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Article

Governing Pandemic Waterscapes: Covid-19 and Nairobi Metropolitan Services as Co-Catalysts of Waterscape Changes

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Abstract: The Covid-19 pandemic and the initial focus on handwashing measures have again highlighted the importance of water access as an essential service in protecting human health. Yet, especially in southern cities, uneven geographies of water access – often mediated by fragmented and unequal infrastructure systems – may hamper the fight against infectious diseases. The spread of SARS-CoV-2 presented a dilemma for water providers as well as residents in water-deprived urban areas as they had to adhere to new hygiene standards and requirements, despite limited access to basic water infrastructure. Therefore, a deeper understanding of pandemic urban waterscapes – the infrastructure and governance systems as well as everyday practices and technologies – is necessary for ongoing debates on (post-) pandemic or zoonotic cities. In our paper, we focus on changes in urban (water) governance and government water projects in Nairobi since early 2020. We show that Covid-19 has contributed to changes in Nairobi's waterscape but only in conjunction with recent changes in the city's overall governance structure. However, if these waterscape changes lead to greater equity in water access, and if they have helped to curb the spread of SARS-CoV-2, is more than questionable.

Keywords: Urban waterscape; Covid-19; boreholes; urban governance; Nairobi

1. Introduction

The emergence and spread of Covid-19 has undoubtedly affected cities across the globe. Since the onset of the pandemic, health experts have recommended frequent and regular handwashing. Thus, the water sector has become critical in the fight against the coronavirus (Hawkins, 2021; WHO, 2020). However, efforts aimed at the prevention of human-to-human transmissions of SARS-CoV-2 are constricted by uneven geographies of water provision and access within cities and city-regions across the globe. Especially in dense urban areas where households do not have direct, piped water connections but rely on a variety of water sources, residents have a heightened risk of contracting the virus while sharing water points, queuing, and interacting with water suppliers (Staddon et al., 2020; UN-Habitat, 2021). This may create unequal and 'layered vulnerabilities to Covid-19 and can render the preventive measures ineffective or simply counterproductive' (Ekumah et al., 2020). The pandemic further challenges water policy makers, service providers, and deprived urban populations to find creative and adaptive ways to react to changed demand patterns, decreased revenues, governmental directives, and economic as well as health effects of the pandemic (UN-Habitat, 2020; Wilkinson, 2020).

To contribute to critical conversations on (post-) pandemic or zoonotic cities (cf. Gandy, 2022; Ruszczyk et al., 2022), we consider the case of Nairobi, Kenya's capital with its historically uneven and highly contested geographies of water (Ledant, 2013; Schramm and Ibrahim, 2019). Specifically, we present an exploration of how the pandemic has shaped Nairobi's waterscape by investigating interventions and policies for water supply during the pandemic. Whereas a growing body of studies of urban Africa discusses dif-

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ferent responses to increased water demand during the pandemic (cf. Jiwani and Antiporta, 2020; Smiley et al., 2020), the intricate ways in which such interventions and policies may have changed urban waterscapes during the pandemic are yet to be investigated. We mobilize the concept of waterscapes to understand any arising changes in Nairobi's geographies of water provision and access since the start of the pandemic. The term waterscape directs attention to the "contested geographies of water" where urban water flows that are mediated by networked infrastructure systems as well as everyday water practices and technologies, reflect uneven power relations (Karpouzoglou and Vij, 2017). Accordingly, our central objective is to analyse how Nairobi's waterscape is shaped by, and in turn shapes, emerging urban water supply policies and governance in the quest to meet new health requirements. Although we follow Bhan and others (2020) in their distrust of the "desire at play in monumental analytic claims and certainties" during this pandemic, we remain open to the possibility that this global event may be a "portal" (Roy, 2020) to reconfigured place-specific waterscapes.

The paper is based on a comprehensive literature review and analysis of books, articles, government websites, policy documents, government directives and media reports on the pandemic and water related issues in Nairobi and beyond, which we use to explain the historical production of Nairobi's waterscape and its (pre)pandemic (water) governance structure. To explore recent changes to the city's governance structure and Covid-19's impact on Nairobi's waterscapes through water policies, governance, and projects, we carried out field visits and 21 semi-structured interviews in the water sector of Nairobi with representatives of municipal and national governments, government agencies, utilities, private water vendors, private sector companies, NGOs, international organizations, and urban planners. This article is organised into nine sections. After the introduction, we explain how we use the waterscape notion to analyse complex interdependent water and societal issues. The third section presents the historical production of Nairobi's uneven waterscape and the fourth section elaborates on the city's (pre)pandemic water governance. After that, section five explains recent changes in Nairobi's overall governance structure and their impact on the city's waterscape. The sixth section explores the role of Covid-19 in changing water-related policies and projects in Nairobi, before we turn to the specific role and importance of free water points and new boreholes in section seven. In our discussion (section eight) and conclusion (section nine), we ultimately point out that Covid-19 has indeed contributed to changes in Nairobi's waterscape in as much as the observed changes were catalysed by recent changes in the city's overall governance structure, and vice versa. We further argue that the longevity of Covid-related interventions in the city's water supply remains questionable. Lastly, we find that these interventions may mark a move away from the city's concentration on centralized, piped networks and related governance arrangements for water supply towards the inclusion of off-grid or non-networked technologies and related governance structures. Whether or not these and future waterscape changes will lead to greater equity and environmental sustainability remains to be seen.

2. Understanding pandemic waterscapes

We evoke the notion of the "urban waterscape" as a situated "key terrain" (Loftus and Lumsden, 2008) for our study on Nairobi's pandemic water landscape. We draw on urban political ecology perspectives foregrounding the situated relations between societies, natures, and materials (cf. Karpouzoglou and Vij, 2017). Swyngedouw first proposed the notion of the waterscape as a way to "overcome the dualisms of the nature/society divide" in water research (1999). Since then, waterscapes have been often referred to as "water landscapes" which may involve different waters and water uses, such as drinking water (Lavie et al., 2020; Rusca et al., 2017), water for agricultural use (Budds, 2008; Mehta and Karpouzoglou, 2015), water for mining purposes (Budds and Hinojosa, 2012) and more.

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Research on waterscapes in particular but not only in cities of the global South covers issues such as groundwater extraction (Budds, 2008; Sultana, 2013),splintering urban infrastructures (Wright-Contreras et al., 2017), and water governance (Budds and Hinojosa, 2012; Sutherland et al., 2015). Waterscapes research has the potential to bridge the gap between global, national, regional, community, and bodily scales (Truelove, 2019) since "water is constantly in flux, thereby perpetually shifting through physical geographies (…) but also cultural, social, and symbolic landscapes" (Karpouzoglou and Vij, 2017; cf. Gandy, 2004). Such wide perspectives do not negate, however, how place-specific local waterscapes are, shaped by "place specific dynamics and daily lived practices" (Truelove, 2011). Embedded in the notion of waterscapes is the entanglement of society, technology, and nature within hybrid hydro-social relations (Swyngedouw, 1999). To untangle those relations, we base our understanding on key characteristics of waterscapes: 1) waterscapes are produced, 2) waterscapes are relational, and 3) waterscapes involve humans, natures, and technologies.

Firstly, most waterscape studies emphasize processes through which situated hydro-social relations are constantly (re)worked and (co)produced (Ahlers et al., 2014; Karpouzoglou and Vij, 2017). Accordingly, waterscapes are produced, which involves everyday practices of users and suppliers as well as historical and governance processes, planning policies and interventions, or the lack thereof (Kooy, 2014; Mehta and Karpouzoglou, 2015; Niranjana, 2021). With the practices of diverse actors over diverse temporal and spatial scales come questions of power and agency (Díaz-Caravantes and Wilder, 2014), since "agency to change, adapt, or ignore the available arrangements is circumscribed by social relations" (Ahlers et al., 2014). The specific agency, powers, and practices are performed or mediated by an ensemble of actors, discourses, technical infrastructures, and – in particular – governmental bodies, who all constitute place-specific "water governance configurations" (Sutherland et al., 2015), which are key in producing local waterscapes.

Secondly, the above makes obvious the relational character of waterscapes that "situates water within social, natural, material and discursive processes" (Mehta and Karpouzoglou, 2015). The relational character of waterscapes emerges from their production through the practices of users, providers, and other actors (cf. Loftus, 2006). Yet, their relational aspect is already grounded in the fluid nature of water. Since water constantly moves and flows, it constantly creates connections and relations.

Thirdly, in line with the premise that water research needs to bridge the nature/society dualism, most waterscapes studies are inherently focused on the entanglements of humans/societies, natures/waters, and technologies/infrastructures. Situated arrangements of this kind involve different human actors and groups, such as governments, utility companies and urban dwellers (cf. Bakker, 2003; Loftus, 2007; Truelove, 2011). Together with natures, waters, technologies and infrastructures, these actor-constellations then constitute waterscapes. Technologies and infrastructures may range from large-scale networked infrastructures to small-scale artefacts and technologies (cf. Lavie et al., 2020; Mehta and Karpouzoglou, 2015; Tiwale, 2019).

Following the propositions above, we understand waterscapes as situated and hybrid constructs produced through multiple relationships between humans, natures, and technologies. For our study on the ways Covid-19 has changed waterscapes in Nairobi, we thus consider the fluid relations and practices that involve water users, water providers, authorities, sourced water for human use, SARS-CoV-2, handwashing stations and boreholes. Particularly we use the notion of pandemic waterscapes to unravel and contextualize how urban governance, policies, and specific projects have changed Nairobi's waterscape since the outbreak of the pandemic.

3. The historical production of Nairobi's uneven waterscape

Nairobi's waterscape is deeply intertwined with broader socio-spatial relations and urbanization dynamics. In a fashion typical for colonial urban and infrastructure planning, Nairobi's urbanization hinged on a paradoxical stance of the city's colonial planners:

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they wanted Nairobi to be as "European" as possible and hence restricted Africans' residence in the city. Yet, the city needed Africans as a workforce (Hirst and Lamba, 1994). This, together with the increasing dependence of many Africans on paid labour, led to the creation and rapid growth of often informal and underserved settlements partly in direct proximity to the wealthy European quarters. These socio-spatial inequalities were reflected in, and exacerbated by, uneven and heterogeneous access to water. These inequalities in water access are thus not the result of natural causes but rather "socially and politically manufactured" (Truelove, 2019), also in Nairobi. Considering the lived experiences and water practices of Nairobi's slum dwellers, Akallah and Hård (2020) explain that from the city's foundation on, "people's daily experiences with water did not take place in a homogenous waterscape. The multiplicity of sources connotes a differentiated system of the supply, use, nature and meaning of water".

In 1899 British colonialists chose "Enkare Nairobi", Maasai for "cool water", as the place for a railway depot. The depot soon evolved into the rapidly growing colonial city of Nairobi, which became the capital of the British protectorate in 1907 (Hirst and Lamba, 1994). Seeing its location as a "tabula rasa", where planning models of the time could be applied from scratch (Sorrenson, 1968; Thornton White et al., 1948), colonialists confiscated land and water resources disregarding interests and practices of the Maasai and Kikuyu people (Hirst and Lamba, 1994). Along with broader national water governance shifts in the 1920s, the Municipality of Nairobi resumed direct responsibility for urban water supply in 1922 (Nilsson and Nyanchaga, 2008). In a fashion typical for colonial urbanization, the municipalisation of Nairobi's water supply did not contribute to increased socio-spatial equity. Instead, the majority of the African population in early Nairobi accessed water via boreholes, streams and other sources beyond the emerging colonial water network (Akallah and Hård, 2020). The heterogeneity of Nairobi's water supply – a key characteristic of the city's waterscape today – is thus a reflection of and evolution from planned segregation during Nairobi's colonial beginnings.

By the time of the municipalisation of Nairobi's water supply and the expansion of sources for the gravity-fed system far into the hinterland of the city, many Africans lived in precarious settlements outside the formal city boundaries. On the other hand, large villas with servant quarters were the norm for wealthy Europeans and a part of the Asian population living in the high-lying, ventilated, and green areas north and northwest of the city (Werlin, 1966). Nairobi's calculated water demand at the time was based on these inequalities assuming that Europeans consume more water than Indians and Africans (Nilsson, 2016). Although, after World War II, Nairobi's waterscape experienced an expansion of its supply sources, networked infrastructure remained insufficient to cover the demand of the growing urban population (Nilsson, 2016; Thornton White et al., 1948). While categories to calculate Nairobi's water demand have changed, it continues to rest on differentiations between people residing in different areas (Interview: Nairobi City County, 2015).

Since independence in 1963, a complex interplay of strategies, policies and practices of urban administrations, residents, and elites have accumulated to increasingly stressed networked water supply of Nairobi (Nyanchaga, 2007; Were, 2019). Thus, as Nyamai and others (2022) have shown, not only are high-income areas in Nairobi six times more likely to receive sufficient water supply than low-income areas, but modes of water delivery continue to differ significantly (ibid.; Ledant, 2013; Sarkar, 2020). Even within neighbourhoods, Nairobi's waterscape remains defined by the entanglements and overlaps of networked infrastructures and multiple non-networked water supply modes such as "privatized enclave infrastructures, water vending practices, private boreholes and rain water harvesting" (Wamuchiru, 2017). Myriad actors, such as private vendors, urban residents, plumbers, and NGOs may engage in buying and selling water, installing tanks, constructing or manipulating the network of pipes, and other activities to access water (Akallah and Hård, 2020; Chakava et al., 2014; Kimari, 2019; Sarkar, 2020; Schramm and Ibrahim,

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2019). Hence, Nairobi's heterogeneous waterscape is fundamentally shaped by negotiations, contestations and accommodations of actors within and outside of formal water governance and management bodies who make more or less collective decisions and come to agreements outside formally stipulated laws and policies. Due to the perpetual inability of the networked water system to provide enough water for the growing city, non-networked water sources – specifically boreholes – and heterogeneous supply modes – such as water delivery with tankers or handcarts – have become increasingly important elements in Nairobi's waterscape. Thus, a complex situation emerges, where water access depends increasingly on the ability to access water beyond the network. In this situation, higher-income, well-connected estates are able to mitigate the insufficient and erratic network supply, e.g. by independent boreholes. Middle- and lower-income areas, however, are still largely dependent on network supply, with or without individual connections, and on the multiple non-networked supply modes that source water from the network as well as unknown sources, including boreholes. In order to reveal the tensions that shape Nairobi's waterscape between network expansion and borehole drilling – an understanding of which in turn help to assess the ways in which Covid-19 related interventions have shaped Nairobi's waterscapes – we explain related water governance arrangements in the next section.

3. Nairobi's (pre)pandemic waterscape governance

"Right now, our demand is about 820,000 cubic meters per day. Our capacity right now is 525,600 cubic meters per day. That leaves us with almost 300,000 cubic meters per day deficit." (Interview: NCWSC, 2021)

Currently, Nairobi's utility network covers an estimated 65% of the city's calculated water demand only, but this estimated calculation is in itself skewed as it assumes low water demand by low-income residents. About 8,000 licensed boreholes spread across the city that cover the gap left by networked water supply, supplying an estimated 33% of the city's water demand or an estimated 270,000 cubic meters per day (Interview: WRA, 2021). On top of the roughly 8,000 boreholes licensed in Nairobi, an estimated 4,000 boreholes have been drilled without license according to media reports (Lang'at, 2016). Thus, boreholes have become key, albeit hardly recognized, elements of Nairobi's waterscape. We argue that the tension between the borehole and the utility network, or rather the inconsistency between the roles either plays in providing the city with water vis-a-vis the attention they get from public policy and planning, is key for understanding the impacts of Covid-related interventions on the city's waterscapes. More specifically, water sector policies, investments, and governance reforms at the national level and concerning Nairobi's waterscape, as well as related critical debates, have since the 1990s mostly focused on the water network, the ways that it may be expanded to draw water from new sources, and the ways it may be governed efficiently in line with current ideals of commercialisation, full cost-recovery and efficiency (cf. Akallah, 2019).

The boreholes, in the meantime, have multiplied comparatively silently and have become essential elements of Nairobi's waterscape while remaining under the radar of intense policy debates or water sector reforms. Indeed, the boreholes are governed by one key actor, which is the Water Resources Authority (WRA). WRA is in charge of all natural water resources in Kenya, regulating abstraction, quality check, issuing permits, and collecting fees. Thus, WRA instructs the local utility, on how and how much they can source from dams, groundwater, and other water bodies. For all boreholes by utilities as well as private actors, WRA tests water quality and issues permits. WRA may deny such permits if a new borehole is not appropriately distanced from existing ones (at least 150 meters) or if the borehole would abstract from a highly stressed groundwater area. Off-the-record conversations with drilling companies and real estate developers revealed however that those rules and bans are not always enforced.

The flows of water through the network of pipes toward or through Nairobi have been mediated via a more complex governance arrangement, which has been subject to

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water sector reforms and intense scholarly debate since the early 2000s. The water sector reforms' core goal was the commercialisation of water that in turn was to lead to greater efficiency of water governance and hence an increased network coverage that would also stretch into the hardly served informal settlements and other low-income areas (Interview: Athi Water Services Board (AWSB), 2014). Following present-day wisdom of water governance and flanked by the Kenya's Water Act of 2016 as well as the 2010 Constitution of Kenya, the reforms led to the creation of three main actors: a water utility responsible for network maintenance and repairs that is able to recover its costs from water tariffs, an institution that owns and develops water infrastructure, as well as a government regulatory body responsible for regulating local water sectors, for example in terms of water tariffs. Hence, Nairobi's top-down water governance is defined by four key entities: WRA, these are the utility, Nairobi City Water and Sewerage Company (NCWSC), the infrastructure developer, the Athi Water Works Development Agency (AWWDA), and a regulatory body, the Water Service Regulatory Board (WASREB). These actors – in collaboration with the county government – plan and govern Nairobi's networked water infrastructure.

AWWDA is the legal proprietor of large-scale water and sewerage infrastructure in the wider Nairobi area. AWWDA plans, acquires funding for, and contracts the construction of dams, distribution lines, and other major infrastructures. While AWWDA is currently expanding its infrastructures – for example, through the construction of the Northern Collector Tunnel (cf. Blomkvist and Nilsson, 2017) – several projects have been delayed for years and additional infrastructure investments are necessary to actually cover Nairobi's current and future water demand (Interview: AWWDA, 2021). There are, however, plans to internalize responsibilities for completed infrastructures and "to operate the bulk water systems and sell water in bulk" as a form of revenue generation for future projects (AWWDA, n.d.).

Before piped water is sold to Nairobi's consumers, WASREB assesses and re-issues licenses to the utilities, and sets up local tariff structures. Additionally, WASREB is further supposed to license and monitor small-scale WSPs in the county, such as water bowsers/tankers, private boreholes engaged in commercial water supply, and water projects by NGOs. However, only over the course of the Covid-19 pandemic the registration of small-scale WSPs was followed up on but has yet to produce feasible results. WASREB and WRA see NCWSC in charge, given their mandate to distribute water in the county, but NCWSC is reluctant to shoulder such a non-revenue task (Interviews: NCWSC & WRA, 2021).

Lastly, to provide water to urban residents, NCWSC is the private yet county-owned utility tasked with water and sewerage management in a financially feasible manner that promotes accessibility, affordability, and equity (WASREB, 2019). With the exception of the affluent suburb Runda (Interview: Runda Water, 2021), NCWSC is the only official water service provider in Nairobi County with a quasi-monopoly on networked water provision (Akallah, 2019). Being in operation since 2003, however, NCWSC has never been able to provide sufficient water to all residents According to their latest numbers, they only reach 76% of all households (NCWSC, n.a.). In response to their massive water deficit, NCWSC has implemented the so-called "equitable distribution programme", through which neighbourhoods only receive water on assigned days of the week for some hours (ibid.). On paper, the equitable distribution program provides water on two or three days only, with different neighbourhoods receiving water on different days. In reality, the number of weekly water days and their reliability can be highly erratic, in particular but not only in lower-income areas (Goswami, 2018; Nyamai et al., 2022). In line with Kenya's overall push towards the commercialization of water, NCWSC is bound to "the ideal of full cost-recovery". This results in a limited capacity for staffing and investments, which further exacerbates the persistent issues of supply (cf. Akallah, 2019; Schramm and Ibrahim, 2019; Schwartz et al., 2017) and results in a dependence on government actors to actually invest in infrastructure.

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"The issue of resources has been the key issue for providing services. [...] The company [Nairobi Water] is mandated to work in commercially viable areas. So, as much as they are working to have extra resources and push services to areas which are commercially not very viable, it means that now the government has to come in." (Interview: NMS, 2021)

The actors governing and planning Nairobi's water supply have different perspectives on these challenges of lacking investment, insufficient upstream supply and incomplete devolution, albeit hardly questioning the route towards commercialisation and full cost-recovery. WASREB for example sees lacking implementation of devolution policies as per the 2016 Water Act and the 2010 Constitution of Kenya as a root cause of current water issues (WASREB, 2019; cf. Gachenga, 2019). AWWDA plans to sell bulk water to NCWSC in order to independently create revenue for their large-scale infrastructure projects. Finally, the question of who is to regulate small-scale WSP remains unresolved. Amidst these debates on formal water governance, boreholes have come to provide water to Nairobi's residents, outside of the utility network and hence outside of the scope of the actors formally governing it as detailed here. Thus, together with water accessed indirectly from the utility grid and related negotiations and accommodations between actors within and outside formal water governance, these boreholes are crucial elements of the city's waterscape but largely remain outside the scope of mainstream water debates. At least until the onset of the global pandemic, when a new governing actor was created: the Nairobi Metropolitan Services (NMS).

4. Re-centralising urban governance: the emergence of the NMS

"We have functions that are devolved, water is one. [...] But if a county government, for any reason, cannot perform a certain function, which is mandated by the law, the national government cannot sit back and leave the citizens without services." (Interview: NMS, 2021)

On 18th March 2020, coincidentally only six days after Kenya's first case of SARS-CoV-2, NMS was officially instated resulting in a transfer of several governmental mandates from the Nairobi County government to NMS. The creation of NMS and the partial transfer of power were the results of long-standing conflicts between national and county governments, accompanied by accusations of mismanagement and misappropriation of funds by the county government. Although NMS was initially instated as a temporal solution until February 2022 (Interview: NMS, 2021), the creation of NMS has contested the constitutional devolution of urban (water) governance and resulted in distinct changes in Nairobi's waterscape.

"NMS is quite a young outfit [...] by February next year, it is supposed to go away [...] previously, Nairobi Water was a department of the City County. So, we are totally owned by the county. Now it is NMS-stroke-county [...] but then, it is an organization that is here in passing, because we don't know what will happen in February 2022." (Interview: NCWSC, 2021)

Before the instalment of NMS, the Nairobi County government was responsible for the planning and coordination of the water sector, allocation of funds, tax revenue collection, and various other municipal tasks. Later charged with constitutional offenses and other misconducts that lead to his impeachment in late 2020 (Oduor, 2020), the former governor signed a deal with the national government in February 2020 to transfer governance power in four key departments - Health and Transport, Public Works, Utilities and Ancillary services, and County Government Planning and Development. The political and governmental reasoning was that the county government, and its governor, were not able to govern the city appropriately and could not find solutions to its most pressing issues, such as its water supply situation, due to rampant corruption and the involvement of so-called cartels (Njeru, 2021; Interview: NMS, 2021). Thus, on 18th March 2020, Kenya's president appointed an Air Force General as head of NMS, which later became an official

public office directly under the president (Omulo, 2020a). This unprecedented development stripped the county of most of its revenues and financial resources, which were reallocated to NMS with additional funding. However, the "political vehicle" of NMS (Interview: NCWSC, 2021) was initially designed as a temporary solution for two years only and, after a rapid implementation of various urban development projects, first signs of stalling projects appeared in 2020 already (Omulo, 2020b). In late 2021, simultaneously with the instalment of a new interim county governor, the National Treasury the budget of NMS for 2022/2023 to nearly zero, further indicating its soon demise (Ambani, 2021; Daily Post, 2021). Yet, as of April 2022, NMS was still active and respondents of our study are certain that NMS will remain active until the upcoming general elections in August 2022, or even longer (Interviews: AWWDA, NMS & SHOFCO, 2021).

The creation of NMS did not only result in a transfer of power and resources but, with exception of upper management, the majority of NMS staff had worked for the county government. Roughly, 6,000 employees were transferred, while mostly remaining in the same positions, in the same offices, and in the same buildings as before (Okoth, 2021; Interview: NMS, 2021). This resulted in a relatively smooth transition with a quick implementation or finalization of urban development projects mostly but not only targeted at informal settlements (Kebaso, 2020; Kinyanjui, 2020; Mueni, 2021). While those developments did not permeate to all informal or lower-income areas of Nairobi (Interview: Katiba Institute, 2021; conversations with residents in Kibera, 2021), the rapid implementation of projects by NMS highlights that plans for interventions had been available all along (Corburn, 2021; Interviews: NCWSC & NMS, 2021).

Nairobi residents perceived NMS and its directorship positively (Interviews: KWAHO & Undugu Youth Group, 2021; Wandede, 2021). Despite its popularity, the instalment of NMS has been a contested development, because devolution – the "democratic decentralization" of power from national to county level – is anchored in Kenya's constitution and further stipulated in the 2016 Water Act. Accordingly, for a vast section of governmental responsibilities – e.g. the planning and coordination of local water sectors – county governments are "neither agents nor subordinates to the center" but independent yet fiscally connected entities (Kanyinga, 2016). The instalment of NMS transferred power back from county to national government and was thus challenged in court, with the petitioner claiming that "the purported creation of the Nairobi Metropolitan Services was unlawful and unconstitutional and, therefore, invalid, null and void ab initio" (Kenya Law, 2020). Ultimately, however, the creation of NMS was upheld (Okoth, 2021). Thus, NMS presents a unique example of the national government reclaiming direct power over municipal responsibilities and urban governance. It questions the independence of Nairobi to self-govern. A heavily top-down, albeit temporary structure was installed that shifted the power relations and governance of Nairobi's waterscape also.

Since NMS took over the responsibility for water sector planning and project implementation from the county government, power relations the key actors formally governing Nairobi's waterscape changed. NCWSC, as a county-owned WSP, now received directives and collaborated with NMS, instead of the county government. Thus, NMS became instrumental in implementing changes to Nairobi's waterscape during the Covid-19 pandemic, since the transfer of power to NMS also meant that planning, funding, and governance of the public water sector in Nairobi was now a national task. As we elaborate below, their interventions focused rather on non-networked water supply technologies such as boreholes and water bowsers, rather than on the long anticipated investments into the expansion of water sources, for example as planned by AWWDA.

5. The impacts of Covid-19 on Nairobi's waterscapes

Upon confirmation of the first official case of a SARS-CoV-2 on 12 March 2020 (Ministry of Health, 2020), the Kenyan government imposed measures such as a travel ban to and from highly affected counties as well as a nation-wide curfew. Increased handwashing, social distancing, and mask wearing in all public spaces were promoted and enforced.

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Over the course of 2020 and 2021, travel bans for certain counties were dynamically adapted and the nation-wide response measures were completely lifted in early 2022 (Reuters, 2022). Covid-19 and related responses had a significant impact on economic lives, food security, and mobility – in particular in informal or low-income settlements (cf. Pinchoff et al., 2021; Schmidt et al., 2020; Shupler et al., 2021). Until now, however, the implications for Nairobi's waterscape – triggered by governmental directives and implemented projects – are to be investigated.

After decades of neglect, the spread of Covid-19 highlighted the uneven geographies of water access in Nairobi. While many, albeit not all residents of upper- and middle-class neighbourhoods could retreat to homes with piped water connections or borehole supply, Nairobians in lower-income or informal settlements faced limited and intermittent supply from water points or water delivery services. Additionally, some private water vendors increased their prices significantly; from 3-5 KSh to 10-20 KSh for fetched water jerry cans (20 litres) or from 20-30 KSh to up to 80 KSh for delivered jerry cans, according to conversations with residents in Kibera in 2021. Simultaneously, people spent more time at home and were repeatedly instructed to use more water for regular handwashing and other hygiene tasks (Interview: NCWSC, 2021). Given the simultaneous changes in Nairobi's governance structure, NMS now oversaw and implemented these efforts.

The most significant policy change for Nairobi's waterscape was announced on 6th April 2020, in form of a presidential and nation-wide directive. With the goal to "ensure continuous supply of water and adequate sanitation" so that "people have adequate water for domestic use and for washing of hands", the directive provided binding guidelines for county governments (UN Habitat, 2021):

'1. Direct all [WSPs] to provide free water to informal settlements and vulnerable groups for the next three months, April – June 2020. Other consumers will pay for the water and sewerage services; [...] 3. Ensure WSPs suspend disconnection of water for the next three months that is April – June 2020; [...] 6. Ensure handwashing points are accessible in strategic locations to serve needy communities.'

The directive was extended to September 2020, and in Nairobi, the "free water to informal settlements" instruction and the promotion of handwashing stations were de facto both still active in early 2022. NCWSC was furthermore directly affected by the guideline to suspend disconnections. According to NCWSC, the company experienced a significant revenue drop in the first months of the pandemic caused by a decrease in water consumption by commercial entities and an increase in non-payments by customers. Either believing that the free water directive would apply to them or simply counting on the non-disconnection directive or just not having the financial resources due to the economic downturn, some customers stopped paying their bills. Over the course of 2020 and 2021, NCWSC's revenue returned to pre-pandemic levels. However, despite some World Bank funded support, the missing revenue from 2020 remains a problem for NCWSC and its already strained financial capacity (Interview: NCWSC, 2021).

Simultaneously, since increased handwashing was an initial key strategy to prevent the spread of the virus, Nairobi experienced a rapid surge in handwashing stations, installed primarily by government actors and NGOs in public spaces, places of worship, and so on. All informants highlighted the importance of such stations for the increase in handwashing but their long-lasting impact is questionable since ownership of, and responsibility for, these stations is often ambiguous. Several stations provided by NGOs were initially equipped and serviced but were handed over eventually to the respective places. How many of those stations are still functioning is thus unclear, since not all of the new owners are willing or able to regularly maintain and fill them. In addition, vandalism and theft were commonly reported, and thus of the 500 stations installed by NCWSC in the city centre in 2020 none are operational anymore (Interviews: KWAHO, NCWSC & SHOFCO, 2021). While the materiality of handwashing stations makes visible small-scale changes and their gradual disappearance in Nairobi's waterscape, some changes to urban water governance and project implementation are less visible. On one hand, some projects

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or programs – from small WASH interventions by NGOs to larger plans by utilities and agencies – have been pushed back or were affected by the reallocation of resources (Interviews: AWWDA, KWAHO & NCWSC, 2021). On the other hand, the pandemic was also a trigger for a further digitalization in the waterscape. Smart water infrastructures were already on the rise in Nairobi (cf. Guma et al., 2019), but utilities and government agencies have now implemented or, at least, are considering additional digital or web-based applications and services (Interviews: NCWSC & WRA, 2021). What all those diverse, sometimes ambiguous changes show, however, is how Covid-19 resulted in rather spontaneous reactions that were hardly part of long-term solutions to pre-existing inequalities in Nairobi's waterscape.

6. Engineering solution to pandemic water stress: 193 boreholes

"You don´t just identify a borehole and drill it." (Interview: Water Trust Fund, 2021)

In April 2020, NMS started to purchase more than 20 water bowsers that extracted water from NCWSC's network to deliver it to public water points spread across the whole city but primarily located at the margins of informal settlements (Interviews: NCWSC & NMS, 2021). While other stakeholders confirmed that, for Kibera, free water was delivered, the regularity of provision has faded out over the course of 2021 (Interview: KDI, 2022). However, the delivery to water points was accompanied by the sinking of a nearly 200 new governmental boreholes in 2020. Following the above directive, NMS – via the respective ministry and the National Treasury - allocated 1.62 billion KSh for its water supply projects, including the drilling and equipping a total of 193 boreholes and the construction of raised up steel water tanks that should have the capacity of supplying about 30 million litres a day. Moreover, the World Bank gave an additional 6.9 billion KSh conditional grant to the ministry to aid the operations of WSPs across the country (Interview: Water Sector Trust Fund, 2021). In collaboration with other government bodies, NMS quickly sank and operationalized those boreholes over the course of a few months based on plans already available (Interviews: AWWDA, NMS & WRA, 2021).

The rapid installation of 193 boreholes – of which 143 were located in "underserved areas" (Khaduli, 2021) – was led by NMS and coordinated by a multi-agency team, consisting of representatives from the Ministry of Water, Sanitation and Irrigation, NMS, AWWDA, WRA, NCWSC, and WASREB. First, NMS proposed borehole locations, mainly on public land, which were then reviewed by WRA and the Ministry: "When we got the funds, we already had a list. It's not like we were just sent out and decided" (Interview: NMS, 2021). For the approved locations, AWWDA tendered orders to private drilling companies. The constructed boreholes were transferred eventually from AWWDA to NCWSC, which is – until today – responsible for maintenance and operation, in collaboration with private service providers for repairs and water treatment (Interviews: Davis & Shirtliff, NCWSC & WRA, 2021). In addition to costs of electricity, treatment and maintenance, NCSWC pays 50 cents per 1,000 litres to WRA for the extraction of water; the standard fee for water abstraction in Kenya. Those running costs are partly funded by a conditional World Bank grant (Water Sector Trust Fund, 2021). However, daily management of boreholes lies not with NSCWS but community water committees:

"The committees were recruited from the community in consultation with the area elders and the local administration. [...] there will be a representative from Nairobi Water, there will be either a pastor or someone senior. [...] They will choose people from among themselves. I think the total is about eight to ten people. Only one or two will be from Nairobi Water. The other ones, they are area elders." (Interview: AWWDA, 2021)

Those committees and additional staff work voluntarily to operate the pumps and attached water kiosks (Interviews: NCWSC & Undugu Youth Group, 2021). The management and implementation of new boreholes thus involved various levels – from the ministry to NMS to community groups – working together to provide free water to informal settlements. However, in order to reveal the actual impact of these interventions on a) the

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fight against the pandemic and b) longer-term changes to Nairobi's uneven waterscape, we will discuss some key issues related to the borehole drilling.

Considering the first aspect, the actual functionality of the boreholes is a key consideration. According to official accounts, 20% of the newly constructed boreholes are non-functional largely due to lacking power supply (Interview: WRA, 2021). Furthermore, a rather secretive stance of governance agencies toward the actual position of the boreholes as well as field visits and conversations with non-governmental stakeholders raise reasonable doubt in the official percentage of functional public boreholes. The lack of functionality is a general feature of free water points (some including boreholes), with local researchers and activists struggling to find operational, publicly accessible, and properly managed points in various informal settlements, such as Mathare, Mukuru and Kibera (Interviews: Katiba Institute, KDI & KWAHO, 2021/22).

"So, [in Kibera] the government sunk those boreholes with these huge metallic tanks. But many have not worked yet, because of the operation of it, I think. You know, who manages the water, are they selling it or giving it out for free, if the pumps breaks, who repairs it?" (Interview: KDI, 2022)

"Now that free water is supplied to informal settlements, you find that there are people who are taking most of the water. So, for you to get it, you have to pay them something. It is free, but people have patronized it now. So, they take the free water and resell it." (Interview: KWAHO, 2021)

Furthermore, even where boreholes are functional, their contribution to curbing the spread of the pandemic remains questionable, because boreholes provide water for certain hours of the day only (Observations; Interview: Undugu Youth Group, 2021). As this may result in long queues, water users often continue to rely on other sources. Furthermore, as reported from other African countries, free water policies during the pandemic may increase the risk of exposure to SARS-CoV-2 since "free water at standpipes has led to large crowds with long lines of people waiting to fill buckets with water" (Baron and Guigma, 2021; cf. Shang-Quartey, 2021). Taking these aspects together, not only do many of the installed boreholes or free water points not work, but even if they work, their effect on curbing the spread of the pandemic remains questionable.

Considering the long-term impact of the boreholes on Nairobi's waterscape beyond the pandemic, the picture is more complex. This is because the future of the NMS as much as the free-water policy and the boreholes themselves is highly uncertain. There are plans to fully incorporate the boreholes into Nairobi's networked water infrastructure and connect them to the grid (Interview: NCWSC, 2021). This would mean that NCWSC will have to operate them, which it does already only hesitantly, given the respective financial burden. However, despite these plans, the future of the boreholes appears highly uncertain to private water vendors as well as local residents. Private water vendors reportedly reacted to the installation of the boreholes with intimidations, harassment, and even sabotage, which indicates that they considered them a serious threat to their water businesses (Interview: Undugu Youth Group & Vajra Drillers, 2021). Kibera's water users, for instance, neither know who was responsible for the creation of the borehole, nor how the future water supply would be regulated. Instead, most assumed that the free water supply will remain (conversation with residents in Kibera, 2021). Despite the involvement of community water committees in the management of individual boreholes, available information apparently did not reach the respective water users.

Relatedly, the future of Nairobi's entire waterscape is uncertain because of two factors – firstly, the use of boreholes for the city's water supply will further stress Nairobi's ground water aquifers, which already "might not be able to support the projected groundwater demand, and the shortfall between demand and supply is expected to start before the middle of the century" due to rapid and ongoing urbanization (Oiro et al., 2020). Secondly, the role of NCWSC as a key actor in the governance and management of Nairobi's water flows has become increasingly uncertain amidst the current governance changes and interventions into the technological system of water supply. This is because the free

water policy, the non-disconnection directive as well as the installation of boreholes as such further strains their financial and personnel capacities. The difficulties NCWSC currently experiences when trying to regulate or manage off-grid technologies such as the boreholes as well as small WSP do not indicate that boreholes will be less prolific elements in Nairobi's waterscape. Instead, the installation of new boreholes has provided a multiplicity of futures in Nairobi's waterscapes, in which some boreholes are used and operated by NCWSC, some are run by private engineers, plumbers or community groups, some are used for schools and other public facilities only, and some might just disappear again. This, furthermore, may lead to a situation where it is mostly the higher- and middle-income groups who may decide to go off-grid, while, in a kind of reverse "infrastructural bypassing" (Graham and Marvin, 2001), NCWSC may be left with providing water to those who cannot afford such strategies, that is residents of low-income settlements.

Overall, the rapid instalment of free water points and new boreholes in Nairobi was clearly a timely and reasonable endeavour at the onset of the pandemic. It ensured better water quality for those able to receive free borehole water, due to monitored sourcing by WRA and the treatment of the water (Interviews: NCWSC & WRA, 2021) – both aspects are not features of most informal provision of water in Nairobi. However, the publicly governed parts of Nairobi's waterscape have fragmented further, within single neighbourhoods where some have received free water but many did not. Further, power relations between actors have shifted, with NCWSC unwillingly left with an unclear number of operational boreholes, water cartels and vendors are challenged but still operational, communities and water users left in the dark about the future of (free) water supply in underserved areas, and NMS facing an unclear future. In the end, even if the boreholes might be out of operation sooner rather than later, and while they have hardly changed Nairobi's uneven water geographies or eased the city's water deficit, they demonstrate once more the fundamental difficulties to install a centrally governed water supply system in Nairobi.

7. Re-producing Nairobi's pandemic waterscape: catalysts and changes

As demonstrated in previous sections, Nairobi's waterscape has indeed experienced significant changes in terms of governance constellations, policy interventions, and implementations of new infrastructures, such as handwashing stations, free water points, and public boreholes. We argue however that these changes – which are rather antithetical towards the city's long-running fixation on networked infrastructures – can by no means be explained by the pandemic alone. As much as Covid-19 triggered the reallocation of funds and a stronger focus on water delivery to underserved areas, namely informal settlements, the pandemic – as a disruptive event – rather co-catalysed changes and plans that have been possible and available all along. Only in the coincidental combination with the instalment of NMS, with its presidential authority and financial resources, as the second catalyst, otherwise unlikely interventions were made possible. When asked directly if interventions, such as free water points and public boreholes, would have been possible with only one of those catalysts, respondents of our research voiced significant doubt (Interviews: KWAHO & NMS, 2021). Without NMS, water-related responses to Covid-19 would likely have been less streamlined and less financially equipped. The fact that – apart from a smaller government project on borehole drilling in Nakuru in 2021 – no other county or city in Kenya experienced such investments and interventions (Interview: WRA, 2021), underlines the importance of NMS in these developments. Vice versa, without the urgency of the pandemic and the initial focus on water use and hygiene practices, NMS might have used its temporary authority and resources in other ways. While speculations on potential changes in the waterscape without NMS or Covid-19 are unlikely to be productive, we want to highlight the actual reconfigurations of Nairobi's waterscape during two pandemic years. For this, we turn back to our understanding of waterscapes as situated and hybrid constructs produced through multiple relationships between humans, natures, and technologies.

Firstly, since waterscapes are constantly (re)worked and (co)produced water landscapes (Loftus, 2007; Rusca et al., 2017), the combination of Covid-19 and NMS – with its implications on governance, policy, and project level – has without a doubt reconfigured Nairobi's waterscape and its underlying production, even if only temporarily. The place-specific "water governance configurations" (Sutherland et al., 2015) were altered and new public infrastructures – i.e. boreholes – are now part of the everyday (re)production of Nairobi's waterscape. In combination with historical developments – from colonial planning legacies to the commercialization and devolution in recent decades – and the everyday practices of users, vendors, and others, the policy and project interventions since 2020 are likely to reverberate into a post-pandemic waterscape that is still shaping up. While the magnitude of such reconfigurations remains to be seen, we argue that – instead of actually addressing pre-existing inequalities – the changes brought by NMS and Covid-19 have the potential to contribute to a further, more fine-grained fragmentation of Nairobi's waterscape, in which boreholes provide benefits only to either those close-by or to those able to erect their own. Additionally, the long-standing, fundamental difficulties to provide universal and equal water access through large-scale infrastructures and networks have everything but decreased, considering the additional economic struggles for many water users during the pandemic, the general problem of unsustainable groundwater abstraction via boreholes, and the additional burden and deteriorated position of NCWSC.

Secondly, when approaching waterscapes as highly relational constructs (cf. Loftus, 2007; Truelove, 2019), we can identify three key changes in relationships and flows within Nairobi's waterscapes. One, the flow of water itself was partially, but maybe only temporarily, changed through the use of bowsers and boreholes towards some formerly underserved areas. Two, the power relations of water actors were altered, with a now further weakened NCWSC, a temporary override of urban governance responsibilities by the national government through NMS, a streamlined collaboration between government agencies, and reconfigured relationships between water vendors, communities, and government agencies around free water points and new boreholes. Three, pandemic-specific relations between humans, natures, and infrastructures newly emerged, in which one nature – i.e. Covid-19 – triggered changes in infrastructures to provide another nature – i.e. water – for the benefit of local communities. Again, the long-lasting ramifications of these altered relations and flows remains to be seen, but they are nevertheless a key aspect of Nairobi's pandemic waterscape, its governance, and (re)production.

Thirdly, by specifically using the notion of waterscapes to bridge the nature/society dualism, we hope to have shown the intricate, situated entanglement of humans/societies, natures/waters, and technologies/infrastructures (cf. Rusca et al., 2017; Swyngedouw, 1999). Although, for this paper, we have used pandemic-specific water governance and policies as our starting point, the openness and inclusiveness of waterscapes as situated "key terrains" (Loftus and Lumsden, 2008) allowed for an in-depth exploration and discussion of urban water supply and access in pandemic times. Ultimately, understanding (post-) pandemic waterscapes involves multiple scales (from a global pandemic to local water points), temporalities (from historical developments to acute health crises), actors (from national governments to water users), technologies (from large-scale infrastructures to single boreholes), and natures (from groundwater aquifers to viruses). We thus argue that – despite a necessary but empirically grounded fixation on certain elements of the waterscape (in this case, water governance and policies as well as boreholes) – through the notion of the waterscape we were able to work out how changes in Nairobi's waterscapes were made possible only through the combination of different natures, different humans and institutional actors, and different technologies.

8. Conclusion

As we are writing this paper in early 2022, Kenya has waived all Covid-19 restrictions, such as mask mandates, as it heads towards its general election season. In the

meantime, NMS has received an official extension with a significantly smaller budget of only 200 million Kenyan Shilling until late August 2022 (Kinyanjui, 2022). Covid-19 is slowly but steadily becoming less of a factor in daily lives, and – according to official numbers – Kenya has only seen a moderate health impact of Covid-19, in global comparison. While we have reasonable doubt that the free water directive and Nairobi's new public boreholes have played a significant role in curbing the spread of Covid-19, some changes in Nairobi's waterscape remain visible. Handwashing stations are still ubiquitous across Nairobi, although their actual use has visibly declined. The large metal tanks above newly installed boreholes clustered with logos of government agencies are still towering above some informal settlements, but their future remains unclear.

Starting in early 2020, water users across the city faced economic struggles, changing policies and governance structures, new supply modes in their communities or the lack thereof, and continuing yet granularly altered inequalities of Nairobi's waterscape. How the city's waterscape, with its new infrastructures and relations, has been experienced and (re)produced on an everyday level through creative adaptations and practices by regular residents need to be investigated further. It also remains to be seen in how far Nairobi's now emerging post-pandemic waterscape will reflect the changes brought by the coincidental overlap of Covid-19 and NMS. What is clear though is that those changes have further manifested the heterogeneity of water supply modes (cf. Wamuchiru, 2017), since even governmental actors moved from the fixation on centralized and piped networks only to off-grid or post-networked technologies of bowsers and boreholes. Amidst these changes, issues of equity and sustainability remain to be tackled. Nevertheless, while Covid-19 might not have been a "portal" (Roy, 2020) to drastically new arrangements of Nairobi's waterscape, it was still a co-catalyst for temporary change and the possibility to now advance more situated imaginations of water supply beyond a network that has never been able to provide water to all Nairobians.

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