Water for Bongo: Creative Adaptation, Resilience & Dar es Salaam's Water Supply

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The uneven development of Dar es Salaam's anthropogenic waterscape owes much to the city's colonial origins. Dar is a relatively young city, born in the mid-nineteenth century just before the onset of colonial rule. In 1862, Sultan Majid of Zanzibar chose a small fishing village named Mzizima as the site for a new town that would be a hub for plantation agriculture and long-distance caravan trading.[3] Centered on a large natural harbor, it was named Dar es Salaam, a name0.5 snteenth ading.

In the early 1960s, Tanganyika gained independence, and Dar es Salaam emerged as the political and commercial capital of the new nation of Tanzania. Rather than improving the water situation, the first decades of independence exacerbated the problem. Much of this owed to explosive population growth. Before 1961, the city had a relatively slow growth rate of 2.6 percent per annum.[15] Since independence, the rate has averaged in excess of 5 percent. According to urban development scholars Peter Siebolds and Florian Steinberg, the 1960s and 1970s saw the highest rates of growth, with an average of 16.6 percent per annum from 1967–1973 and 24 percent from 1974–1976.[16] In terms of overall population, the city grew from 128,000 residents in 1957 to 151,000 in 1963 and 800,000 in 1978.[17] The period also saw a shift in racial demographics. Between 1957 and 1967, the African population of the city rose from 93,363 to 272,821, mostly due to rural-urban migration.[18] Meanwhile, both the Asian and European populations shrank, from 29,986 and 4,479 to 29,192 and 3,547, respectively. As time passed, the city became predominantly African yet highly diverse, with a population comprised of dozens of ethnicities. It also remained young, with over three-quarters of its residents under the age of thirty-five, and it had a rising proportion of women to men (from 42 percent in 1957 to 46 percent in 1978).[19] The majority of the city's growth occurred along the four main arterial routes into the city: Bagamoyo Road, Morogoro Road, Pugu Road, and Kilwa Road.[20] These new settlements formed a mosaic consisting of peri-urban villages enveloped by urban expansion such as Manzese and Segerea, formally planned residential areas such as Kijitonyama and Sinza, and informal settlements such as Ubungo and Makongo.[21]

Amid this explosive growth, the city suffered from the development priorities of the new government, which privileged rural areas. Julius Nyerere, the first president of Tanzania, and the ruling party, the Tanzania African National Union (TANU

third water supply, the Lower Ruvu system. Commissioned in 1976, this scheme tapped the Ruvu River 22 kilometers downstream of the existing Upper Ruvu works, around 55 kilometers northwest of the city.[24] From there treated water was pumped to storage reservoirs at University Hill, from which secondary distribution lines brought it to users, mostly in the wealthier northwest part of the city. Aside from this project, and some expansion of the existing Upper Ruvu works, the city made little investment in extending the formal water supply, and almost none in maintenance. While other African states stressed rural development as well, few regarded urban spaces with as much contempt, or starved them of resources, as did Tanzania.

The TANU government made other changes that negatively affected Dar. In 1973, the government announced plans to move the national capital to Dodoma, which led to the commitment of vast resources to develop what was essentially a brand-new city.[25] This followed a year after

How do we explain Dar es Salaam's rapid growth in the absence of an adequate public water infrastructure? The answer lies in creative adaptations made by the city's residents, particularly those in the poorest neighborhoods. Since the early years of the city, African populations relied on their own ingenuity to procure water for their homes and businesses. The knowledge and practice that informed these strategies owe much to the rural origins of most of the population, and the influx of rural knowledge remains a part of the city's growth. Environmental historian Emily Brownell points out how the city's population has continuously brought the rural into the urban. By drawing on resources, ideas, and practices from the rural, these urban populations engaged in "an ongoing process of negotiating the opportunities and struggles of the city through seeking the relief of rural resources rather than a finite transition from the village."[28] Though Brownell does not focus specifically on water, it is a good example of the process she describes. In most African neighborhoods, residents developed local strategies for procuring water that drew upon knowledge and practices employed in rural areas. This enabled them to remain resilient in an urban landscape with uneven and inadequate provision of services.

A key strategy adopted throughout these communities was multiple sourcing. In rural areas of the country, such as Kilimanjaro

borhoods. While these proved popular among some users, they did not outright replace other sources of water. Rather, they became part of a menu of options of which users took advantage.

In the past two decades, private water vending has become a prominent part of Dar es Salaam's anthropogenic waterscape. This involves water that is resold by a private entity to end users. As noted by UNDP Senior Water Advisor Marianne Kjellen, this can take many forms.[30] The most basic consists of an individual or business selling water from their private water connection or borehole. Others involve home delivery, carried by hand, carts, bicycles, or tanker trucks. As much as 50 percent of the population relies, at least in part, on private vending to secure water. It provides not only for users in poorly serviced formal and informal neighborhoods, but also wealthier households dissatisfied with their tap water service. The proliferation of vendors, many of whom are local entrepreneurs, embodies the notion of Dar es Salaam as Bongo, a city of residents whose resilient spirit enables them to thrive despite the odds. And it has a number of benefits. It has allowed for urban growth not constrained by the limitations of formal infrastructure. This is reflected in the physical shape of the urban sprawl, which follows transportation routes rather than water infrastructure. It also has eased people's dependence on the formal water infrastructure with its poor track record of reliability. And it is generally better quality than unprotected surface resources such as streams, which have become less clean and reliable over time.

There are significant drawbacks, however. Foremost, private water is expensive. The cost for water from vendors can be as much as thirty times the price of water from a piped connection.[31] Actual prices vary dramatically depending on location and whether fetching is involved. Kjellen, in a 2000 study on water vending, notes a going rate of 20 Tanzanian shillings (TSH) per 20-liter jerrycan for water fetched by the user directly from a vendor.[32] Prices rise steeply for water delivered to one's home. The price for vendor-delivered water averages TSH100 per jerrycan, or TSH5 per liter. Neighborhoods closest to pipe infrastructure, such as Temeke, have lower average prices (TSH50–70), while those further away (such as Kiwalani), or at higher elevation (parts of Ubungo), have prices ranging from TSH150–200. Furthermore, prices vary depending on supply and demand and therefore spike during times of heightened scarcity, such as a drought or a breakage in the vendor's supply. On the whole, these prices do not compare favorably with those of public sources. Kjellen notes that people collecting from public standpipes typically pay TSH10–20 per jerrycan (TSH0.5–1 per liter), while those with direct connections to the public water supply who pay a flat rate average TSH

ter availability and reliability notes that lower-income African neighborhoods in the city have an average consumption rate of just 29 liters per person per day,[34] whereas a UNDP report from 2016 found that residents in Oyster Bay, home to many diplomats and expatriates, use an average of 166 liters.[35] This represents almost a six-fold increase for users in wealthy neighborhoods. The much lower rate of consumption in poorer neighborhoods can be attributed to the high cost of water as well as the time and effort needed to fetch it. Given the premium paid for delivered water, and the labor burden of procuring water from distant sources, many households have no choice but to make do with smaller quantities of water.

Low rates of consumption, in turn, contribute to other problems. According to the World Health Organization, between 50 and 100 liters of water per person per day are required to ensure that basic needs are met.[36] Many neighborhoods in Dar average well below this, with implications for hygiene and sanitation such as infrequent bathing and cleaning. This exacerbates the health risks already inherent in private water. Most vendors are unregulated, and many procure water from wells that are not registered or tested for quality. Given the lack of improved sanitation or sewerage in most neighborhoods, many water sources are prone to contamination, especially during the rainy seasons, when floodwaters often overrun poorly protected sources. This raises the potential for disease outbreaks. According to environmental scholar Caroline Kihupi and colleagues, the city has experienced localized outbreaks of cholera every year since 1974, with a case fatality rate averaging 10.5 percent.[37] And a recent study by urban planner Tumpale Sakijege, based on research in the city's Goba settlement, notes a connection between private vending and outbreaks of typhoid, diarrhea, and dysentery.[38]

Perhaps the biggest drawback to private vending is the extent to which it represents the commodification of a basic human right, the high cost driven by necessity rather than by design. Users pay inflated sums for a vital resource that, at least in theory, should be available at a much lower cost. It is an ironic outcome of the / era. Whereas Nyerere's government attempted to decommodify water in rural areas by making it free, it essentially encouraged its commodification in urban areas, not merely by allowing water utilities to charge for it, but by underserving the population and giving them little option but to resort to private vendors who charge for it by volume. While there are many examples of people resisting the commodification of water, through creating illegal connections to the piped network or stealing from public taps, there is nonetheless widespread dependency on expensive, purchased water. The uneven commodification of the resource, which most impacts the poorest, therefore perpetuates social inequities that have long been part of the city's history.

Despite the drawbacks of private water vending, it has become a cornerstone of Dar es Salaam's multiple-source water economy. In many ways, it embodies the resilient spirit of Bongo. Despite the uncertainties and hardships associated with

Dar es Salaam's waterscape illustrates the depth and interconnected nature of these challenges. Climate change will exacerbate rainfall seasonality, producing more intense dry periods and more intense rainfall events during the rainy periods. For the Ruvu watershed, the result will be a heightened risk of pollution from heavy rainfall during the rainy seasons, but an overall decrease in runoff that will increase water stress to the city as well as to Morogoro, Kibaha, and Dodoma. The reduction in available clean surface water will force a greater reliance on groundwater, which is itself under threat. Over the past several decades, the aquifer under Dar es Salaam has been threatened by saltwater intrusion, resulting from overextraction of fresh water.[45] Rising sea levels will exacerbate this phenomenon, leaving many existing boreholes with water too salty for consumption, limiting the viability of new boreholes, and forcing populations away from low-lying areas that are prone to flooding or lack access to drinking water. The problems posed by climate change dovetail with the challenge of continued population growth. If its current rate holds (around 5 percent per annum), the population will reach 13.4 million by 2030. By 2050, it could exceed twenty million. The city's growth will likely be exacerbated by the negative impacts of climate change in rural areas, resulting in even greater rural-urban migration, which could increase the service gap at the same time that urban planners are trying to narrow it. This is a problem faced by other African cities as well, including Lagos, Kampala, Nairobi, and Maputo.

How does one build a modern water infrastructure for a city that has a history of uneven development and is growing faster than pipes can possibly be laid? Part of the answer lies in leveraging Bongo's history of creative adaptation in the face of urban challenges. The city has grown by leaps and bounds despite the fact that its government has been unable, and at times unwilling, to provide adequate, safe, and reliable water to its people. It has done so through local initiative and with the knowledge and practice generated by local communities in response to the challenges they face. Despite the many drawbacks of these solutions, they embody the Bongo spirit of flexibility and dynamism.

Yet the solutions cannot be strictly local. The tandem of climate change and population growth will continue to strain existing water sources, necessitating large-scale projects that will bring in more water from the countryside. The best prospect for successful water development seems to be at the intersection of the formal and informal, the large-scale and community-based. While much of the

of water supplies (such as discouraging illegal connections and encouraging compliance with payment schemes). In short, the best strategy may be for the Tanzanian government, the World Bank, national development agencies, and NGOs to direct more resources to community projects that draw on local knowledge and expertise, while investing in a modern, flexible, scalable water infrastructure.

Dar es Salaam encourages us to think more deeply about the place of local knowledge and expertise in the development of urban resilience strategies. For over one hundred years, the city has grown and expanded despite the lack of adequate public services, largely through the adaptability, initiative, and dynamism of its people. The need for water, a necessity of life, exemplifies the extent to which communities thrived against the odds. Urban dwellers