

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

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*Global climate change poses a serious threat to the water supplies of the world's cities. This is perhaps no truer than for Dar es Salaam, the largest city and commercial capital of Tanzania. What was eighty years ago a small town of a mere forty thousand residents is today the world's second-fastest growing city, with a population of more than six million. This growth has come despite a history of racist, colonial urban development and the inadequacy of its formal water supply, which services a fraction of the needs of its residents. This essay examines the development of Dar es Salaam's anthropogenic waterscape, or water infrastructure, and argues that the city's tremendous growth has come despite its inability to provide basic services. In the absence of reliable public water, its residents have adapted creatively, developing their own solutions in a way that has drawn on knowledge and practice from rural areas as well as new urban-centered strategies. This history of creative adaptation, and its benefits and drawbacks, provides a useful framework for thinking about the meaning of resilience in Africa's urban centers in an era of increasing climate uncertainty.*

**D**ar es Salaam, the seaside commercial capital of Tanzania, has recently become Africa's fifth-largest city.<sup>1</sup> Just eighty years ago, the city was a small coastal town with a mere forty thousand residents, an afterthought compared with cities such as Lagos and Johannesburg. Since the 1960s, population growth rates averaging 5 percent have pushed the city to the forefront of Africa's burgeoning urban centers. Now the world's second-fastest growing city, Dar is on track to become a megacity – with a population exceeding ten million – before 2030. One of the most striking aspects of Dar's rise is that it has come without the benefits of much formal planning. Like many cities in the Global South, a large percentage of its population, roughly 70 percent, live in informal settlements. Furthermore, the city has been among the world's worst when it comes to formal water access. Nearly 80 percent of residents lack access to piped water in their homes or plots. For those fortunate to have these private

connections, quality is questionable, reliability is poor, and twenty-four-hour availability is rare. The city's growth has come, in many ways, despite the poor availability of water.

Global climate change poses a serious threat to the water supplies of the world's cities. This is especially true for African cities such as Dar es Salaam, which have experienced high rates of population growth amid endemic poverty and histories of racist, colonial urban development. The term "resilience" has become popular in the literature to describe the process of preparing urban spaces and their populations for the challenges that will inevitably come from higher temperatures, rising sea levels, and lower precipitation. Yet as some scholars have noted, the term itself is poorly defined, existing definitions are inconsistent and underdeveloped, and the expression has not adequately taken into account the question of context: resilience for whom and to what, when, where, and why?<sup>2</sup> The case of Dar es Salaam adds an additional question to these interrogations of the term. If resilience is inherently about the need for adaptation, how do we account for, and possibly leverage, the long history of adaptation shown by urban dwellers? Might part of the solution to developing a more resilient Dar es Salaam lay in its past?

This essay proposes an answer to these questions by analyzing the history of Dar es Salaam's anthropogenic waterscape. This term refers to the human-built water infrastructure of the city: the amalgamation of formal and informal waterworks, both surface and subsurface resources, and the social structures that manage them. This essay argues that the history of the city's development is one of creative adaptation in the face of inadequate provision of public services. The lack of adequate water service (as well as other amenities) dates to the city's founding as a segregated space under colonial rule and was perpetuated by post-colonial policies that favored rural over urban development. Dar es Salaam's water system, designed from the start to provide water unevenly, has not scaled to meet the needs of new users, and has become increasingly unreliable to existing ones. Yet the ineffectiveness of Dar's formal water system has not hindered urban growth. Rather, urban communities have employed a number of strategies to ensure sufficient water to survive, if not thrive. The most recent of these approaches is private vending, which provides the predominant supply of water to the rich as well as to the poor. This spirit of adaptation is embodied in the city's nickname, *Bongo*, a term that implies cunning and street smarts. While these innovations have allowed the city to grow astronomically, they have not come without drawbacks, such as high cost, low rates of consumption, and related health impacts. Dar's changing waterscape, a case study in urban adaptation, thus indicates a need to rethink notions of resilience in a way that recognizes the long history of Africa's urban populations adapting to difficult and changing circumstances.

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.<sup>3</sup> Centered on a large natural harbor, it was named Dar es Salaam, a name likely derived from the Arabic for "Harbor of Peace."<sup>4</sup> In the late 1880s, the town came under the control of the German East Africa Company and, on January 1, 1891, became the capital of German East Africa. Under German control, the town grew rapidly as a center of colonial and military administration. Its commercial fortunes came more slowly, but with the completion of the Central Line of the railway in 1914, Dar es Salaam emerged as the most economically important town in the colony.

As a coastal town, Dar es Salaam was defined by its natural waterscape. Its predominant maritime feature, and reason for being, was its natural deep-water harbor. The rest of its coastline blended sandy beaches and mangrove swamps. While a number of small freshwater streams passed through on their way to the ocean, the town did not feature a major river or large lake. Rainfall was one of the most abundant sources of freshwater. As for much of the coast, rain fell in a bimodal pattern, with a long season from March to May, and a shorter season spanning October and November. This meant that freshwater availability was highly uneven, with periods of alternating abundance and scarcity. The most abundant source of freshwater was the Dar es Salaam Quaternary Coastal Aquifer, lying underneath the region.<sup>5</sup> By the turn of the century, this source of groundwater had become the primary source of drinking water for the burgeoning town, made available through springs and man-made boreholes.

Like most colonial cities, Dar es Salaam developed as a segregated urban space. The town's initial footprint consisted of three concentric zones: a commercial and administrative core, surrounding shamba fields, and outlying villages.<sup>6</sup> These divisions reflected not only the use of the land, but also the people who lived there (ruling class, unfree labor, and peasant). With the town's swift growth at the turn of the century, the Germans developed a formal plan for urban development in 1914. According to historian James Brennan, the German Building Code called for the city to be divided into three zones based on racial categorization: one for Europeans, one for Asians, and one for Africans.<sup>7</sup> Each zone would be developed according to different building and sanitary standards. The plan remained on the drawing board due to the onset of World War I. In 1916, German East Africa came under the effective control of the British, and after the war, it became the Tanganyika Territory, a League of Nations Mandate under British administration. The new government largely adopted the plan developed by the Germans, using building and sanitation codes to create a Dar es Salaam with three areas: a

Zone I for European residences, a Zone II for government and commercial buildings and Asian residences, and a Zone III for “native” quarters, separated from the other two zones by a three-hundred-yard sanitary “neutral zone.”<sup>8</sup> Conformity to building standards, rather than legalistic segregation, proved the main tool for building this divided urban landscape.

The city’s segregated development can be seen in the making of its anthropogenic waterscape. For its first fifty years, it lacked a public water supply. Rather, urban dwellers relied on unprotected surface resources, cisterns, and boreholes. The uneven nature of development and the absence of regulation, combined with the lack of sewerage, meant that water quality was questionable even in the wealthiest neighborhoods. In 1919, the town opened its first public water system. The Gerezani works consisted of four wells from which water was piped to users primarily in Zones I and II.<sup>9</sup> This small scheme proved vulnerable to seepage and salt-water intrusion, and quickly proved inadequate in terms of scalability. In 1951, the city commissioned a new supply at Mtoni, just south of the city.<sup>10</sup> Like its predecessor, this system mainly supplied neighborhoods in Zones I and II, as well as limited areas in Zone III. In the late 1950s, the city augmented Mtoni by developing a new supply from the Ruvu River, 65 kilometers to the west. This represented the first time the city procured water from the rural periphery. The Upper Ruvu works, designed with a capacity of 18,000 cubic meters of water per day, consisted of an intake, a treatment facility, and a cast-iron transmission pipe that carried water to the city.<sup>11</sup> Though the system produced some water meant for formal African areas, such as Kariakoo and Ilala, the bulk of the water went to commercial and government users, as well as residents of European and Asian neighborhoods such as Upanga, Oyster Bay, and Msasani.<sup>12</sup>

African residents of Dar es Salaam were for decades a second thought when it came to the city’s water infrastructure. This mirrored the history of urban planners neglecting formal planning in areas designated for African settlement, a pattern common in many African colonial cities. The decision to prioritize Zones I and II had an impact not only on the service area, but also on consumption. Figures for the city’s Public Works Department show that between 1933 and 1938, Africans consumed just 3 – 4 liters of water per day, compared with 140 – 195 liters for Europeans and 34 – 65 liters for Asians.<sup>13</sup> Despite this, the African population of the city grew substantially over the first half of the century. Whereas the European population rose from one thousand to five thousand between 1940 and 1957, and the Asian population from under nine thousand to more than thirty thousand, the African population grew from 34,750 to 93,363.<sup>14</sup> This occurred in part from the rising population within Zone III, but more so due to the incorporation of polities beyond the formal boundaries of the city: peri-urban villages, such as Mikoroshoni and Buguruni, as well as informal settlements. These communities became thriving population centers without the benefits of formal planning or public goods.

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.<sup>15</sup> 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.<sup>16</sup> In terms of overall population, the city grew from 128,000 residents in 1957 to 151,000 in 1963 and 800,000 in 1978.<sup>17</sup> 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.<sup>18</sup> 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).<sup>19</sup> 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.<sup>20</sup> 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.<sup>21</sup>

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), felt that the country's future lay in transforming rural areas into the heart of development. In 1967, the government issued the Arusha Declaration, which laid out an ambitious economic policy called *Ujamaa*.<sup>22</sup> Through *Ujamaa*, Nyerere aimed to recreate the economy along the lines of African socialism, with cooperative villages becoming the locus of agricultural export production. This new policy led to the redirecting of resources to rural areas, most notably through a villagization scheme known as *Ujamaa Vijijini*, which established new planned villages throughout the country complete with schools, health clinics, water, and electricity.<sup>23</sup> As an incentive for people to relocate, the government's newly created Water Development Department embarked on a massive rural water development program, the Rural Water Supply Program. Furthermore, the government promised to provide water to rural users for free. The Free Water Policy became a cornerstone of rural development policy in the 1970s.

By comparison, urban areas received much less attention. For Dar es Salaam, the most significant water project during the period was the development of a

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.<sup>24</sup> 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.<sup>25</sup> This followed a year after TANU embarked on a program of “decentralization,” whereby it reorganized the structures of local governance inherited from the colonial administration. For Dar, this resulted in the abolition of the town council and its replacement with three district councils: Ilala, Kinondoni, and Temeke.<sup>26</sup> This fragmented city governance made it difficult to deal with problems (such as water provision) requiring coordination at the city or regional level. At the same time, the national government replaced local taxes with a direct government tax, which gave it more control over city finances. For a four-year period, the three municipal budgets were essentially frozen. This starved the city of needed resources, in particular for infrastructure maintenance, which resulted in the deterioration of the water system. The government reversed course in 1977 with the creation of a Water Board for the city, and again in 1981, with a new parastatal called the National Urban Water Authority (NUWA).<sup>27</sup> However, these initiatives did little to solve for the systemic problems that had been created.

These changes had the effect of stifling infrastructure development in Dar es Salaam at the same time that the city was experiencing exponential growth. The lack of resources allocated to formal water development resulted in systemic problems. For one, urban planners did not have the resources to expand the system to reach the growing base of potential users. Users in the wealthier, northern neighborhoods of the city received better access to the infrastructure improvements than others. Second, the fracturing of city governance and the lack of resources contributed to a maintenance crisis. Older parts of the system experienced more frequent failures due to breakage and corrosion. Lastly, payment collection became less efficient, due in part to poorly staffed offices, but also to the lack of desire of residents (in particular, recent migrants from the countryside) to pay for unreliable water. This reflected a problematic divide in the nation’s water policy, whereby urban users had to pay for a resource given to rural residents free of charge.

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."<sup>28</sup> 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, communities developed multiple-source water economies by which they procured water from different locations, for different purposes, over the course of the year.<sup>29</sup> This practice acknowledged environmental factors such as seasonal variability and the unpredictability of rainfall, where certain streams and springs, as well as rainwater catchment, might be available at only certain times of the year. It also reflected the role of personal preference, where users preferred water with certain characteristics (taste, salinity, turbidity) for certain tasks, and made trade-offs based on the distance required for fetching water.

Multiple-sourcing allowed urban users to make use of a range of sources available to them, both naturally occurring and man-made, and also to incorporate new kinds of sources as they became available. In the first half of the century, African neighborhoods had access to up to four types of sources: streams, springs, captured rainfall, and boreholes. In choosing sources, users made decisions based on quality, availability, and the amount of labor required in fetching water (which could consume hours per day). Typically, women organized this work, and therefore held the role as arbiters of the household water supply. Both women and children engaged in the work of fetching water, using either clay pots or metal jerrycans. Boreholes were often the most desirable source, as they generally provided cleaner, more reliable water and could be dug closer to homes, thus requiring less work to fetch. Therefore, neighborhoods tended to be dotted by shallow wells, dug by individual users or as partnerships among several households. By the 1950s, public taps, or standpipes, became more common in formalized African neigh-

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.<sup>30</sup> 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.<sup>31</sup> 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.<sup>32</sup> 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 TSH0.3 per liter.<sup>33</sup> The pattern that emerges is that users in the poorest neighborhoods pay the highest rates for their water, and likewise spend the most time per day fetching it.

Another drawback tied to cost is the relatively low rate of consumption for the city's poorest households. Geographer Sarah Smiley's 2016 study of urban wa-

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,<sup>34</sup> whereas a UNDP report from 2016 found that residents in Oyster Bay, home to many diplomats and expatriates, use an average of 166 liters.<sup>35</sup> 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.<sup>36</sup> 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.<sup>37</sup> 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.<sup>38</sup>

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 *Ujamaa* 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

procuring water, people have made it work. The opportunities associated with urban living simply outweigh the drawbacks. And several studies have shown that, despite the challenges, human development indicators are better for urban populations in Tanzania than for rural ones. Nonetheless, the water situation in Dar es Salaam is far from optimal, and the city's growth raises the question of how much longer these systems will be sustainable.

**M**eanwhile, the national and municipal governments have addressed the city's water supply issues largely through attempts at redeveloping the formal infrastructure. This has been a struggle. Decades of underinvestment in capacity, amid population growth and the nation's near economic collapse in the early 1980s, have resulted in a piped water supply both unreliable and unable to service many neighborhoods. In 1991, the Japan International Co-operative Agency (JICA) released a study on a proposed rehabilitation of the city's water system that highlighted the numerous problems.<sup>39</sup> It noted that the water supply was in "very bad condition – insufficient water supply, low pressure, deteriorated facilities, [and] leakage from pipelines." Some of the specifics were particularly damning. Only 30 percent of the system's water was actually consumed through registered connections, meaning that 70 percent of water was unaccounted for through leakage (35 percent) and illegal connections (29 percent). Few new pipes had been laid since the 1970s, except for a proliferation of narrow-gauge PVC connections to end users that were prone to breakage. The Mtoni works, in particular, was plagued by the worn-out condition of the facilities and a shortage of intake water. JICA's plan proposed a redevelopment of the existing works, with the overall goal of covering 80 percent of the city's existing population with 27 liters of water per capita per day, as well as a reform of NUWA to make it self-sufficient through collection of fees and arrears. Notably, the plan did not expand the footprint of the system, but rather called for the development of a long-term strategy to address the city's growing population.

Though many of the plan's elements were implemented, the system remained plagued by underfunding and poor management, amid growing demand for water. The Tanzanian government sought additional funding from the World Bank and, in the late 1990s, managed to negotiate a long-term rehabilitation loan. The loan included a number of conditionalities, reflecting a broader push by the development community to encourage structural change in Tanzania and other African states. Under pressure from the World Bank, in 1997, the Ministry of Water Affairs transformed NUWA into a new entity, the Dar es Salaam Water and Sewer Authority (DAWASA), and it began developing a plan to privatize the utility. The general thinking was that a private utility could succeed in revenue collection and system rehabilitation in ways that the parastatal had failed. In August 2003, as its population passed 2.5 million, the city leased its water supply to City Wa-

ter Services, a joint venture between British, German, and Tanzanian companies, for a period of ten years.<sup>40</sup> City Water assumed management of DAWASA, with the stated aims of improving revenue collection and rehabilitating infrastructure. Within months, the water situation in the city worsened, with a combination of new breakages, delayed repair and redevelopment projects, tariff increases, and unpopular shutoffs for nonpayment. Less than two years after its inception, the privatization came to an abrupt end with the termination of the City Water contract, the deportation of company leadership, and the filing of multiple lawsuits. The government handed the water supply over to two new parastatals: a reconstituted DAWASA to distribute water and handle payments and DAWASCO (Dar es Salaam Water and Sewage Corporation) to manage infrastructure. The failure of privatization in Dar mirrors the experience of other African cities, notably Johannesburg and Cape Town, where these programs resulted in skyrocketing prices and poorer service.

In the years since the renationalization of the water supply, the performance of DAWASA has been mixed. By some measures, it has made progress in extending the reliability, reach, and quality of piped water. The number of residents with access to piped water within 200 meters of their homes has increased to 75 percent.<sup>41</sup> Hundreds of millions of dollars have been invested by the World Bank and NGOs to improve water infrastructure. And partnerships between community-based organizations and NGOs have led to the improvement of water supplies in a number of informal communities. Yet studies indicate that serious challenges remain. For example, a 2012 survey of users conducted by Tanzanian NGO Twaweza found that 76.9 percent of the city's households lacked access to water via a tap inside their home or plot.<sup>42</sup> And research by Smiley has shown that accepted standards for availability (distance to an improved water supply) and reliability (whether or not water is regularly available) do not adequately reflect the lived experience for many people in Dar.<sup>43</sup> Perhaps the most daunting problem is the continued population growth of the city, which effectively keeps pushing back the goal line.

Looking forward, Dar es Salaam faces a number of challenges related to its water supply. Global climate change poses some of the most daunting. According to a 2018 report by the United States Agency for International Development, Tanzania ranks as the twenty-sixth most vulnerable country to climate risks.<sup>44</sup> The report projects a number of changes to the climate by the year 2050 that include increased average annual temperatures of 1.4 to 2.3 degrees Celsius, increased duration of heat waves and dry spells, increased frequency and intensity of heavy rainfall, and a rise in sea levels of between 15 and 42 centimeters by the 2050s. These changes will in turn threaten agriculture, ecosystems, energy production, infrastructure, and human health, as well as the availability of water resources.

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.<sup>45</sup> 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 World Bank's funding has targeted the formal water supply, some of the most impactful developments (such as community boreholes in informal settlements) have been done by partnerships between local communities and NGOs. In some areas, local Water User Associations have been developed to facilitate local engagement with the water supply. These groups have the ability not only to lead to more relevant development projects, but also to change community perceptions

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.

**D**ar 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 built a dynamic, thriving urban life without the benefit of the expansive, formal water infrastructures common in the cities of the Global North. Despite the drawbacks of these solutions, they nonetheless represent a capacity for local innovation that should be part of urban resilience strategies. While the challenges posed by climate change are indeed serious, they can be made more manageable by leveraging not only new innovations but also the city's spirit of creative adaptation.

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#### ENDNOTES

- <sup>1</sup> Jonathan Rosen, "This Tanzanian City May Soon Be One of the World's Most Populous. Is It Ready?" *National Geographic*, April 5, 2019.
- <sup>2</sup> Sara Meerow, Joshua Newell, and Melissa Stults, "Defining Urban Resilience: A Review," *Landscape and Urban Planning* 147 (2016): 38–49.
- <sup>3</sup> James Brennan and Andrew Burton, "The Emerging Metropolis: A History of Dar es Salaam, Circa 1862–2000," in *Dar es Salaam: Histories from an Emerging African Metropolis*, ed. James Brennan, Andrew Burton, and Yusufu Lawi (Dar es Salaam: Mkuki na Nyota, 2007), 16–18.
- <sup>4</sup> There is some ambiguity as to the meaning of the name. While Brennan and Burton assert that the city's name is a contraction of *bandar as-salam*, which translates to "harbor of

peace,” others have claimed that the name is literal, *dar as salaam*, which means “house of peace.”

- <sup>5</sup> Yohana Mtoni, “Saltwater Intrusion in the Coastal Strip of Dar es Salaam Quaternary Aquifer, Tanzania” (Ph.D. diss., Ghent University, 2013).
- <sup>6</sup> Brennan and Burton, “The Emerging Metropolis,” 21.
- <sup>7</sup> James Brennan, *Taifa: Making Nation and Race in Urban Tanzania* (Athens: Ohio University Press, 2012), 29.
- <sup>8</sup> Ibid.
- <sup>9</sup> Japan International Cooperation Agency, *The Study of Rehabilitation of Dar-es-Salaam Water Supply in the United Republic of Tanzania, Final Report* (Dar es Salaam: Japan International Cooperation Agency, 1991), 2.18. For more background on the development of the city’s formal water supply, see Valerie Messer, “Water Management—Institutional Weaknesses and Urban Answers: Towards a New Urbanity?” in *From Dar es Salaam to Bongoland: Urban Mutations in Tanzania*, ed. Bernard Calas (Dar es Salaam: Mkuki na Nyota, 2010), 279–311.
- <sup>10</sup> United Republic of Tanzania, Ministry of Water, Dar-es-Salaam Water and Sewerage Authority, “Mtoni Water Supply System,” <https://www.dawasa.go.tz/en/pages/mtoni> (accessed December 28, 2020).
- <sup>11</sup> United Republic of Tanzania, Ministry of Water, Dar-es-Salaam Water and Sewerage Authority, “Upper Ruvu Treatment Plant,” <http://demo.egatest.go.tz/dawasa/en/pages/ruvu-juu> (accessed December 28, 2020).
- <sup>12</sup> Messer, “Water Management,” 280–281.
- <sup>13</sup> Cited in J. M. Lusugga Kironde, “Race, Class and Housing in Dar es Salaam: The Colonial Impact on Land Use Structure 1891–1961,” in *Dar es Salaam*, ed. Brennan et al., 106.
- <sup>14</sup> Brennan and Burton, “The Emerging Metropolis,” 44.
- <sup>15</sup> Alphonse G. Kyessi, *Community Participation in Urban Infrastructure Provision: Servicing Informal Settlements in Dar es Salaam, Tanzania* (Dortmund: SPRING, 2002), cited in Wakuru Magigi, “Urbanization and Its Impacts to Food Systems and Environmental Sustainability in Urban Space: Evidence from Urban Agriculture Livelihoods in Dar es Salaam, Tanzania,” *Journal of Environmental Protection* 4 (10) (2013). See also Method Gwaleba, “Urban Growth in Tanzania: Exploring Challenges, Opportunities and Management,” *International Journal of Social Science Studies* 6 (12) (2018).
- <sup>16</sup> Peter Siebolds and Florian Steinberg, “Tanzania: Sites and Services,” *Habitat International* 6 (1/2) (1982).
- <sup>17</sup> Charles Mkalawa and Pan Haixiao, “Dar es Salaam City Temporal Growth and its Influence on Transportation,” *Urban, Planning and Transport Research* 2 (1) (2014).
- <sup>18</sup> Brennan and Burton, “The Emerging Metropolis,” 53.
- <sup>19</sup> Ibid. See also Andrew Burton, “Urbanization in Eastern Africa: An Historical Overview, c. 1750–2000,” in *The Urban Experience in Eastern Africa*, ed. Andrew Burton (Nairobi: British Institute in Eastern Africa, 2002).
- <sup>20</sup> Fikreselassie Kassahun Abebe, “Modelling Informal Settlement Growth in Dar es Salaam, Tanzania” (M.S. thesis, University of Twente, The Netherlands, 2011), 14.
- <sup>21</sup> Brennan and Burton, “The Emerging Metropolis,” 53–54, 65.

- <sup>22</sup> For a summary, see Michael Jennings, "Ujamaa," in *Oxford Research Encyclopedia of African History* (Oxford: Oxford University Press, 2017), <http://doi.org/cwtr>.
- <sup>23</sup> Emily Brownell, *Gone to Ground: A History of Environment and Infrastructure in Dar es Salaam* (Pittsburgh: University of Pittsburgh Press, 2020), 18.
- <sup>24</sup> Messer, "Water Management," 289; and United Republic of Tanzania, Ministry of Water, Dar-es-Salaam Water and Sewerage Authority, "Lower Ruvu," <http://demo.egatest.go.tz/dawasa/en/pages/ruvu-chini> (accessed December 28, 2020).
- <sup>25</sup> For more on Dodoma, see Brownell, *Gone to Ground*, 20–23.
- <sup>26</sup> *Ibid.*, 30; and Messer, "Water Management," 281.
- <sup>27</sup> Messer, "Water Management," 286.
- <sup>28</sup> Brownell, *Gone to Ground*, 5.
- <sup>29</sup> For more on multiple-source water economies, see Matthew Bender, *Water Brings No Harm: Management Knowledge and the Struggle for the Waters of Kilimanjaro* (Athens: Ohio University Press, 2019).
- <sup>30</sup> Marianne Kjellen, "Complementary Water Systems in Dar es Salaam: The Case of Water Vending," *Water Resources Development* 16 (1) (2000): 144–145; and Kate Bayliss and Rehemata Tukai, *Services and Supply Chains: The Role of the Domestic Private Sector in Water Service Delivery in Tanzania* (New York: United Nations Development Program, 2011).
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- <sup>32</sup> Kjellen, "Complementary Water Systems," 150.
- <sup>33</sup> *Ibid.*, 151–152.
- <sup>34</sup> Sarah Smiley, "Water Availability and Reliability in Dar es Salaam, Tanzania," *The Journal of Development Studies* 52 (9) (2016): 1322.
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