Technology's Stories
Vol. 8, no. 2, September 2020

Technologies from Below: Water and Sanitation Supply in Nairobi's Informal Settlements

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In a study on water vending in Tanzania, Marianne Kjellén points out that in most developing countries, a piped water supply in the city is the norm for the richer households, while poorer households struggle to access water by other means.[1] Most of the urban poor live in "illegal" spaces (slums, informal and squatter areas). City authorities often refuse to provide or plan for water or sanitation services in those sites, arguing that incorporating these informal areas in city planning would institutionalize illegality.[2] Yet these areas absorb more than half of city residents. Still, they are treated as blank spaces on city master plans and policy papers.

Diminishing state resources, deficient urban management, and the utter inadequacy of conventional approaches have made it impossible to provide basic

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[1] Marianne Kjellén, "Complementary Water Systems in Dar es Salaam, Tanzania: The Case of Water Vending," *International Journal of Water Resources Development* 16, no. 1 (2010): 143–54.
[2] Jethron Akallah, "The Role of Government in the Social Fragmentation and Marginalization of the Urban Poor in Kibera Informal Settlement, 1963-2002," master's thesis, Maseno University, Kenya, 2012.

ISSN 2572-3413 doi:10.15763/jou.ts.2020.09.28.03

infrastructure in urban areas in developing countries such as in the city of Nairobi, Kenya.[3] Faced with these realities, how do urban residents sustain themselves?

Nairobi, like any city has its urban materialities: the things that make up the city like roads, buildings, water pipes, and other objects, embody the aspirations of different people in the city's history. As a colonial city and an urban space, Nairobi's infrastructure was imprinted with colonial models of social difference, control, and domination. Nairobi's postcolonial history has seen elitist ideals of municipal provisioning of water and sewer flourish in parallel with a rapidly expanding group of urban poor who are shut out from such plans. When it comes to providing key urban services, global players such as financiers and consultants determine the technological path for most cities in the Global South. How do "off-grid'' populations that dominate cities like Nairobi respond?

Small-scale Independent Water Suppliers

The informal areas of Nairobi's waterscape have historically been treated as blind or blank spots on the city planning maps. Centralized city services like water run along the boundaries of such settlements. One result is that these areas become incubators for bottom-up approaches to providing water to the people who live there. Small-scale initiatives on the individual or communal level fill the gaps left by mainstream infrastructures.

Small-scale suppliers of water come in the form of fixed-point water providers and portable or mobile suppliers. Fixed-point water vending has a long history in Nairobi. It started with the first colonial standpipes strategically located on the fringes of the African-settled areas. Standpipes, as the name suggests are vertical pipes attached to a water main. These pipes have a tap so that users can fill their own water containers. However, they were informal—it was not clear who had rights to them. More recently owner-vendors who are connected to municipal water will fill standard jerry-

[3] Alphonse Kyessi,"Community-Based Urban Water Management in Fringe Neighbourhoods: The Case of Dar es Salaam, Tanzania," *Habitat International* 29 (2005): 1–25.

cans (originally made to hold cooking oil) with water and sell them in kiosks. The water-kiosk supply systems are operated by different groups and individuals who are either officially connected to the water mains through a metered system or steal water through unauthorized connections that are locally identified as “tapping.” On the other hand, those with private boreholes sell water to their neighbors or to motorized vendors and pushcart operators (see figure 1).

Figure 1. Door-to-door delivery of water through vending by use of pull carts and the standard 20-liter jerry cans that have become synonymous with the water business in informal settlements in Nairobi, Kenya. (Photo by author.)

As for the mobile or portable suppliers, oral interviews in Kibera—one of the largest informal settlements in East and Central Africa—shows that trucks, locally made wheelbarrows, and push-pull carts in use as early as in the 1940s. Mobile suppliers either deliver water to customers directly to the door or as close as possible, based on the road network. The difference between fixed-point supply and mobile providers comes down to cost. Door to door deliveries and motorized supply are more expensive than simply “going for water” oneself.

Centralized water provision is metered and charged by use. By contrast mobile vending and fixed standpipe supplies have seen the development of informal standard-sized containers instead. From the debe (a metallic container that was mostly used for carrying oil) to the modern-day 20-liter plastic jerry can, these containers are the shared standard for comparing the cost of water. During ordinary times, a jerry can of water costs between 2 and 5 Kenya Shillings (Kshs). However, this cost can rise to as much as Kshs 60 during periods of scarcity.[4]

Pit-latrine Emptor: The "Big and Small" of Sanitation in Informal Areas of Nairobi

Like water supply, basic sanitation services are difficult in Kibera. The ground in Kibera does not allow for pit-latrines to be dug beyond 6 feet in depth. The colonial government published this finding in a major study carried out in the 1920s as it grappled with what it called the "Kibera problem."[5] This is because Kibera, like many other informal settlements around the world, occupies zones considered uninhabitable, such as abandoned quarry fields. The construction of pit-latrines, where they can be built at all, thus required innovation. Some were raised a few meters from the ground. Others have mechanisms for both hand emptying and allowing them to be emptied into open drains during heavy rainfall. Ensuring that the pit latrines have broad enough drop-holes facilitates hand-emptying. Having an opening on the sides, which is closed by a lid that can be lifted whenever the heavy rains are on, on the other hand, enables efficient draining into the "open-sewers."

However, the congestion in areas like Kibera creates the biggest problem for emptying latrines. While development agencies like UNDP and the World Bank thought of providing tractors to help. That solution is not entirely workable, however. Tractors are large—a problem in the tight quarters of Kibera. By contrast, a local group, by

[4] Michael Murume (pseudonym), interview by Jethron Ayumbah Akallah, 31 August 2016, Lindi, Kibera, Nairobi.
[5] Akallah, "The Role of Government."

mounting a metallic oil-drum on a small two-wheel push-pull cart, has created a solution that has a small enough footprint to navigate the narrow alleys that litter most informal settlements (see figure 2).

Figure 2. Localized push/pull cart pit-latrine hand-emptors in Kibera Informal Settlement, Nairobi, Kenya. (Photo by author, 2016.)

That is not the only problem, however. The operators interviewed noted that non-biodegradable materials often find their way into pit-latrines. Tractors normally require long pipes to extract fecal matter. These pipes are inefficient and inappropriate; they are not designed to deal with the enormous challenge presented by mixed materials in the pits. Hand-emptying is therefore the most efficient approach to this sanitation challenge. They can sort by hand to facilitate removal of excreta. Having worked for over twenty years, the hand-emptors are widely known. Customers can easily procure their services from a common site where they hang out when not contracted. While dumping raw excreta can pose a threat to the rivers where they would probably be dumped, a partnership between these operators and other agencies has provided a solution. They take the excreta to a centralized site where it is passed to city authorities for treatment.

The picture provided by these two cases shows independent, distributed systems working seamlessly with centralized networks to attain a working equilibrium. It highlights cooperation rather than conflict the large and small, and the formal and informal, amongst other binaries. It clearly demonstrates the role of "people as infrastructure," a point made by scholar Simone AbdouMalique.[6]

These small-scale operators have firmly integrated themselves and their technological solutions to the provision of water and sanitation into the day-to-day lived experiences of the residents of informal settlements in Nairobi.

Revisiting Localized Technological Approaches

"Small technologies" are often understood as ways of providing improved livelihoods and ecological balance, in contrast to large-scale technologies that are viewed as often distant from communities and destructive to the environment. Yet these two types of technology need to be understood as complementary approaches, rather than mutually exclusive, as suggested by Harvard professor, Harvey Brooks. The potential benefits of both are greatly enhanced when the two are made to coexist.[7] Rather than seeing the small as "appropriate" and the large "inappropriate" solutions for providing essential services, the coexistence of the large and small, the contemporary and the old, the sophisticated and the simple, or the imported and the indigenous, show us that infrastructures are really a heterogeneous set of social and technical options rather than homogeneous solutions. The best choices are based on the objectives to be accomplished and the human and environmental consequences that result.[8]

Rather than see certain technologies as efficient and others as inefficient, it is more useful to see any technology that enhances a community's capacity to satisfy their

[6] Simone AbdouMaliq, "People as Infrastructure: Intersecting Fragments in Johannesburg," *Public Culture* 16, no. 3 (2004): 407–29.
[7] Brook Harvey, "Innovation and Competitiveness," in *The Technology Race: Can the U.S. Win?* J. Herbert Hollomon Memorial Symposium, MIT (Cambridge, MA, April 1991).
[8] Anthony Akubue, "Appropriate Technology for Socioeconomic Development in Third-World Countries," *Journal of Technology Studies: an E-Journal* 26, no. 1 (2000): 8.

goals and aspirations as efficient.[9] Rather than paying attention to the product, we should emphasize the process: how tools mediate between humans and the attainment of their needs.

In Nairobi, for example, water kiosks are wholly dependent on the municipal authority's network for their water supply, whether legally connected from above or illegally connected from below. But so too are the municipal water supplies dependent on water kiosks to get the water to the people who need it.[10] Ultimately, water provision is not a single, centralized system. The "spaghettification" (running PVC pipes that characterize informal areas) and use of porters that is characteristic of the informal areas, the boreholes that serve exclusive and expansive former colonial and European rich urban ranching citadels like Karen, the motorized water bowsers, trucks, and pushcarts that service the intermittent middle-income residential settlements, and the overhead storage tanks that augment the high-end suburbs of Nairobi represent a collage that is the waterscape of Nairobi. Likewise municipal networked sewage systems are complemented by the septic tanks, cesspools, soak pits, pit-latrines, motorized exhausters, and hand-pulled carts that make sanitation management possible.

Conclusion

Exploring the day-to-day experiences of ordinary people gives us a clear view of how technologies are constructed and mediated so as to make them responsive to the needs and aspirations of their users. Paying attention to all the users, and not just those who are taken into account by city planners, gives us a much better sense of the real scope of a city's infrastructure, in all of its complexity. People interface with technologies as both users and co-producers, innovating new elements, and reconfiguring existing

[9] CSIR Built Environment Unit, *Appropriate Technologies in the Water Sector in South Africa* (Position Paper), May 2008, 3.
[10] Benard Njoroge, *Small Scale Independent Providers of Water and Sanitation to the Urban-Poor: A Case of Mombasa Kenya,* Nairobi Water and Sanitation Program (International Water and Sanitation Centre: World Bank, 1999).

technology to extend access and supply more people, more satisfactorily. For cities in the Global South, centralized and "off-grid" modes of supply need to be seen together if we want to better understand the infrastructure that really sustains urban life.

Suggested Readings

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