Hacking the pipes: Hydro-political currents in a Nairobi housing estate

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Abstract

Nairobi's water supply reflects broader dynamics of urban resource distribution, politics and power relations. Continuous disinvestment into the city's large technological system of water supply has contributed to extreme water shortages in some parts of the city, while residents in other parts have enjoyed unrestricted access to the resource largely since the colonial period. Also, recent water sector reforms that focus less on technological networks and artefacts than on water governance have not alleviated the highly uneven distribution of water in the city. This is the context for our investigation of variegated technopolitics of water pressure management by different actors in one specific settlement: Nyayo Highrise estate. This middle-class housing estate has suffered extreme water shortages in the past decade. We start our investigation from a perspective of technology as a space of possibility – infrastructural networks and artefacts as well as related mobile technologies are not stable or fixed results of past planning decisions, but they are affected by, and at the same time shape, the ways in which people exert social and political pressure (or not). We analyse the manifold ways in which urban actors try to access, negotiate and change the city's water flows, be it through manipulating the network of water pipes, through the provision of decentralized technologies, or through activism and public protest. We argue that this is an important intervention into current debates on African urbanisms, because it demonstrates how technology and infrastructure are spaces of possibility that may work towards emancipation and repression at the same time.

Keywords

Urbanization, infrastructure planning, water management, technology, politics

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Introduction

Nairobi's water flows have since the city's founding reinforced its stark socio-spatial fragmentation, a fragmentation that is also visible in extremely uneven housing conditions and income patterns (Ledant, 2013). Water supply generally reflects broader dynamics of urban resource distribution, politics and power relations, but for one important deviation. Following recent water sector reforms and NGO interventions targeted at improving supply to informal settlements, the expansion of the city means that Nairobi's grid-dependent middle-income neighbourhoods are now more marginalized by water flows than are some of the poor neighbourhoods. While long-standing supply and price advantages for higher income localities persist, geographic distance and heightened demand have turned many of the city's built-up middle-class estates into water deserts. This paper is a situated analysis of water supply in Nairobi's Nyayo Highrise estate – a series of concrete blocks that has been hit particularly hard by recent water shortages. It is situated on the eastern edge of Kibera – the informal settlement infamously described as Africa's largest slum.

We see Highrise as a place where what should be is not. Water, the temporality and geography of its absence and presence, is an anxiety-filled staple of conversation in this middle-class housing estate that was carved out of Kibera in the mid-1990s. The estate, developed as a landmark slum-upgrading project, pledged the accoutrements of modern citizenship – connection to the city's electricity, fibre optics, transport, sewerage and water infrastructures. All these, but for water, have been delivered. Highrise's residents were promised piped water in their kitchens and flush toilets in private bathrooms connected directly to the city-wide water reticulation. This promise has not been kept, and water supply in Highrise is defined not by an absence of taps, but by dry taps, an infrastructure of lack. The architecture of the middle-class housing blocks – four and five storeys high – makes it particularly strenuous and expensive to find alternative water sources. Unlike city residents in the wealthy suburbs who may solve water supply shortfalls by hiring water trucks or digging private boreholes, or those in the lower end who may make illicit intrusions into the grid, those stuck in the middle resort to a mix of individual and collective measures in order to survive the unreliable water supply. It is important to note that the population in Highrise is by no means a uniform block when it comes to the provision of water and activism around it. Measures include the daily purchase and management of high-cost water from private vendors, as well as longer term measures that press state institutions for improved water service provision. Along with the vagaries of the mains water supply, this privatized acquisition of a public resource has resulted in a variegated delivery that produces and elaborates a water inequality inside the estate just as much as across the city's districts.

We consider in this paper the local technopolitics of water supply in Highrise, the ways in which material infrastructures and technological devices reflect and mediate residents' political and social engagement. Our findings are relevant for scholarship on urban flows, and on the dynamics of inclusion and exclusion mediated by material artefacts and networks. Our work is in conversation with studies that emphasize infrastructural networks and artefacts as arenas for the negotiation of urban citizenship in post-colonial cities (Fredericks, 2014; Kooy and Bakker, 2008). Alongside other scholarship, we explore the multiple pathways through which a diversity of urban actors appropriate and change perpetually incomplete urban infrastructure networks. Thus, we describe an infrastructural politics that works against and alongside the conventional political sphere – a politics that is enacted through technology (Schnitzler, 2013). We agree with scholars who consider

the quiet, slow and yet potentially subversive mechanisms by which ordinary people find access to vital necessities as a political act, one that bears alternative visions of citizenship (cf. Bayat, 2010; Silver, 2014). We explore how urban residents employ both traditional political activism and more subversive means to achieve infrastructural inclusion. This work investigates how residents' organizing, individual activism, resistance and explicit political efforts have shaped water distribution to and within the estate.

In engaging with these literatures, we find that the effect of technological artefacts and networks is not predetermined. Instead, we consider them as spaces of possibility that have the potential to work towards both, repression and marginalization, or emancipation and social justice. Proceeding from Anand's (2011: 543) use of 'pressure' as a concept to understand how access to water is achieved through 'enabling both physical and social relations', this paper analyses how Highrise's residents satisfy their water needs. We find that the city's infrastructural artefacts and networks, as well as an array of mobile technologies, are appropriated to produce mechanisms of social and political pressure that effect changes in the estate's water supply. The use of these mechanisms (re)draws water supply patterns, casting residents as co-participants with the water supply company and policy-makers, in the design of service provision. Residents seek to manipulate urban water flows in manifold ways including through technological interventions (such as tinkering with valves, and installing private pipes, tanks and pumps) and through political activism (demonstrations, petitions, mobile phone mobilizations, the practice of suborning utility officials and campaigns for electoral office). Additionally, this paper considers the counter-pressure produced by state strategies to manage residents' water demand. Following neoliberal reforms in the water sector, these do not include a wholesale investment in the city's water sources and reticulation. Rather, these localized mechanisms – a water rationing schedule, an articulation of boreholes and elevated tanks, dedicated staff to turn valves off and on inside the estates, mobile information dissemination and complaint gathering platforms, and a coopted pseudo-activism – mirror and respond to prevailing resident strategies. We propose that this bifurcation produces a negotiation between resident and state strategies that may either subvert or strengthen top-down regimes of water supply.

This case study of the technopolitics of water supply in Nairobi's Nyayo Highrise estate is based on a lengthy analysis of qualitative interviews, policy documents and media articles. Between 2014 and 2017, we spoke with 22 respondents: ordinary residents, water activists, staff of the water utility, and property managers, as well as representatives of the city's water regulatory body and policy-makers in the city's government. With some of these respondents we had regular conversations throughout the period of research. We employed ethnographic methods of data collection, including participatory observation realized through lengthy visits to and residence in the housing estate. By combining the situated knowledge of Highrise's struggles for water supply with a dissection of the infrastructural networks and politics shaping water services in Nairobi, we aim to provide a nuanced picture of the evolving spaces of possibility that technologies allow for different actors as they access, negotiate and transform the city's water flows. Shifting the focus from the informal settlement to a middle-class estate, we elaborate the divergence in strategies, practices and technologies of water access even where state policy and household connection to the grid would imply equity in service provision. By situating the middle-class estate within the wider sociotechnical system of Nairobi's water reticulation, we show that the various spaces of possibility that technologies open up for different people – ordinary residents, activists, water utility staff – have limits. Dry taps and bucket showers in homes that must pay grid subscriptions, we propose, indicate how precarious access to water remains in the face of perpetuate underinvestment into the wider system of water supply. Our analysis

of manifold ways in which actors manage water pressure within and beyond the estate, by reverting to precarious private solutions or by turning to mobile technologies to either steer or disperse collective action as public water infrastructures fail, speaks to the literature on urban inequality under late capitalism. Our examination demonstrates how technology and infrastructures may work towards emancipation and repression at the same time. Therefore, we argue, it is an important intervention into current debates on African urbanisms and the contingency of everyday urban life.

Spaces of possibility: Towards a technopolitics of pressure management

As sociotechnical systems, urban infrastructures affect and are in turn shaped by broader social and spatial dynamics. Scholarship of urban political ecology maintains that studying how infrastructure networks and artefacts mediate material flows as they traverse cities uncovers the power relations that are otherwise obscured in policy documents and debates (Monstadt, 2009; Swyngedouw, 2004). In order to 'rematerialize' questions of citizenship, power and political participation, scholars have turned towards infrastructures – the built environment and technological artefacts, as sites where the political takes place, and where visions of modernity and citizenship are negotiated (Fredericks, 2014; Larkin, 2013). It is in this vein that Von Schnitzler (2013: 673) apprehends water meters as 'technopolitical devices'; artefacts whose design, proposed and actual functionality, and their various appropriations by end-users explicate the political agendas inherent in infrastructural networks. Von Schnitzler thus considers the ongoing interaction between technological inventions, their subversions and reinventions, as an elaboration of political struggle, even as these struggles take place outside the conventional political sphere (Schnitzler, 2013: 673).

While scholars have long discerned infrastructure networks and artefacts as stable and long-lasting materializations of past planning and design decisions 'frozen in space' (Harvey, 1985; Hommels, 2005), newer research from the Global South invites a consideration of infrastructures as dynamic technopolitical systems (Kirsch, 2006; Schramm and Wright-Contreras, 2017; Silver, 2014). Anand (2015: 307) reminds us that in the postcolony, infrastructure networks, which he describes as 'dense historical accretions of technology, material, and social life', have momentum, and display a resistance to changes imposed by planning processes. However, as underserved urban actors apply multiple, place-specific strategies in order to supply or access basic necessities such as water, they subject these solid historical aggregations to perpetual re-construction. As Fredericks (2014) states, 'Technologies of rule are manifest in sedimentations of urban infrastructures that are negotiated and transformed in everyday practice' (536). In their examination of the co-construction of identities, infrastructures and space in colonial and post-colonial Jakarta, Kooy and Bakker (2008) explain how city residents become important agents in the material re-production of urban space when they repurpose centralized systems of water supply. Hacking these material installations, underserved residents resist the discursive and material constructions of segregation and exclusion that were, from the outset, inscribed into the networks and artefacts (Kooy and Bakker, 2008: 386). As Silver (2014) points out, the incremental manipulation of infrastructures by urban dwellers not only provides them with access in the present moment, but it also repurposes entire networks and expands the space of possibility for a more just urban future. Thus, the everyday appropriation of

centrally planned infrastructure networks by underserved urban residents is a political act – an act in defiance of systematic barriers.

Some scholars have argued that these everyday reorientations of infrastructure bear the potential for effective subversion of excluding and marginalising urban regimes. In an attempt to bridge the divide between traditional Marxist-inflected urban political economy and more recent scholarly production on 'African' urbanism, scholars have proposed a 'situated' urban political ecology (Lawhon et al., 2014). While older approaches to urban political ecology trace socio-material constellations in cities back to the driving force of capitalism (Castree, 2002), contemporary African urban studies approach cities from the everyday, make-do perspectives of urban dwellers. By this approach, they look to build theory from their experiences and interactions. Pieterse (2008) suggests that the myriad, dispersed activities of the marginalized have the potential to incrementally deliver a more just landscape of service provision. Along similar lines, Lawhon et al. (2014) consider the mundane and often individualistic ways in which people use each other 'as infrastructure' (Simone, 2004) as bearing the potential for progressive realization of more inclusive urban systems. These scholars argue that this focus is meaningful, as more 'visible rebellions', coherent with structuralist argumentation and aiming at systemic change, have all too often failed (Lawhon et al., 2014).

Focusing on the role of technological artefacts and networks in these dynamics, scholars of urban infrastructure consider technology itself as manifesting a space of possibility for progressive change. Coutard and Guy (2007) emphasize that the contingent appropriation of technology permits its development into a tool for either repression or resistance, for exclusion, or for the subversion of exclusionary regimes. Departing from what they call a 'dystopian alarmism' in which the roles of technological innovations in stabilizing and supporting uneven power relations in cities are predetermined, they propose a 'significant potential for contestation of, and resistance to, technology-supported forms of discrimination' (Coutard and Guy, 2007: 714). Complementing this approach, McFarlane (2011: 221) considers technologies to be important agents in the struggle for justice by urban activists. He shows how 'mundane' objects can change their functionality in unforeseen ways and take on tasks beyond, and at times in contrast to, the purpose for which they were intended.

We draw on these debates on technopolitics, infrastructure and societal change to examine broader dynamics of resource distribution mediated by networks and artefacts. These debates guide our investigation of the manifold appropriative activities of urban residents, as well as their interactions with policy-makers and utility staff. While there has been a tendency in urban studies to create a dichotomy between situated, ethnographic studies of everyday lives and struggles of urban dwellers vis-à-vis broader structural analyses, our approach considers these two traditions compatible (cf. Kihato, 2013). Our study reveals the ways in which structural issues concerning the uneven distribution of resources, changes in water governance as well as economic trends are reflected in the everyday lives and activities of Nairobians. Those adversely affected by the landscape of allocation may in turn appropriate infrastructures and use technologies in ways that subvert the intentionality of top-down design, and by so doing redirect urban water flows in a 'radically incremental' way (Pieterse, 2008). Our work shows that although this subversion extends and redraws the distribution map, it remains dependent on the sources and distribution capacities of the grid.

We mobilize Anand's (2011) conception of pressure management to understand the dissident capacities of technology, that is how the everyday appropriation and manipulation of infrastructure functions as an arena for a struggle that though not explicitly confrontational is nevertheless political. This concept of pressure is also useful as we analyse how technologies and infrastructures play an important role in more directly adversarial forms of

resistance: supplying tools and platforms with which activists and communities demand improved service provision. Complementing discourses that analyse how technologies affect, and are arenas for, political action, we aim to show how these subversions are in turn dispersed and countered through elaborate forms of top-down, technopolitical pressure management. All told, we base our study on an understanding of technology and infrastructure as spaces of possibility, carrying the potentiality for both subversion of official distribution channels and patterns by the underserved, and suppression of these actions by the state and its institutions.

In the next section, we set the stage for our study of the water supply system in Nyayo Highrise. We do this by examining the city-wide water supply reticulation and the centralized technopolitics that have shaped it over the last two decades. We show that an aggregate of factors have (re)shaped water distribution patterns to the unacknowledged disadvantage of Nairobi's dense lower-middle and middle-middle income estates. We examine the combination of factors that reduces the capacity of the residents of these neighbourhoods to subvert the supply system and that renders these residents susceptible to the Kenyan state's techniques of pressure management. In the subsequent sections, we focus on the specific 'technologies of pressure management' of actors who attempt to appropriate, change or stabilize the socio-spatial order incorporated in Highrise's infrastructures for water supply, among them underserved residents as well as water utility staff. Ours is by no means a complete account of all the technologies of pressure management that different actors may employ in the struggle to improve water flows, but it offers a useful supplement to existing literature on the politics of urban water systems. In particular, it revisits the sedimentation of neoliberal reforms into governance systems, explores the shape and scope of collective resistance in an atomized urbanity energized by new communication platforms but deprived of access to large infrastructure networks and considers the complicated teleology of resistance as austerity is normalized. In an ideological context in which access to water is not understood as a question of social justice, and where large-scale investment in the city's water is not an option while access to mobile technology is almost ubiquitous, it explores the coping innovations produced by both the state and thirsty residents, asking whether these induce progressive change.

Water supply of Nairobi: Centralized technopolitics of pressure management

The city's districts take three main typologies. The first of these has homes with taps that satisfy the modern ideal, showing off well-watered gardens, swimming pools and household taps that always flow with water. Homes in the city's informal settlements, where a large fraction of city residents live, remain largely off-grid. Water supply there is dependent on stand-pipes, water vendors and a constellation of large tanks built by NGOs, politicians and state bodies. This paper explores the dense, built-up core, a growing phenomenon of the city's development. Row houses, tenements, apartment blocks and even housing estates of semi-detached houses, this growing category is home to the bulk of Nairobi's middle-class. According to official calculations, water demand outstripped supply more than 10 years ago, between 2005 and 2007 (Athi Water Services Board, 2012; Nairobi City Council, 1998). Urgent, necessary investments in a large-scale expansion and rehabilitation of the city's water sources and distribution networks are nowhere in evidence, even as the city is in a period of massive infrastructure works.

Nairobi's water distribution reflects extremely uneven socio-spatial arrangements, which are descended from colonial era segregation planning. The greener, higher elevation districts of Nairobi's North have better water supply, while its Eastern and Southern districts are both far from the city's reservoirs and situated in arid savanna. The gravity-fed system thus privileges Northern residents, further enforcing their existing structural advantages (Nairobi City Council, 1996; Nilsson and Nyanchaga, 2008). Both the near and more distant districts of the vast Eastlands, much of which was previously ranch-land, the city's southern districts and informal settlements in general, face dire water scarcity (Kervanto Nevanlinna, 1996). The city's water sources, in the counties of Kiambu, Murang'a, Kirinyaga and Nyandarua in the highlands to the city's North, have not kept up with Nairobi's rapid population growth. The network's pumps and tanks are also outdated, unsuitable for supplying a city that has expanded beyond its old geographic bounds. Importantly, the water reticulation has not either kept up with the massive densification and verticalization of the city's housing typology, where a network branch once served a neighbourhood of family homes each situated on a quarter acre of land – a similar area may now hold a four-storeyed apartment block with 50 family units (Interview Nairobi City County Officer, 2015; Interview Water Policy Expert, 2014).

Rather than attend to these infrastructural and resource shortcomings, Kenya's national water sector reforms focused on a realignment of water governance. The governance shifts of the early 2000s were informed by a 1998 study which positioned financial flows and institutional forms as the primary obstacles to the improvement of Nairobi's water services (Nairobi City Council, 1998). These reforms created the Athi Water Services Board (AWSB) as the asset-holder of water infrastructures for Nairobi, the Nairobi Water and Sewerage Company (NWSC) as the more or less independent grid operator and supplier, the Water Services Regulatory Board (WSRB) as a national regulator for water supply and the Water Resources Management Authority as the national regulator for water sources. This institutional architecture was established to facilitate the commoditization of water supply. Under the market logic of structural adjustment, it was imagined that efficiency would come in two ways. First, the marketization of water services would generate more funding for system maintenance than could be raised from budgetary allocations. Second, ring-fencing the sector would lead to rationalization, i.e. water service provision would be forced to generate revenues from user subscriptions and fees for its own sustenance. This, the theory held, would make the sector much more efficient in its expenditure, staffing and revenue collection. The utility would not be accountable to councillors at the city hall, but to end-users (see K'Akumu, 2006, 2007 for a discussion of the formal changes in Kenya's water governance since the water sector reforms).

In spite of constitutionally set aspirations, these reforms have produced a political shift: water supply is no longer understood as a right, but as a commodity to be earned. This subtly recasts the end-user not as a rights-bearing citizen, represented by an elected councillor at the city hall, but as an unmediated client, a customer of the water company. An economy of lack is introduced that demands active end-user participation in order that water services are gained. While this participation is primarily achieved through subscription and fee payments, Nairobi's water users are also asked to play an oversight role: directly monitoring water suppliers. To facilitate this function, Water Action Groups (WAGs) have been established under the WSRB. Composed of 'community members', these bodies serve as mediators between the utility, private water vendors, the regulator and water users (WRSB, 2010).

The consequence of these changes is that the discriminatory landscape of water supply in Nairobi, delineated by geography and an unbroken colonial legacy, is reinforced by

a modern distribution configuration that is shaped by varying capacities to draw water out of the system. If for some city residents this demands only the regular payment of subscriptions and fees for water consumed, this paper investigates the varied strategies of pressure management that underserved residents employ to squeeze water out of the system.

The entrenchment of the market logic has developed alongside significant concessions to Nairobi's poor. Like in other locations where public service reforms proved politically incendiary, these concessions created segregated mechanisms by which the residents of informal settlements can access water. As elsewhere in the developing world, the political pressure from these reactions has stayed, reversed or delayed the full onset of neoliberal reforms. They produce accommodations that no matter how temporary have served to placate those who rose against unjust regimes of resource allocation. But these prosthetic adjustments do not diverge from, compete with, nor threaten the logic of the primary system. In Nairobi, their consequence is that relatively speaking, significant sections of the city's informal settlements experience better access to water than those of its built-up middle-class neighbourhoods. These reforms, enacted in collaboration with NGOs, aspiring politicians and the discretionary constituency and ward development funds have, since the early 2000s, brought more regular, higher quality water in larger quantities and at more stable prices into some of Nairobi's informal settlements (Interview KENSUP, 2014; Interview K-WatSan Water Point Manager, 2015).

What we develop here then, is an analysis of the particular situation of those caught in the middle – Nairobi's middle-class. Although excluded from the water privileges of the wealthy, they are better able to tolerate the economic cost implied by the privatization of water supply, and thus, even though frustrated, unable to mobilize the political pressure necessary to extract concessions from the state. Given the extensive underinvestment in the water infrastructure, this underserved and overcharged section of the population finds itself playing the role of financial underwriters of the water system, in effect subsidizing the water use of the entire city. This evolution describes an intentional practice of pressure management by the national and county governments, the regulators and the water utility. It is intentional insofar as interventions are not focused on resolving inadequate physical pressure in the water system. Rather, they take the form of highly contingent, responsive attitude to counter political pressure rising from the demands of the underserved. This may be due to the fact that large-scale interventions into the flow of water through the city would require large investments, and, as these investments are absent, it becomes increasingly difficult for urban actors to control the water flow itself. In the following sections, we discuss how these dynamics play out in Nyayo Highrise estate, how residents and the water system manage political and physical water pressure, how they attempt to release or increase it to reach their particular goals.

Technologies of pressure management 1: Pipes and tanks

The network of water pipes represents the idea of Highrise being part of a city-wide system of reticulation, a constant flow of water, underground and thus steady, smooth and reliable, uninterrupted by any unforeseen interference. However, water flowing through pipes to Highrise is 'unreliably rationed', that is water does not flow all the time and people do not know at what times the pipes carry water. The rationing of water is part of the official strategy to distribute the scarce resource within Nairobi. A representative of the AWSB states that

> Developments distort the initial water pressure and volume because the number of people has increased. So for equitable distribution, there has to be water rationing so that one part of the

city receives water today and the other part receives the next day. (Interview AWSB Senior Economist, 2014)

As the city is growing rapidly while the water supply network has been largely stagnating in size for roughly 30 years, people connect themselves to the water mains in ways that the water network has not been designed for (Interview Nairobi City County Officer, 2015). These connections may be done by NWSC staff for 2,000–10,000 KSh, or by private plumbers (Interview NWSC pressure manager, 2016). These connections, where at times pipes connecting households to the network have a larger diameter than those of the distribution networks itself, contribute to a loss of pressure in the system. Water pressure is further reduced through leakages in pipes, which allow for air flowing into the pipes, which in turn accelerates corrosion contributing to more leakages. Thus, pressure in Nairobi's water distribution network is too low for the water to flow into the higher-lying estates further away from city's main reservoirs, such as Highrise estate. In order for the water to arrive in those places, NWSC regulates the water flow through the city by storing it in some parts of the network to create 'artificial pressure'. According to a local NWSC staff member, the 'pressure management team' of NWSC operates those 'down regulations' with a strict timeline (Interview NWSC pressure manager, 2016).

What is not officially part of this strategy is the intransparency and unreliability of the 'rationed' water flow through the estate. Depending on the position of households in relation to water pressure, the pipes carry water more or less often. Some higher-lying blocks within the estate may receive no water for periods of two months or more. This situation makes people move within the estate in order to position themselves favourable in relation to the pressure of water in the local network of pipes. Also, the estate's housing prices depend on the position of the house in relation to water pressure (Interview Real estate broker, 2017). Through Anand (2011), we understand this unreliable water supply itself as a technique of pressure management. Stable and ubiquitous supply of quality water leads to high demand, as people rely on this for their everyday activities. In contrast, water arriving, for example, on an odd day in the early morning hours, or at too low pressure for it to be worth waiting to fetch, discourages many people, therefore diminishes demand and ultimately increases water pressure in the pipes. Water can only flow across the entire estate if only few residents draw from the mains in the lower lying areas. As a consequence, paradoxically NWSC can only deliver its promise to fill all of Highrise's pipes with water if few residents expect it to.

Proposing immediate access to water from the centralized network, water pipes are the entry point for the NWSC into the settlement, their justification for issuing bills and payment requests, and connecting and disconnecting household water connections. The pipes are often empty, but from time to time they do carry water into the settlement, and sometimes even on a regular basis, keeping the hope alive that one day the residents of Highrise will enjoy steady and reliable access to water. The connection of Highrise to the NWSC via the water network is particular. The underground pipes, the meters, the utility employees with their lists, the bills and the standing charges imply order, certainty and accountability. However, the capricious flow of water, the arbitrary figures on bills, negotiations and transactions between meter readers and residents reflect the contingent nature of water supply in Nairobi, where nobody knows where piped water is going to arrive and when and at what price exactly. This capricious water flow perpetuates long-standing inequalities in water supply also after the water sector reforms, bearing the marks of intentionality since Nairobi's colonial past.

There are instances of residents taking matters into their own hands rather than waiting for the NWSC to manage the situation. According to an NWSC staff member who controls the water meters in the estate, when disconnected for non-payment, residents may reconnect themselves to the water supply network or they may sabotage the re/installation of meters (Interview NWSC staff, 2017). Sabotage may work through the destruction or de-installation of meters, or by locking pipes in so that local utility staff cannot reach them to install a meter. A water activist explains that disconnected residents at times call a plumber to re-open water pipes: 'Nairobi Water comes and they disconnect because you have a bill of 3.000, so what you do and you need water? You just call a fundi [plumber]' (Interview water activist 1, 2015).

Though the company veils its flexible, arbitrary role in redirecting the water flows with ordering devices such as pipes, bills, fee structures and smartphone apps to report service failure, residents are only partially persuaded by the veneer of order. The practice of disconnected residents reconnecting themselves to the water pipes without formal procedure, but often with the help of NWSC employees, is an example of the negotiation inherent in the system. The NWSC has employed a person whose job is to manage water pressure within the local network bringing water from the Kabete reservoir to Highrise and other estates in the area. He is well connected to Highrise's residents and responding to their complaints, he opens or closes valves of the water network to redirect the water flow on an ad hoc basis. Beyond this technical task, he also acts as an intermediary between the people and the NWSC, thus managing social pressure on the company. The NWSC knows that it is not in complete control of urban water flows, but rather that it manipulates it on a day-to-day basis. Even though its systems and innovations persist in describing its activities as transparent, predictable and reliable, residents let down by these promises at times manage to subvert the designed system. Far from being passive consumers of externally provided services, not only local NWSC staff, but also active residents apply technologies of pressure management, such as manipulating flows through the NWSC's valves, or diverting scheduled flows intended for neighbourhoods beyond Highrise into the estate.

However, many residents regularly pay the fees demanded by NWSC in order to get reconnected, continuously hoping for the utility to fulfil its promise to modern citizenship. Furthermore, they do not rely on the provision of water through pipes. Indeed, the presence of water tanks in the estate's public spaces securing steady water access for some flats, and of people ferrying 20 litre jerrycans up the estate's stairwells for those who lack the means to buy their own tanks, are material indicators of the estate's stratification and the aggravation of inequalities through the de facto privatization of water access.

Technologies of pressure management 2: Complaint collection and participation

In light of the estate's stratification through insufficient networked water supply and the increasing frustration among residents, the NWSC is keen to show itself to be caring for and listening to its customers. It has innovated a broad system for the collection and address of complaints. At meetings, officials of the company willingly share USSD shortcodes, apps, call-centre numbers, web addresses and other technological innovations that ease the transmission of grievances to the company. However, these are focused on ensuring that service disruptions triggered by payment disputes are quickly resolved.

Kenya's water reforms created a cascade of complaint escalation mechanisms that are typical of liberal attempts at paying attention to the growing shortcomings of public service

systems constructed on a market logic. Fashioned as a response to complaints that the water company was deaf to consumer feedback, these reforms created the complaint collection mechanism, that is the WAG. Policy documents portray the WAG as an independent citizen-led, end-user dominated association (WRSB, 2010). Formally, they have three core functions: information dissemination to the public on consumer rights regarding the water sector; top-down and bottom-up feedback, i.e. collecting information on the water supply situation in specific areas and relaying this information to WSRB to inform policy and to 'empower' people on their consumer rights; to engage with water institutions, i.e. the water utilities, water boards, WSRB, the county government, etc. According to an advisor to the water regulator, 'the WAGs are like an extended arm of WSRB but based on the ground', through this 'bottom-up' regulation, they are supposed to 'not only influence policy but also put pressure on institutions that are lagging behind' (Interview WSRB advisor, 2014).

However, in contrast to these objectives, in Highrise, the WAG has come to function as an arm of the NWSC. At a WAG meeting we attended, officials of the WAG (whose provenance is unclear but who are said to be elected representatives) spoke in one voice with the PR department of the NWSC. WAG officials were even brought to meetings in NWSC vehicles and took up a lot of meeting time defending the NWSC. WAGs call meetings in response to a mass of complaints from an area. These meetings are framed as events for a collective decision-making around needs and priorities. However, in the meeting mentioned here, this stated intention has been countered by the scheduling of the meeting alone, on 11.00 am on a Tuesday morning. Furthermore, the meeting started two hours late and the first hour of the meeting was spent with speeches by NWSC engineers and public relations staff. They talked at length about proper ways for residents to file complaints and explained the formal channels and forms of citizen participation. This set-up of the meeting not only prevented many Highrise residents (e.g. those with formal jobs) from attending the meeting in the first place, but it also led many to leave before they had the chance to voice their concerns, let alone discuss them. Thus, the 'collective' potentially involved in the participatory process was already considerably diminished.

Some residents did have the stamina to stay and talk about their grievances in terms of water supply. However, the problems in service delivery concerning Highrise have already been known to the NWSC before the meeting. Thus, contrary to the official function of the WAG to facilitate the exchange of information between water users and the utility and other water institutions, the meeting became a space for the placation of those residents agitated enough to tolerate the timing and delays of the meeting described above. To this end WAG officials together with NWSC staff made new promises, presented confounding technological plans and attempted to portray the water company as incapable of addressing the challenge caused by Nairobi's population growth. Residents were urged to be patient. When they pointed out that they've heard those explanations for close to two decades, they were enticed with discussions of temporary remedies like additional water days. In the process, officials from the WAG and NWSC worked to isolate individual complaints and to deter the solidarization of complainants. They eagerly offered their offices, phone numbers and advice, proposing this individualization, this channelling of complaints on an individual basis as the proper way to have problems solved.

In sum, the WAG functions as a space for the cultivation of good compliant, submissive citizens, good NWSC clients. The WAG reflects the idea that large investments and privatization or commercialization alone do not suffice to transform urban citizens into paying customers. Rather, these measures are accompanied by mechanisms, which make urban dwellers take part in the formalization of their own practices, to render themselves transparent and thus to facilitate their control. In short, the creation of this participatory

mechanism serves for the re-interpretation of water as a marketable good. Mobile technologies are important agents in this endeavour, as they help to create an image of accessibility and responsiveness to people's grievances. The WAG is thus a manifestation of how 'citizen participation' is at times far from having empowering effects (cf. Roy et al., 2015). Instead of putting the water company under pressure, it is a tool to release pressure on them and the government. Instead of holding the water company accountable, it is a way to control the population in order to stabilize an existing socio-spatial order, which is inscribed in networked service provision.

Technologies of pressure management 3: Activism

> Look at us. We sit here expected to be grateful that water will come in sometime on Wednesday every week. How is it that we are asked [by a WAG official] to applaud this when we need water and pay for water [through standing charges] every day and at all times of the day!? (Highrise resident's comment at WAG meeting in 2015)

As this quote from a WAG meeting indicates, many residents are not satisfied with the pressure management of NWSC through complaint collection and participation – they continue to demand actual water access. For example, in times of dire water shortages, residents blocked the main road along the estate twice, demonstrating for access to water (Interview water activist 1, 2017; Lochita, 2015). Some of Highrise's residents have become active, employing a range of ways to increase water pressure, from mobilizing other residents with the help of mobile technologies; over negotiating with, threatening or beating up NWSC staff; to manipulating the technological network. One water activist explains that one of their strategies is to prevent water trucks from entering the estate (Interview water activist 1, 2017). According to him, water trucks are part of powerful water cartels, who not only profit from, but also actively create 'artificial water shortages' in order to make profits from vending water. He explains how he noticed NWSC staff colliding with people from the estate and the neighbouring slum Kibera in preventing water from a pipe that runs through the slum from entering the estate. He found three water points for selling water from trucks in the estate, earning 50.000–70.000 KSh from every truck load of water. When asked how he discovered this collision, he states that one of the water vendors told him '*Nairobi ni shamba ya mawe*' (Nairobi is a stony field), and according to the activist 'if someone tells you this, it means [they employ] other ways to get money [than honest business]' (Interview water activist 2, 2017). This particular piece of evidence may be rather thin regarding NWSC actively cutting the estate off from networked water supply. Still, narratives of NWSC staff as being part of 'cartels' operating in the background, wilfully manipulating urban water flows together with influential politicians represented by young men from Kibera slum, have motivated activists to struggle for water and to mobilize some of the residents. In a similar vein, the activist explains how directly after resident demonstrators have blocked the road, water came into the estate. For him, this is evidence that NWSC has intentionally directed water away from Highrise and is able to bring it there if social pressure is sufficient.

Framing the lack of water as a deliberate act is the rationalization for the more aggressive activism. Some activists are willing to go to great lengths to get water, including the use of violence against NWSC staff and residents who refuse to support their activities, or just to share their perspective. However, other activists have rather adopted the view that NWSC promotes, and see the lack of water in the estate as a broader problem of the technological

'system'. This perspective triggers other kinds of activities. One activist states that 'because of his faith' he does not apply violence to increase pressure, but he rather tries to persuade the NWSC to bring water to the estate, not least by going through their formal participation channels (Interview water activist 1, 2017). In his effort to understand NWSC's take on the lack of water in the estate, he has become an expert of technological pressure management. He shares intricate technological details of where pipes and access points of the local network are, which parts of the estate share a network and which are separated by vaults, and which vaults he has to open or close in order to direct water to specific parts of the estate. He also manipulates water flows beyond formal utility planning together with activists and NWSC staff.

It is important to note that water activism is an important way to position oneself in the local politics of the estate, a politics which is directly connected to more formal political arenas. Two activists explain how they have been approached by local politicians who promised to support them in case they decided to run for local positions as Members of County Assembly (MCA), Highrise's representative in the city's legislature. These positions are potential entry points into lucrative political careers in the Kenyan system (Interview water activist 1 and 2, 2017). Thus, water infrastructures and their management, which are framed by the utility as purely technological issues, are not only implicitly political, but they are also very intricately linked with the 'conventional political sphere' (cf. Schnitzler, 2013).

Another incident that illustrates how local water pressure management is intricately linked to the urban political sphere is that of the borehole. An aspiring competitor to the then serving MCA had planned to make the water shortage his campaign topic after he spoke to some residents who signalled their support. He arranged for a meeting with the city governor, who agreed to speak to Highrise's frustrated residents. However, the then serving MCA heard of these plans and managed to turn the situation around, by not only making the city governor cancel the meeting arranged by the aspirant, but furthermore by inviting the governor together with NWSC's chief executive. Stunningly, they brought with them a borehole drilling truck from the Kenya Water Institute and two large water tanks. For the next two months, the truck drilled down a hole, replacing Highrise's old borehole, and putting in the foundation for storage facilities triple in size of those of the old disused system. This new infrastructure for alternative water sourcing and pressure management has replaced the old borehole, which was declared unsafe, its supply oily, unfresh and for its low pressure, unable to flow far around the estate. The new borehole reaches deep into the aquifer and is protected from pollution by the effluent of Nairobi Dam by which Highrise sits. If the borehole is a material artefact that speaks of the ways in which different people manage political pressure through technology, then it is important to note that its construction is faulty. As a resident of Highrise estate has shown us, the pipes that are supposed to transport the water from the underground to the elevated tanks, from where it should flow into the homes of Highrise's residents, connect in a way that diminishes pressure within the system. This is the case, because a smaller pipe, the one that serves to bring the water up from underground, is connected to a larger one, which is supposed to bring the water up into the tanks. Thus, on the way, water pressure is lost, and according to our interlocutor, not nearly as much water as anticipated flows into the tanks and into the homes of Highrise's residents. If the construction of the borehole implies a certain technopolitics that asserts the right to water of people who can no longer be expected to wait for the centralized network to provide it, then the faults in construction indicate that the technopolitics of this borehole might be less about the actual right to water than about asserting this right as part of a political strategy. The faulty construction shifts the meaning of this technological artefact from fulfilling a certain function towards the symbolic value of the

intention to fulfil this function and therefore reveals the borehole's main purpose in terms of pressure management.

Again, mobile technology appears as an important agent in local water pressure management. One intervention of water activists is the creation of a digital 'Water Alert Group' through a mobile phone application. Residents use it to inform each other about the water situation in their blocks, to lament or applaud the work of local pressure managers, or to just talk about different issues. According to one activist, most of the people in the group just share news and information, but he doesn't mind, as long as there are some people who can actually 'do something about the situation'. For one activist, this group has proven to be vital. When he got reported to the police for threatening to kill someone and arrested, he posted a message to the group. As a response, members of the group showed up at the police station and talked with the officer, who finally let the activist go. While activism and local politics do not seem to reverse the dire water situation of the city as a whole, pressure exerted by Highrise's resident activists and residents through their entanglements with local politics apparently does have an impact on water supply in Highrise. According to the activists it also draws attention from other housing estates in the city which suffer from insufficient water supply.

Conclusion

We investigated a range of ways in which people manage water pressure, influencing water flows of Highrise and Nairobi as a whole. In light of the precarious lack of water in the city and the estate, people manage water pressure through technological devices as well as political and social interventions. As explained above, not only are the installation and manipulation of pipes or storage tanks a means to redirect water flows, but so are participatory meetings, complaint management and activism. The access to such technologies of pressure management is highly unequal; it reflects and intensifies socio-spatial inequalities within the estate. Residents of Highrise, NWSC, local and national administrations have particular agendas, which become apparent in the ways they relieve or increase pressure through different technologies of pressure management. These may support or subvert centralized water management of Nairobi, which perpetuates socio-spatial fragmentation since the colonial period. Depending on the perspective one takes, these effects may appear differently. For example, the manipulation of household connections by residents may subvert the role of NWSC as being the sole provider of services, but it may also relieve pressure on the company as it can argue that these activities make it impossible to fulfil its mandate in the first place. Or, Highrise's activism is a means to increase pressure but it might just bring about a redirection of water towards Highrise at the expense of other places in the city suffering severe water shortages.

While this is mere speculation at this point, our mobilization of Anand's (2011) socio-technical understanding of 'pressure' helps to provide for a nuanced understanding of the technopolitics around water supply in a fragmented city and the multiple ways in which people try to stabilize, appropriate and change a sociotechnical system. Our study shows that urban dwellers' manifold activities are not just individual and quiet, but also organized, collective and at times very explicitly political. Powerful actors within and outside the government employ elaborate strategies to manage water pressure. We have demonstrated how this pressure management relies less on technological interventions to increase physical water pressure, than on ways to relieve political pressure on those responsible for the socio-technical system of water supply in Nairobi. WAGs are central to this endeavour, as a way to discipline urban dwellers to become paying customers of water services. Our account

reveals how technology figures as a space of possibility in two slightly distinct, albeit closely interrelated ways. First, technology, and particularly mobile technology, has become an important agent in the explicit political struggle for water – potentially subverting repressive technopolitics, but potentially also reinforcing them, as we see in the use of mobile applications for the organization of activism vis-à-vis the use of mobile technologies for the dispersion of collective claim-making. At the same time, the ways in which residents manipulate the water supply network or sabotage centralized attempts at controlling their water use through water meters speak of a claim to the right to water and hence citizenship outside the traditional political sphere. Importantly, our study also reveals how these spheres, the explicitly political and the technopolitical, merge, as not least exemplified in the (faulty) construction of the borehole.

Our study speaks to scholarship on the subversive potential of everyday activities in relation to infrastructure and technology. We agree with scholars who call for a focus on the situated ways in which people appropriate and change centralized infrastructures. This the case because it this focus on the everyday that merges the technological and the political, which makes apparent the limits that urban actors face in transforming large sociotechnical systems of urban water supply – if technology is a space of possibility, it has limits. This is particularly apparent in the context of continuous disinvestment into centralized infrastructure in a city that has come to be heavily dependent on the centralized provision of water. However, we do not wish to imply that everyday activities and collectivization of people around access to basic services are generally hopeless. Rather, we argue that our study calls for more nuanced analyses of technology as a space of possibility – analyses that situate everyday activities within broader systems of resource access and distribution and consider the relationship and interdependencies between them. These analyses may come to different conclusions concerning the limits of technologies as spaces of possibility for different actors – this may depend on the technologies themselves as much as on the broader sociopolitical context within which people get active to provide for their everyday life.

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