID	NGO
I5	Carolina for Kibera	NGO
I7	Umande Trust	NGO
IC1	World Waternet	Development Partner
IC2	World Waternet	Development Partner

TABLE 2. LIST OF INTERVIEW RESPONDENTS

Two sets of respondents were targeted in order to create a full image of the flow of water in Nairobi. The first group of respondents constitutes out of governmental actors that are involved in the decisions around water distribution. The main criterium was that they were

established as a governmental organization. The respondents were; NCWSC, WASREB, WAG and AWWDA.

The second group of respondents constitutes out of staff from governmental water distribution and management institutions. A focus has been put on finding NGOs that are active in Nairobi as they often work on the ground and are more aware of the informal dynamics that take place around the phenomenon of NRW. The criteria on which these respondents were chosen was that they have to be active in Nairobi, deal with daily water practices (in the personal or professional sphere), or have substantial knowledge about the daily water practices. Knowledge on the water losses is not necessary for these respondents as the interviews will mainly focus on the daily water practices, without always addressing the issue directly. The respondents were: KIWASH, KPWF, Carolina for Kibera, Umande Trust and Nairobi Water Action Group (WAG).

The respondents were approached via email, via phone or through snowballing. The interviews itself have taken place online via Teams or Zoom, or over the phone, due to the inability to meet in person. On average, the interviews took between 30-60 minutes. The interviews were not recorded, but elaborate notes were taken during the meeting, in order to allow the respondent to speak as freely as possible. These notes were then written more detailed directly after the interview. As the topic of this research aims to dive deep into politics, it is important that the respondents feels free to elaborate on topics that could be politically sensitive. However, it is made clear before the interview that the data will be used for public research and that the name of the organization that they are involved with is used in the research, if they agree with it.

Data analysis

The policy documents were coded in Nvivo, a software tool for qualitative analysis that is accessible through the university of Utrecht, based on the two of the three aspects of the politics of water governance namely, the formal institutional structure and the political system that was represented. First it was looked at the different roles and responsibilities of the different actors by searching for their mandates and tasks. Secondly, the way in which they described their work and goals was used to understand the logic behind their actions. Lastly,

special attention was given to their activities towards NRW and their description of NRW¹. All the codes that were used for the analysis can be found in appendix C.

The elaborated notes from the interviews were coded with the use of Nvivo as well. The coding happened both inductively and deductively, to allow for important topics to arise from the interviews themselves. All the codes that were used can be found in appendix C.

After the analysis of data, the different codes were grouped and categorized into several topics, which are represented in bolt in appendix C.

Ethics

All the participants in the study were informed of the purpose of the study and have been made aware of the fact that this thesis will be made public through the University of Utrecht at the start of the interview. The respondents were also told that at any point of the interview, or even after the interview, they could stop and redraw themselves from the research. None of the respondents did this.

The respondents were told that their names would be anonymized and were asked if they agree to the mentioning of their organization, and in some case the department, that they worked at. All the respondents agreed to this. Some of the respondents also indicated that they wouldn't mind being mentioned by their actual name. The researcher decided that it would not add any value to the research to mention their real names. Additionally, as the interviews regarded topics of corruption and illegality, it seemed best for the respondents to stay anonymous.

The collaboration with World Waternet was also explicitly mentioned in the email that was send to request the interview. As individual identities do not add value to this research, all participants remain anonymous and are only mentioned by the organisation they work for.

The notes of the interview were send to the respondent to check for correctness and to eliminate the researcher's own interpretations. Small changes and additions were made by the respondents but substantial changes were made for the information that was given.

¹ NRW is commonly used in the water sector to refer to the water that leaves the governmental water system

Positionality of researcher

In qualitative research, being aware of your own positionality is important because it can have an effect on the research. Three important aspects are highlighted below.

First, even though the internship position at World Waternet gave me access to the respondents, it might also have had an impact on the conversations that were held with these respondents. My relation to them could have led to socially desirable answers from the respondents from the water utility company, NCWSC, that World Waternet works with.

Secondly, managing the expectations with the respondents was for most not an issue. They all indicated to be happy to have helped and looked forwards to hearing something when my thesis would be finished. However, there was one respondent that has been requesting funds for a new project. I have had trouble managing his expectations even though I clearly stated that I was only doing research and will not offer anything else.

Thirdly, coming from the Netherlands has affected my view on the water sector in Kenya. In general, I was never really surprised by the stories that they told me. However, because I was not from the area, it was sometimes hard to picture the stories that they were telling me, for example on how the pipes were lying on the ground in the informal settlements. This was corrected by looking for videos and images of Nairobi and its informal settlements but the dynamic of the city and social relations was still missing, which could have affected the interpretation of the results.

Empirical results

Based on the desk research and the interviews, the result section will be structured into three different chapters. The first chapter will focus on the governmental water supply in Nairobi that is provided by NCWSC. This chapter will mostly be descriptive on how the governmental water distribution system has and is currently operating. This information is necessary for the understanding of the second chapter in which it will highlight the flow of water that goes from the governmental water distribution system by NCWSC to the informal system. This chapter will discuss the different methods of supply by NCWSC and put a critical analysis from the politics of water governance on what kind of implications this holds. The last chapter will discuss what the effect is on the access to water in the informal settlements in Nairobi, Kenya.

Governmental water distribution system

This first chapter focuses on the governmental water distribution system in Kenya and the central governmental actors in the provision of water to Nairobi and its informal settlements. The chapter will start off with the changes that have happened in the governmental water distribution system over the past 20 years as many critical changes have been made that have influenced the access to water in the informal settlements. Then, the chapter will move to an introduction of the main players in the governmental water provision in Nairobi and its informal settlements; AWWDA, Nairobi County (and NMS), and NCWSC. These players are important to highlight as they have a direct effect on the governmental water supply in the area and thus also influence the access to water in the informal settlements.

Changes in the governmental water distribution system over the past 20 years

In the past two decades, Kenya's and thus Nairobi's, governmental water supply has been through some changes. It has started with the National Policy of Kenya that has been developed in 1999, which aims to reach sustainable development and management in the governmental water distribution system, through the conservation of all available water resources, the provision of good and sufficient supply, the establishment of an efficient and effect institutional framework and the development of a sound and sustainable financing system (D12).

As a result, Water Act 2002 brought some substantial changes to the administrative system of the governmental water distribution system in Kenya. Regional water agencies (now known as WWDAs) were set up and responsible for overseeing the operations of the local water utilities and the development of major assets (D3). Additionally, WASREB was created and would be in charge of the licensing of the utilities and also, oversee the actions of the Water Service Providers (WSPs) (D1). Lastly, NCWSC was also created in 2003 after the establishment of Water Act 2002 (D9).

In 2007, a new plan by the national government was presented. Kenya Vision 2030 was produced as the country's blueprint to transition into a middle-income country (D1). In the vision, water has been described as an essential resource that will help support the goals of the vision, especially in the social and economic pillar (D12). A focus has especially been placed on the implementation and planning of water management. When looking at the future, the

plan keeps in mind the growth in demand of water that will take place, for domestic use, irrigation and industries (D12). In line with the constitution and SDG6, Kenya Vision 2030 has the goal to ensure improved water and sanitation that is available and accessible for all Kenyan citizens (D6). To reach the goal, four different targets were set. The first target focuses on 100% coverage of improved water supply in urban and rural areas. The second target states increasing the coverage of piped water supply for 100% of the urban population. Target three aims to increase the unity water supply amount to the national levels. Lastly, NRW has to go down to 20% (D12). All of these targets focus on improving the coverage of the piped, or improved, water supply in the areas, but say nothing about the accessibility of the water. Additionally, these suggest ideas that a piped water connection by the government is an improved water supply. Important to note here is the absence of a focus on the informal settlements that are lacking sufficient water access.

In 2010, the change in the Constitution of Kenya led to some major changes for the governmental water distribution system again. Article 43 of the new constitution states that water and sanitation services are a basic human right (WSUP, 2018). In contrast to the goals of the Kenya Vision 2030, this right to water does include ideas on the access to water. It suggests that water should be in adequate quantities, which refers to the availability of water, and it should be clean and safe². Furthermore, the change in the Constitution forces the state to take legislative, policy and other measures to hold up to this right (D2). To that end, the water agencies, are responsible to develop bulk water and sewerage infrastructures to be able to give all citizens access to water and sanitation (D6). According to WSUP³, this change created a mounting pressure from the government leadership, local politicians and citizens to improve the water services, and acknowledgement of NCWSC that existing structures with the utility could not support the required level of service delivery to the informal settlements. This indicates the acknowledgement of the government that the informal settlement deal with a lack of investments for a governmental water supply.

Secondly, the new constitution of Kenya led to a new administrative system in Kenya, expecting to increase the accountability of the actors involved (D6). From 2010 onwards, there are two levels of government; one central national government and 47 county governments

² D2/D3

³ D1

(D12 + D2). The national government is in charge of the regulation and legislation of water, while the county governments are in charge of the actual provision of water (D2). Both levels of government, national and county, are expected to take policy, legislative and other measures to ensure that the rights of the Kenyan citizens are met (D2).

Due to these changes, Water Act 2002 was repealed and replaced by Water Act 2016 (D1). The responsibility of the WSPs has shifted to the new county governments that were established in the constitution of 2010. According to D5, the expectation of the new Water Act 2016 was that it make the responsible actors more capable to adhere to the right to water. The WSPs now get their license from the national water regulator, WASREB (D1). This shift towards decentralization of water supply belongs to a liberal democratic political agenda, where decentralization is assumed to be increasing water use productivity.

[Main actors in governmental water supply in Nairobi](#)

Athi Water Works Development Agency

To start off with, Athi Water Works Development Agency (AWWDA) is a state cooperation that falls under the ministry of water, sanitation and irrigation and is responsible for the development of new water and sanitation infrastructure, such as dams, water storage, transmission line, networks and treatment facilities, in its area of jurisdiction; Nairobi County, Kiambu County and Murang'a County. Additionally, it is responsible for overseeing the operations of the water and sewerage companies in its jurisdiction⁴. It was established in 2003 with the main goal to enhance the coverage by increasing access to safe, affordable drinking water and sanitation services and to accelerate the achievement of SDG6 (D6/D10). While D6 suggests that AWWDA is funded by the government, respondent I10 mentions that the building of infrastructure mainly comes from multilateral banks such as the World Bank, AFD and the German Development Bank (I10).

Respondent I10 explains that even though AWWDA is not deemed responsible for the water losses of the governmental distribution system in Nairobi, they still help NCWSC with ways to reduce in the water losses. According to respondent I10, AWWDA carries out studies, rehabilitates the old pipeline network, tests new meters to avoid under registration, invest in

⁴ D3

building capacity of the NRW department at NCWSC, helped with the customer identification survey and developed a new and robust billing system, GIS data base and a hydraulic model.

Nairobi City County

The county of Nairobi has the responsibility to ensure efficient and economical water services delivery. Together with the national government, it is the duty of the county government to take policy, legislative and other measures to ensure citizen's right to water (D2). However, while the national government is responsible for the water resources, Nairobi county is in charge of water distribution and investments in smaller public works. The county fulfils its responsibility through NCWSC, which is fully owned by the county (D3/D2). Money is allocated from the county to NCWSC to invest in the provision of water (I7).

Currently, Nairobi county is not responsible for the water provision as the Nairobi Metropolitan Services (NMS) has taken over this and other functions of the county since 2019. NMS is part of the national government. The takeover by the national government represents... As the take-over is scheduled to end in 2022, this thesis will still refer to the Nairobi county as being responsible.

Nairobi City Water and Sewerage Company

As a result of Water Act 2002, NCWSC was established in 2003 under the Companies Act Cap. 486 to provide clean water and sewerage services to the residents of Nairobi County, in a sustainable manner and within the government regulations. NCWSC is licensed by WASREB to distribute water and do minor repairs on the infrastructure or create smaller networks of water provision.

Within NCWSC, there are different departments. Two of them are worth to highlight for this research. The first department is the non-revenue water department, which is solely focused on reducing the water losses from the water utility. The department has been growing quite fast as its staff grew from 36 persons in 2016 to 156 persons in 2020 (D8). The respondent from the NRW technical team of NCWSC explains that one of their tasks is to make a water

balance which would show the amount of water that has been put into the system and the amount of water that has been paid for and to calculate how that water has been 'lost'.

Secondly, the Informal Settlements Department was formed because all the informal settlements of Nairobi were grouped together to form the seventh administrative region. D1 states that the reasons for this regrouping was because the residents in the informal settlements required a different approach than the other customers and to bring down the level of water losses. However, the issues that the informal settlements department was trying to solve were all connected with other departments. Because of this, the projects of the informal settlements department were undermined by the failing of other departments according to the report by WSUP (D1). The informal settlements department was initially tasked with the coordination of various donor-funded projects that were implemented by local and international development organizations. However, these projects did not lead to better access to water but rather increased non-revenue water and exploitation by the cartels (D1). Nowadays, the department is able to take a more holistic approach.

The establishment of the informal settlements department suggests that the water utility has recognized the informal settlements to be areas in which water has to be supplied. However, one of the drivers of the establishment, NRW, also suggests that the department was set up for the benefit of the revenue of the water utility rather than the provision of the water in the areas.

Following the flow of water

The following chapter will adhere to the request of Zwarteveen and colleagues (2017) to “literally follow the water” (p. 8) as an approach to understand water distributions. Therefore, the chapter will highlight the flow of water from the governmental water distribution system into the informal system to the residents of Nairobi. As highlighted by Bromley (1978), lines between formal and informal are not always clear as he suggests that (in)formality is more of a spectrum than it is a duality. Additionally, in many occasions, formality and informality are intertwined with each other. For this reason, the following chapter will be divided into three sections in which three different flows of water are described; through individual piped connections, the water vendors and kiosks, and the water trucks. Each section will start with a description of the governmental system of supply and continue to describe its flow into the informal water system.

Individual piped water connections

While the high and middle income areas often have an individual water connection in their house or yard of NCWSC, data suggests that 12%-36%⁵ of the residents in the informal settlements have an individual water connection of NCWSC.

Connection procedure

To get a formal connection through the NCWSC, the residents can apply either online or in person. During the application several documents will have to be transferred, such as a tax paying document or a Kenya Revenue Authority⁶ pin number and a land ownership document. The respondent from the NRW technical team of NCWSC describes that in case the resident is not the owner of the land, they will have to transfer a document showing their connection to the owner of the land that they want the connection on. He continues to explain that in the case of informal settlements, where land is owned by the government, a reference letter from the area chief is used instead of a land ownership document.

⁵ Based on Ledant (2013) and World Bank (2016)

⁶ Organization in Kenya that the Kenyan residents pay their taxes to

This connection procedure suggests that land owners have quite some power when it comes to the residents installing new connection from NCWSC. A document from WSUP (D1) suggests that in some cases, landlords don't want to pay NCWSC for water used by their tenants or have even started to blocking-off the water to their residents during the day to save money. This would suggest that because of this, these residents would be limited in their access to their water as water is not always available. It could also lead to a search for other places for their water, and draw them to the informal water system. However when asked about this to respondent from the NRW department of NCWSC, he responded that he had never heard of these instances as the water connection is usually included when you start to rent an apartment and if it's not, nobody would want to rent the place. This could suggest that conflict between the land owner and resident over the connection only happen in a limited amount of situations. It could also be that the respondent lives in the areas of the city where the connections are well-established.

Additionally, the fact that a tax paying document has to be handed in. As many organizations suggest that many more people live in the informal settlements than those that are registered at the government, and the fact that many people in the informal settlements work informally, suggests that many people in the informal settlements will not be able to hand in such a document. This ways a getting a connection makes a separation between those who do benefit from formality and those who can't.

Costs and installation

The installation of a new connection comes with a couple of costs for both the meter, the installation and the materials. The respondent from the NRW technical team of NCWSC tells that after the connection has been granted, a staff member from NCWSC comes to the property to check out what kind of connection will be possible, what the infrastructure looks like and where is the nearest main pipes are that can be connected to. The customer will have to pay for the meter deposit and a survey fee. A legal connection at NCWSC costs 2,500 Kenyan Shillings and can be paid in instalments for low-income citizens. This money will be given back when you move (I12). Additionally, the resident will have to pay a monthly fee for the use of the meter (I12).

These costs can limit low-income residents to be able to get a connection with NCWSC. NCWSC has given low-income residents the opportunity to pay in instalments and the money will be returned when you end your connection with NCWSC. The costs that remain are the costs for the meter itself, that has to be paid monthly. According to the respondent of KIWASH, the initial investment weighs more than the possibility that the pipes will break on the long-term for the customer.

Even though the respondent from WASREB indicated that the new connection procedure is that the water utility has to connect the pipes of a new connection, the interviews with the respondents from Nairobi show that the water pipes are bought and installed by the customers themselves. The respondent from the NRW technical team of NCWSC explains that after the inspection, a list is presented to the customer with the required fittings and the customer has to buy their own material according to the respondent from the NRW technical team of NCWSC. Respondent I3 explains that due to the fact that customers want to keep the price as low as possible, the quality of the pipes is often sub-standard. Respondent I5 argues that same as he explains that the material for the pipes that is used in Kibera is often PVC, which is not a very durable material. Especially because in Kibera, where the pipes lay on the ground, the pipes are long, the place is crowded and there is a lot of digging, the pipes are more likely to break. The respondent from KIWASH also describes that poor quality of pipes in the informal settlements.

According to the respondents from the NRW department, the pipes are laid under the supervision of a staff member of NCWSC. However, this was not mentioned by any of the other respondents, which could indicate that this is the rule but doesn't happen on every occasion. Also when looking at the fact that one of the reports indicates that most of the water is lost by the connection, it can be argued that the connection of water is not well done, supervised or not.

Another issue with the connection to the governmental pipes system is the fact that in some areas, the main pipes of NCWSC are far away from people's homes. Respondent I5 describes that in Kibera it is very common that the nearest water source is two to three kilometres away from their own water point due to a lack of main water pipes in the area. Because there is a lot of movement along these pipes, bursts are common to happen (I5). Besides, their length

gives loads of opportunities down the road to vandalize the pipes or tap water illegally (15). The connections could be shorter if the area would have their own boreholes. Parts of the city are now installing boreholes at public schools. However, as Kibera doesn't have any public schools, there is a fear that Kibera will probably miss out on this new initiative (15).

This indicates the lack of recognition of the informal settlements, and especially Kibera, in Kenya which have led and is still leading to a little investments in the areas.

In this procedure, there seems to be a conflict of interests and responsibilities in the way in which the pipes are laid. The customer is placed in the position to buy the pipes but is not very interested or capable to invest in the quality of the water pipes. On the other hand, NCWSC is losing a lot of water, and therefore also revenue, due to the low quality of these pipes.

Informalities in the piped water distribution system

From the individual piped connections, two main methods are used to gain water in an informal matter. Whether this is informal in the sense that more water is taken than is registered or that there is an informal connection, both will be addressed as belonging to the informal water system in this chapter.

Meter tampering

Part of the water that goes unaccounted for by the water utility is due to meter tampering or the disconnection of the meter.

The meter can be disconnect from the pipes. According to the respondent from the NRW department, it is rather easy to disconnect the meter from the pipe. Respondent I8 explains that residents often disconnect their meter during the night, when the water comes, and is put back on during the day when staff from NCWSC might come to read the meter. The respondent from the NRW technical team of NCWSC adds that the disconnection of the meter will not visually be noticeably by the staff as there are no seals on the meter that could have been broken. Even though residents can easily disconnect the meter of their pipes by themselves, the respondent from the technical staff of the NRW department of NCWSC

explains that the disconnection also occurs with the help of staff from NCWSC in exchange for money. Respondent I4 adds that it can also occur with the help of a plumber.

This easiness in which the different respondents talked about the topic showed that tampering with the water meters is quite a common practice for the customers of NCWSC. Respondent I8 states that the meter tampering and collusion with the staff is known by the managers of the water utility. According to him, they usually look the other way. The company has been trying to reduce this by implementing disciplinary matters, but respondent I8 indicates that this is hard to do in a city with more than 300.000 connections. Because of this, there is quite some room for the residents and staff to continue to tamper with the meter and collect more water than they will be billed for.

The tampering with the meters does not occur completely under the radar is quite known among all respondents and documents. Also known/occurs on a national level as they recommend to switch around the meter reader continuedly to avoid fraud (D10).

Illegal connections

The exact number of illegal connections in Nairobi is uncertain but the Customer Information Survey undertaken by NCWSC in 2020 found that, in the areas visited, approximately 25% of the connections were illegal⁷.

Illegal connections can be installed in different forms. The first option is through the use of by-passes, where water is diverted from the pipes before it reaches the meter with the use of a straight piece (I8). According to the respondents, these by-passes can especially be found in the business area or in the formal settlements. The customers can place the by-pass themselves, get help from a plumber or help from a staff member of NCWSC in exchange for money. The enterprises are checked by the inspectors of NCWSC. When these by-passes are discovered both the staff and the enterprise get warnings or face more drastic measures like dismissal of the staff member or financial penalties for the enterprise according to the respondent of KIWASH. These collaborations between the staff and enterprises do not always come to the light as the inspectors are sometimes compromised as well according to the

⁷ D8

respondent of KIWASH. Often, the placement of a by-pass is in combination with the removal of the water meter (I8). When the water flows through the pipes in the night, the by-pass is placed. In the morning, the by-pass is removed again and the meter gets reconnected. When the NCWSC staff comes to check the water meter, there is no sign of the by-pass or the removal of the meter (I6). Additionally, when collaborations between NCWSC and enterprises or residents are announced to the responsible manager, they are often already aware of the issue (I6).

Secondly, new pipes can be attached to the main pipes without a meter connected to them. This type of illegal connections often, but not exclusively, happens in the informal settlements. Also, this type of illegal connection is in some cases facilitated by the staff of NCWSC. The respondent from WAG Nairobi tells about NCWSC-staff going into the informal areas with their uniforms and badges on, trying to sell connections without adding a meter. These connections are even sold to well-known water cartels according to the respondent from WAG Nairobi, adding to the re-selling of water for higher prices.

In general, it is hard for the staff of NCWSC to find these illegal connections in their supply area due to the need for sophisticated techniques, such as GIS and zoning the supply areas (I3). In general, the use of this technology is still a bit challenge for some WSPs or is simply out of reach (I3). However, technology is not always necessary to detect the illegal connections. According to respondent from the technical team of the NRW department, visibility of illegal connection in the informal settlements is not an issue. In the informal settlements, the pipes are often lying on the ground, making it fairly easy to find a connected pipe that is illegal. The respondent from WAG Nairobi tells about a success story in which they managed to bring down NRW from 90% to 10% in part of the informal settlements by putting the pipes above the ground so the illegal connections are more easily visible. However, having the pipes above the ground also makes it more easy to connect to them in the first place, so whether it is a permanent solution for other areas can be debated.

On the other hand, the informal settlement do offer other challenges when trying to find illegal connections. First of all, several of the respondents mention that staff of NCWSC is too afraid to enter the informal settlements because of security reasons (I4). When an illegal connection is found, NCWSC will have to disconnect the pipes by hand. In the case that the

illegal connection is found in the informal settlements, NCWSC is often escorted by the armed police due to the fact that the 'cartels', whom often own the illegal connection, are also armed (I8). Additionally, the fact that the informal settlements are so crowded that houses are built on top of the water pipes, makes some illegal connection still hardly visible according to the respondent from the NRW technical team of NCWSC.

From the interviews many different ideas on why people connect illegally to the formal water supply came to the forth. According to the respondent from WAG Nairobi, illegal connections are usually the result of the low supply of water, non-supply of water and corruption in the water sector. Due to this, opportunities arise for people to take advantage of and provide illegal connections for those not formally supplied yet (I6). A legal connection at NCWSC costs 2500 Kenyan Shillings. For those residents who won't be able to afford a legal connection, they can buy one with the cartels for a lower price (I6). Besides the point of not having any formal water supply, the respondent from the technical team of the NRW department also believes that illegal connections are taken to save some money. As it is harder to save on rent or food, water bills are more easily avoided according to The respondent from the NRW technical team of NCWSC. Due to poor levels of service and intermittent water supply, dissatisfaction of customers increases. As a result, the legitimacy for illegal connections is increasing (D11).

A new law in 2016 ensured a higher penalty for those who vandalize the water system and also for having an illegal connection. Before this new law, it was hard to give a penalty. According to the respondent from WASREB (I3), the degree of vandalism has gone down after the implementation of this new law (I3). As an additional result, the county of Nairobi has earned 12.907.647 Kenyan Shillings through the penalties in the financial year of 2018-2019 (Kinyanjui, October 2019).

Water vendors and water kiosks

Both water vendors and water kiosk function as a central point from which water supplied by NCWSC is redistributed into a certain area. WSUP (2016) argues that 64% of the residents in the informal settlements rely on these sources.

In the informal settlements of Nairobi, water kiosks are a very common way of providing water to the residents. Depending on the type of kiosk, it will have several taps and allows a range

of 100 to 400 people⁸. According to respondent from the NRW department of NCWSC, the water kiosks were used to fight the illegal connections in the informal settlements. He describes that those who are able to connect to the governmental distribution system could redistribute the water to the rest of the area.

Internal data on the water kiosk shows that only 14 litres of water is consumed per day per customer, which is far below the recommended 40 litres of the WHO.

Another way of getting water to the informal settlements is through informal water vendors. This means that one person is having a metered connection and resells that water to the rest of the community.

Informalities with water vendors and water kiosks

Water vendors that function as cartels

The respondent from WAG Nairobi explains that water vendors and owners of kiosks often belongs to 'cartels' as they re-sell the water for higher prices. The report from WSUP⁹ suggests that they sell the water for 2 to 5 Kenyan Shillings, while the normal tariffs in the informal settlements is 50 cents per 20 litre jerrycan. He continues to explain that they do not only resell the water from their connection with NCWSC but often also have illegal connection a few kilometres away.

Both in policy documents and in the interviews, 'cartels' were often referred to. However, when asked of a description of whom would belong to these cartels, a diverse set of responses came up. The respondent from the NRW department of NCWSC explains that the cartels operate in the background and "don't have a face". Furthermore, there is some doubt about the size of the groups or if we can even talk about organized groups at all, as they could also be operating on their own. According to the respondent from WAG Nairobi, the cartels are quite organized and even have meetings. "The cartels are just water vendors" during the day, and at night they go out and vandalize the pipes to keep control over the water and its price. Moreover, the different cartels work together and sometimes operate in shifts according to the respondent from WAG Nairobi. The number of cartels is still unsure but respondent the

⁸ D4

⁹ D1

respondent from WAG Nairobi stated that 8 different cartels were active in the informal settlement of Mukuru. Another member from NCWSC, from the production department, also suggests that the cartels are not as unknown as initially mentioned. He states that the armed police are necessary to go into the informal settlements to disconnect pipes as the members of the cartels are also armed themselves. Even though little is known about the exact functioning of the cartels, it has become clear from the interviews and policy documents that these 'cartels' have a major influence on NRW. The discrepancies between the answers on the cartels could be explained by the fact that those who could tell most are the actors that also operate on the ground, while those who were quite vague about the situation were from the water utility.

For example in Kibera, where the limited amount of connections is controlled by the cartels according to the respondent from Carolina for Kibera. Members of the cartels often have both a formal connection and an illegal connection further away according to the respondent from WAG Nairobi. In this way, they have one part of the water for which they pay, making them less suspicious for NCWSC personnel. The respondent from KPWF illustrates that they put the water into 20 litre jerry cans of water and walk around the neighbourhood to sell it .

Members of the cartels cannot only be found on the customer-level but also within the staff of NCWSC, according to I7. This is backed-up by I6, when he explains that illegal connections, piped connections without a meter, are sold by the employees of NCWSC to well-known water cartels. In other cases, the staff of NCWSC is bribed by the cartels to look the other way (I7). Besides their connections at the utility company, the cartels also have political connections (I8).

Free water through water tanks

The informal settlements get free water from the county government. The respondent of Carolina for Kibera tells that NMS¹⁰ water trucks come in Kibera four times a week. The trucks arrive in the morning at 9am and distribute water, free of charge. However, there is not enough water for everybody. Usually, people already start standing in line at 3am in the morning. He also explains that when you aren't strong enough to stand in line for this amount of time, you can't get water. Figure 4 illustrates residents of Kibera waiting in line for the water

¹⁰ NMS has taken over the power of Nairobi City Council

truck to arrive. The fact that people have to invest a lot of time in getting water from these trucks by standing in line for a few hours, while often not getting enough water, suggests that the government might not care enough about supplying these areas with sufficient water.

Informal in free water through water tanks

The respondent from Carolina for Kibera explains that some of the informal water vendors also stand in these lines and receive water from the NMS. This water is then used again to re-sell for a higher price in the area.



FIGURE 4. WAITING IN LINE FOR THE NMS TO GIVE OUT FREE WATER IN KIBERA (PHOTO BY RESPONDENT 15)

Influence of governmental and informal water supply on the access to water

The two chapters above have described the water distribution systems in Nairobi and its informal settlements. As discussed by Bromley (1978), the two systems are fully intertwined with and dependent each other. This chapter will discuss deeper how these two systems are intertwined and they both influence the access to water in the informal settlements.

Intertwining of the formal and informal water distribution system

As stated by Bromley (1978), informality and formality in the urban areas often go hand in hand. In Nairobi, this happens in mainly two ways; the formal water distribution system has given room to the informal water distribution system to develop and grow, and actors operate in both the formal and informal systems.

The development of the informal water distribution system in the informal settlements aligns with the development of the informal settlements in the colonial period of Kenya. Both during the colonial period and in the first plan of the city after decolonization, the informal settlements were ignored. Because of this, there was no provision of services in the area, including water. As a result, the informal water market had to come into existence for residents of the informal settlement to still meet their basic needs in water .

While the origins of the limited amount of investments in the informal settlements lay in the colonial period, also today the respondents indicate that there was a lack of services provision in the informal settlements by the government.

First of all, the government is still hesitant in investing in the informal settlements. The respondent from Umande Trust explains that the informal settlements are officially built on government land, making the residents illegal squatters. He continues by explaining that on paper, the informal settlements are not meant as residential areas. So technically, no water supply was necessary in these areas as no people are supposed to live there. The respondent from Carolina for Kibera adds to this by stating that it is feared by the governmental bodies that when investments are made, the residents want to continue living there, something the government rather doesn't want to happen. While more than half of the city's residents live

in the informal settlements, both respondents show that the lack of investments in governmental water supply stem from the idea that the residents from the informal settlements do not belong to the city and are treated as second-ranked civilians. This same ideology is why the informal settlements were created and is the same reason why they still exist today to a certain extent. This lack of acknowledgement of the informal settlements by the government was also found by Njoroge and colleagues (2020).

WSUP's report on the informal settlements¹¹ states that local politicians are cautious when supporting new projects where land claims are uncertain (D1) as it could mean that residents would have to move away from the area. This indicates that the government is not pushing for the formalization of water in the informal water supply. Another explanation is that they are using these as excuses not to follow the law and provide water for those who have a right to water.

Both respondent I5 and I7 mention that a change in investments occurred together with the change in constitution of 2010. The respondent from Umande Trust (I7) mentioned that it wasn't even allowed to invest in the informal settlements before 2010. As the right to water of 2010 stated that every individual had the right to water, it didn't matter when the person resides. According to Zwarteveen and colleagues (2017), the right to water highlights a the political agenda of liberal democracy.

From the interviews and document analysis it became clear that the government has not been the only party that has been limiting the amount of investments for water supply in the informal settlements. As tenure and land ownership issues are very common in Nairobi, especially in the informal settlements, WSUP¹² (D1) states that some donors are hesitant to invest in these areas.

The report from WSUP on the informal settlements¹³ states that the residents of the area are also not always eager to have new investments done in the area. Residents are nervous for any type of intervention that could mean that land tenure is formalized, meaning that they would have to leave. Such an intervention could also be the water and sanitation

¹¹ D1

¹² D1: WSUP document on the informal settlements of Nairobi

¹³ D1

improvements that are initiated by the NCWSC. In contrast, when the respondents of the organizations that work in the informal settlements were asked what had to happen to increase the access to water in the informal settlements, all pointed towards the government and argued that they had to invest in the area. This suggests a push for formality as being the solution to the lack of access to water in the informal settlements.

The respondent from Carolina for Kibera, he assumes that because the opposition of the current government has a stronghold in Kibera, the current government does not want to invest in the services in the area.

This lack of investments from the government has given room for the informal water system to build, meaning that the informal water distribution system has been created by the lack of a formal system. This aligns with Bromley's (1978) idea of the 'fluctuating state' of formality.

Secondly, the formal and informal systems are intertwined because actors operate in both the formal and informal system. The staff of NCWSC is both active in the governmental and informal water distribution by formally and informally selling water connections. Besides, the interviews indicated that the staff has been involved in helping customers disconnect their meters. Furthermore, the water vendors and water kiosks are also involved in both the governmental and informal water distribution as they get water from NCWSC and then re-sell the water without any regulations from the governmental entities. Lastly, with the customers, there is also a fine line between formality and informality. Customers receive water through the governmental water distribution system but apply informalities so they can get their water for much cheaper. The fact that all these actors function both in formality and informality implies that the lines between these two systems is very thin, or even non-existent.

[The influence on access to water](#)

This section will reflect on the influence of both systems on the access to water in the informal settlements. While this section on looks at the access in the informal settlements, it will also include practices from all around the city because flows of water in one part of the city will have an impact on the flow of water in the informal settlements (Zwarteveen et al., 2017).

Availability of water

The two systems of distributing water both diminishes and enhances the availability of water in the informal settlements.

First of all, the connections procedure with NCWSC has shown to lead to physical water losses. Due to the fact that sub-quality material is used and the pipes are often connected by the customers themselves, physical loss of water is prone to occur. This influences the availability of water in the informal settlements because less water is able to be distributed. In the long term, these losses might mean that the rationing scheme of has to be more tight. As shown by Ledant (2013), the informal settlements are often the ones that are rationed the most.

Secondly, cartels vandalize the pipes that do not belong to their group in order to maintain their monopoly and keep the price high. The respondent from Carolina for Kibera explains that because these cartels are not interested in new pipes flowing into their area as the might lose their grip on the available water in the area and thus their control on the price of water. He illustrates that the members of the 'cartels' go out at night and start to deliberately demolish other people's pipes. This influences the availability of water in the informal settlements as the demolition of the pipes leads to water dripping out from these pipes, back into nature.

Lastly, the availability of water in the informal settlements enhances due to informality. Without the illegal connections of individuals or by the water vendors and kiosks, the amount of water that would flow into the informal settlements would have been less. Due to these informal practices, the availability of water in the informal settlements rises.

Affordability of water

Both systems of supply influence the affordability of the water in the informal settlements.

First, the governmental distribution network provides water to the informal settlements for a reduced tariff of 50 cents per 20 liter jerrycan¹⁴, instead of the standard tariff of 2 Kenyan shillings. Through the water tanks that arrive, the water is even delivered for free. These aspects should increase the affordability of water for the residents in the informal settlements.

¹⁴ D1

However, in practice, residents of the informal settlements often pay more than those living in the formal residents areas. This was already established by Ledant (2013) who states that residents in the informal settlements pay up to 25 times more for their water.¹⁵ The interviews that were held showed that this was still presently still the case. Respondent I1 states that “on average they [residents of the informal settlements] pay 10 times a liter what I would pay for water delivered to my house”. The costs of the water kiosks are often passed on to the residents¹⁶

When asked, the respondent from the NRW department of NCWSC argued that the residents in the informal settlements didn’t pay much more for their water and pressed on the fact that the tariff is even lower. This statement could suggest two things. One the one hand, it could mean that this person is not aware of what happens on the ground. On the other hand, it could mean that this person, and most likely the organization, is deliberately looking away and not taking responsibility for what happens with the water after it has been delivered.

¹⁵ Also by D1 and many more

¹⁶ D1

Conclusion

Access to water is a global challenge with 2,2 billion people lacking this service. In Nairobi, 64% of the residents have piped access to water, with major differences between the higher-income areas and the lower-income areas. It is assumed that in the latter area, around 80% of the residents get their water from other sources such as boreholes, legal and illegal water vendors and rivers. In contrast, 40% of the water is assumed to be lost by the water utility company as it is not being paid for to the utility company. However, to a large extent, this water flows from the governmental water distribution system into the informal water distribution system. As a crisis in water is often a crisis in water governance, this research took a the perspective of the politics of water governance to explore the flow of water from the governmental water distribution system to the informal water system. Through a policy document analysis and interviews with various experts in the water sector in Nairobi, the following research questions was answered;

How does current water governance create water losses and how does this influence the access to water in the informal settlements in Nairobi, Kenya?

Governmental water supply has shown to not be able or willing to supply water to the informal settlements. This stems from the colonial period but is kept in place through various ways. First of all, the connection procedure of a governmental water connection with NCWSC excludes residents of the informal settlements by requiring a tax-paying form, a land-owning document and high initial costs. Secondly, the lack of investment in the area before 2010 has given room for the informal water system to build and remain its grasp on the area currently.

The informal water distribution system influences these loses by installing illegal connections and removing meters in order to get their water for a cheaper price. These actions are partly driven out of a necessity or because of the commercial opportunities that they provide.

These actions all influence the access to water in the informal settlements. Both systems enhance and diminish the availability of water, and both systems enhance and diminish the affordability of water as outline in the chapter above. Informal water vendors often charge high prices for the water, up to 10 times as much as the NCWSC tariff, making the water unaffordable for the residents in Nairobi with low-incomes. Additionally, the use of low quality

pipes and vandalism decreases the actual availability of the water supply, leaving less water to be distributed in the pipes.

Who wins and who loses?

The winners in this story are the water vendors that are re-selling the water for a higher profit margin. They are an example of those for whom informality has given them opportunities that would not have been possible in the formal system.

Another group of winners are those that tamper with their meter or have an illegal connection for themselves. This group of residents are able to get relatively safe drinking water from NCWSC without paying the full sum of money.

The losers in this story are the residents of the informal settlements which fall in between the benefits of the two systems. On the one hand, they can't profit from the formal system as it requires a certain amount of investment and they are often neglected. On the other, they can't profit from the informal system as this is in the hands of a few strong water cartels. Additionally, the informal system creates a system in which water is expensive, unreliable and unsafe.

Discussion

While the chapters above have been focused on the case of Nairobi, the following chapter will discuss the finding of the research in relation to the theories and concepts elaborated in the theoretical framework.

Access to water in informal settlements

As outline in the theoretical framework, the majority of the scholars on access to water agreed that access is much more than the simple idea of coverage. Therefore, this research took Ribot and Peluso's understanding of access to water as "the ability to benefit from things – including material objects, persons, institutions, and symbols" (p.153-154). However, various scholars work with different determinants of what this access then entails.

The research has shown that two determinants of access have been extremely important; the availability of water and the costs of water. The availability has shown to be important because this has been both limiting and enhancing the access to water for the residents of the informal settlements.

The affordability of water has especially been important in this research because this has been both limiting and enhancing the access to water for the residents of the informal settlements.

I would like to add to the discussion on the affordability of water, that it should only be looked at the prices of water itself but also the costs that are associated with it. In this research, it became very clear that the initial costs that were required for the connection from the water utility formed an obstacle for the lower-income households. This was mainly due to the fact that

Intertwining of the formal and informal

Some claim that formal and informal systems develop separate from each other, this research has shown that the formal and informal water system are intertwined with each other. Therefore, this research aligns with Bromley (1978) and McFarlane (2013) who have shown that formality and informality cannot be seen as separate entities and that they are interconnected to each other. The formal and informal systems are clearly connected with

each other as the flow of water has shown to move through the formal water distribution system to the informal water distribution system. This makes the systems interlinked with each other. The informal water distribution systems partly depend on the water that comes from the formal distribution system and can therefore not be seen as separate systems from each other.

This research supports the idea of Bromley (1978) of the 'fluctuating state of interaction' in which he describes that one system can be dominated or even created by the other system. This research has shown how the informal water distribution system is dominating the water distribution system that was placed by the government in the informal settlements. Additionally, this research has shown how the informal water distribution system has been created due to the neglect of the governments in providing water supply in the informal settlements.

Additionally, this research has also contributed to the work Bromley (1978) and Wright Mills (1965) whom have states that people, enterprises and neighborhoods are not always only formal or informal. This research has shown that informality happens in most areas of the city. Both in the informal settlements, the residential areas and the business districts, forms of informality were found. Additionally, it has shown that people can be involved in both formality and informality. For example, in Nairobi, staff from the water utility company were also involved in the tampering of meters and the selling of illegal connections to water cartels. Therefore, it would be untrue to argue that informality is equal to poorer residents of the city.

Lastly, the interconnections of the systems mostly comes from the discrepancy between how the governmental water distribution system was intended to work according to the government and how this system is used in practice due to the occurrence of informalities.

[Informality as a necessity and commercial opportunity](#)

Some scholars romanticize the water supply through informality as they see it as a sign of revolution. However, this research has shown that the informal water distribution systems were build out of a sense of necessity to procure a basic need, rather than a revolution, due to the lack of investments by the government in the informal settlements. Even though, nothing can be said from this research on the motives of those who dominate the informal

water market, the organizations spoken with in the informal areas all pointed to the government as the solution for the lack of access and not to the informal actors. Little positive feelings, or feelings of revolution, were spoken of towards the informal water providers. Furthermore, the informal water market has also shown to be an extremely commercial opportunity for those who are able to function in the market. These findings align with the ideas of Varley (2013) that perceiving informalities as a form of resistance is often at the expense of recognizing the constraints of the urban poor and how they are able to overcome these.

Limitations

Every research has its limitations. The first limitation is the lack of ability to create substantial rapport with the respondents. Due to the fact that the interviews had to be held online, there was only limited informal interaction between the researcher and the respondents. It was tried to start off with some unrelated questions, for example about the covid-19 crisis in Kenya. However, often the camera of the respondents would be off or had to be switched off due to a lack of a stable internet connection. This also has an effect on the rapport between the researcher and the respondents as non-verbal communication wasn't possible anymore. Due to this, the respondents might not have been as open with the researcher as they might not have felt a personal connection to the researcher.

Secondly, the internet connection or cell reception also caused for struggles in understanding the respondent when they were speaking. Often, the researcher had to make the decisions between keep asking the respondents to repeat themselves, which could cause some frustration, or continuing the conversation. Due to this, some of the answers to the questions were not fully written down, leaving some gaps and a missed opportunity for follow-up questions. A part of the issue could have been solved by stressing the importance of a good internet connection to the respondents. Also the researcher should have had an internet cable at hand at every single moment.

Thirdly, as the interview was not recorded but notes were taken throughout the interview, some of the details of the respondent's stories were lost. Parts of the missing details were recollected by emailing the respondents after the interview with the notes and some

questions for further explanation. All of the respondents were so kind to elaborately respond with additional notes and responses to the questions. Additionally, follow-up interviews were held with two of the respondents that also gave a second opportunity to gather more details on their stories. Even though this decisions was carefully taken, and not regretted, the limitation has to be mentioned for the sake of the quality of the research.

Fourth, interviews are always subjected to biases, both from the researcher and from the respondents. The goal of the research was to understand the politics of NRW. Each of the respondents was able to give a piece of puzzle. However, this piece was always subjected to their own interpretation of the situation and their own perspective. Because of this, the research aimed to find various respondents from different perspectives as outlined above. Nevertheless, not all perspectives were represented in all sub-topics of the research.

Further research

Due to a lack in funding from the national government and the high levels of NRW, the utilities in Kenya is forced to work together with private partners and foreign development agencies. According to the respondent of KPWF, 90% of the funds for the Kenyan water system come from external partners, resulting in a high external dependency. Often money implies powers and influence on the decision-making processes. To what extent this influences NRW and NRW-reduction tactics, especially in combination with access to water, allows for further research.

A second avenue of further research is the effect of the change in constitution in 2010 in Kenya, giving all Kenyan citizens the right to water. Interesting would be to see to what extent such a change in the constitution has actually led to more access to water or whether it has created another type of outcome. From this research it can be distilled that, the change has led to some justification of the illegal connection. This has resulted in a discussion around whether illegal connection are actually bad as people are taking their own rights in their own hands. Therefore it is interesting to see what the effect is of such formal changes on the way that people handle their daily water practices.

Lastly, more research has to be done on the politics of water governance. In current literature, there is not enough empirical research done on the politics that goes on behind water governance. This research has focused on the institutional and city level, focusing on the different formal and informal actors involved. However, more research opportunities lie in smaller analytical levels such as a focus on a specific neighborhood or the household level. Additionally, a better understanding of individual decision-making of their action could help gain a better understanding of the politics behind water governance.

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Appendix A: Topic list for governmental actors

Topics on the formal institutional structures in the water sector (depending on which actor was interviewed):

- Role national government
- Role WASREB
- Role AWWDA
- Role Nairobi County
- Role NCWSC
- Role WAG Nairobi
- General idea of questions:
 - What is the main goal of the organization?
 - How is NRW defined and which aspect is deemed most important?
 - How is the interaction with other actors in the water sector?

Topics and questions on the daily negotiations between formal and informal actors (depending on which actor was interviewed):

- Physical losses
 - Leaks
 - Vandalism
- Commercial losses
 - Meter inaccuracies
 - Illegal connections
 - How are people able to connect illegally to the main pipes?
 - Which people connect illegally to the main pipes?
 - What causes people to connect illegally to the main pipes?
- Authorized NRW

Topics and questions on the political system:

- Who allows for the actions to happen?
- Why are the actions taken in such a way?

Appendix B: Topic list for informal actors

General questions about the situation in Nairobi:

- What are the main challenges that Nairobi faces today?

Topics and questions on the formal institutional structures in the water sector:

- Role NCWSC
- How does an individual receive a connection?

Topics and questions about the daily negotiations between formal and informal actors:

- Physical losses
 - o Vandalism
 - What is the motivation of individuals to vandalize the pipes?
 - What is the role of the cartels in the vandalization of the pipes?
- Commercial losses
 - o Meter inaccuracies
 - What are the main reasons for meter inaccuracies?
 - What is the role of NCWSC in meter inaccuracies?
 - o Illegal connections
 - How are people able to connect illegally to the main pipes?
 - Which people connect illegally to the main pipes?
 - What causes people to connect illegally to the main pipes?
 - What is the role of NCWSC in the process of illegal connections?
- Authorized NRW

Topics and questions on the political system:

- Who allows for the actions to happen?
- Why are the actions taken in such as way?

Appendix C: Codebook

Formal institutional structures

- Constitution 2010
- County Disputes
- County vs national
- Kenya vision 2030
- National Water Policy
- Path dependency
- Penalties
- Responsibility AWWDA
- Responsibility MWI
- Responsibility NCWSC
- Responsibility State
- Responsibility WASREB
- Responsibility WRMA
- Right to water
- Role County
- Tariff
- Tenure
- Water Act 2002
- Water Act 2016

Daily Negotiations

- Authorized NRW
- By-passes
- Capacity NCWSC
- Cartels
- Community Responsibility
- Constructions

- Corruption
- Economic opportunity
- Equity
 - o Access to water
 - o Education
 - o Health facility
 - o Higher prices
 - o Sanitation
 - o Unemployment
- Functioning NCWSC
- How to get a connection
- Illegal connections
- Informal water supply
- Infrastructure
- Informal settlements department
- Intermittent Water supply
- Landlords
- Meter inaccuracy
- NCWSC corruption
- NCWSC vs AWWDA
- Police
- Political neglect
- Quality of pipes
 - o Old pipes
 - o Length of pipes
 - o Laid by formal institutions
 - o Laid by consumers
 - o Installations
- Regulation of connections
- Stolen meters
- Trust NCWSC

- Vandalism

Political System

- Water is free
- View on iSR
- Tenure
- Religion
- Lack of funding
- Economic
- Communication
- Commercial viability
- Awareness
- Arrogance Nairobi

Access to water

- Quality and safety
- Financial sustainability
- Equity
- Availability
- Affordability

Context Nairobi

- Supply
 - o Administrative regions
- NRW
 - o Commercial
- Location
- ISR

- Water supply
- Population growth
- NCWSC NRW reduction strategy
- Land tenure
- Infrastructure
- Infrastructure
- Economy
- Demographics
- Climate

Context Kenya

- National water supply
 - Financial