



## City profile

# Motion but no speed: Colonial to post-colonial status of water and sanitation service provision in Mombasa city

Justus Kithiia<sup>a,b,\*</sup>, Gamoyo Majambo<sup>b</sup>

<sup>a</sup> School for Field Studies, 100 Cummings Center, suite 534g, Beverly, MA 01915, United States of America

<sup>b</sup> Coastal and Marine Resources Development I Bamburi, 2nd Avenue, Links Road, Nyali, Mombasa, Kenya

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## ABSTRACT

Amidst climate change, coastal cities in Africa will face serious water and sanitation problems owing to the predicted flooding of coastal land and saltwater intrusion into freshwater aquifers. For cities such as Mombasa, the problems will be further compounded by high prevalence of informal economies and settlements superimposed on western style governance systems. Yet, right from colonisation to the present day, the water supply and sewage systems have been characterised by a series of inequalities in access. This review paper, discusses the water and sanitation backlogs in the coastal city of Mombasa, tracing them from the colonial times to the post-colonial period. Against this background, we overview the current situation of the water and sanitation sector in the city and discuss possible sustainable interventions. We argue that any analysis of the water and sanitation challenges must consider the motive of the development of the infrastructure during the colonial times. We conclude that sustainable water and sanitation services are likely to remain a mirage unless the issues of funding, cost recovery, data availability and overall governance are fully addressed. A good understanding of both historical inadequacies and current investments would help in designing sustainable interventions going forward.

## 1. Introduction

African cities have the world's fastest population doubling time. The growth in population increases demand for services, not least the demand for the provision of water and a working sewage system, which are central to proper functioning of every city. Safe drinking water, sanitation and hygiene are fundamental to improved standard of living, and lack of these can have an economic impact of as much as 7% of the GDP, not including the social and environmental consequences (Hutton & Chase, 2016). Yet, the infrastructure for the supply of water and the treatment of sewage and wastewater remains inadequate across African cities. It is no wonder that the continent accounts for the bulk of the 842,000 deaths each year, arising from contaminated or unsafe drinking water, poor sanitation and inadequate hygiene (Mannak, 2019). Climate change and potential outbreak of pandemics will add uncertainty to the already precarious future for the water and sanitation service infrastructure. Solving future water and sanitation challenges in Africa will remain a priority as the urban population is expected to triple by 2050 (Hajjar, 2020).

Most water and sanitation utilities continue to operate aging infrastructure aimed at supplying the city as it once was. The main drawback to service provision is underfunding for capital expenditure. The

expenditure for utilities from other jurisdictions such as India, South East Asia and Australia are approximately 3, 7 and 160 respectively, more than those from African countries (see Table 1) (Jacobsen, Webster, & Vairavamoorthy, 2012). To meet sustainable development Goal 6 by 2030, African will need to invest massively in water and sanitation sectors. Currently, African countries allocate no more than 0.5% of their GDP to the sector and invest only a very small proportion of international assistance in this area (Ndaw, 2020).

An additional challenge is the increasing urbanisation, coupled with weak institutional capacity to expand and maintain water infrastructure, which affects the reliability and quality of water supply (United Nations, 2016). While challenges in service provision remain uncontested at the macro-level, these may differ in magnitude across regions, cities, user types and so on, within the same country. This coupled with differences in levels of development, governance, hydrology and proximity to water sources, create the need to undertake a thorough analysis of the water and sanitation challenges in specific regional, urban or rural areas. For example, while both inland and coastal cities experience water and sanitation challenges, amidst climate change, the potential for coastal areas to subside due to heavy settlement, changing storm intensities and frequencies, risk of flooding, failure of defences, infiltration and inflow of salt water into the water

\* Corresponding author at: School for Field Studies, 100 Cummings Center, suite 534g, Beverly, MA 01915, United States of America.

E-mail address: [justuskithiia@gmail.com](mailto:justuskithiia@gmail.com) (J. Kithiia).

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**Table 1**

Annual average capital expenditure for African utilities.

Source: adapted from World Bank calculations (Jacobsen et al., 2012).

Utility	Av. annual capex per person served (US\$)	GDP per capita in 2006 (US\$)
Kisumu Water and Sewerage Company (KIWASCO) - Kenya	0.03	616
Mombasa Water and Sewerage Company, Kenya	0.13	616
Chipata Water and Sewerage Company (CWASC) - Zambia	0.19	911
National Water and Sewerage Corporation (NWSC), Uganda	1.27	340
Lusaka Water and Sewerage Company (LWSC) - Zambia	1.04	911
Borno State Water Corporation (BSWC), Borno State, Nigeria	3.49	1015
National Water and Sewerage Company (ONEA), Burkina Faso	13.17	395
Senegalese des Eaux (SDE) Senegal	0.24	839
National Water Company of Benin (SONED), Benin	0.66	602
Togo Water Company (TdE), Togo	1.14	398
Average - India	3.06	822
Average, South East Asia	7.02	–
Average, Australia	165.80	36.226

and sanitation infrastructural elements have the potential to compound these challenges (see Arnell et al., 2014). It has been predicted that sea level rise and inland inundation and blockages in natural drainage structure will be exacerbated by the impacts of climate change making these effects more difficult to manage for those water and sanitation utilities that are unprepared and financially weak (Danilenko, Dickson, & Jacobson, 2010).

### 1.1. The coastal city of Mombasa

Located on the edge of the Indian Ocean, the Mombasa is one of the African cities where two thirds of low-income residents have no access to safe and affordable water, and just over half use and improved sanitation facility (WSUP, undated). Home to 1.2 million people (KNBS, 2019) and the country's foremost tourist city, the city is strategically located to service the interior through importation and exportation of goods. It is not only Kenya's second largest city after Nairobi, but is also one of the 47 counties, which are geographical units of devolved governments. Being a port city, it plays a significant role in the economies of Kenya and other neighbouring landlocked countries, including Uganda, Rwanda, Burundi and South Sudan.

The city faces water and sanitation challenges due to its coastal location, however, these are compounded by the prevalence of informal economies and settlements superimposed on formal western style governance systems (see Dodman, Leck, Rusca, & Colenbrander, 2017). The combination of lack of technical skills, political will and resource allocation makes it difficult to meet the water supply deficits and to expand sewage coverage to all city residents. These challenges have defied the passage of time, being rooted in the pre-independence design, installation and operation of the infrastructure and persisting right through Kenya's independence to the present time. Considering the population and the needs of the harbour and the tourism industry, the demand for water and sanitation services is, and has always been, very high.

The available information on the water and sanitation situation in Mombasa is unanimous in describing the challenges faced by this sector. However, there is a dearth of published literature, with much of the information found in grey literature, namely, government documents and World Bank reports. The information is fragmented, and there is lack of analysis on how the water and sanitation challenges have come about, and how they can be sustainably addressed, given the city's importance to the economies of Kenya's and the surrounding region. A thorough understanding of the issues relating to water and sanitation in Mombasa, from as far back as pre-independence times to the present day, would help address the systemic impediments to progress. Examining past and current factors such as funding policies, effectiveness of interventions and approaches to service delivery, would inform decision-makers to rethink broader institutional policy frameworks that

would, among other things, accelerate sustainable progress towards achieving the UN Sustainable Development Goal 6 (SDG:6); that is, *equitable access to safe and affordable drinking water and adequate sanitation for all* (see, United Nations, 2015).

In view of the above, this review paper evaluates the water and sanitation services in Mombasa from the colonial to postcolonial periods. It further draws from past experiences and uses insights from best practices to discuss sustainable strategies for water and sanitation service provision in the city. The thesis of the review is that water and sanitation challenges were bred during colonialism, sustained in the post-colonial times and continues to present as organised chaos to date. Hence, to discuss the current challenges of water and sanitation in Mombasa without reference to the motive of the development of the infrastructure during the colonial times is to make a conceptual mistake. The water and sanitation services backlogs, including the current skewed distribution which favour the well to do formal settlements and business can be explicitly attributed to the creation of the colonial society (see Acemoglu, Johnson, & Robinson, 2005). It is not our claim that the challenges of the contemporary water and sanitation infrastructure and services are wholly attributable to the inherited inventory. Instead, we trace the current backlogs to historical fundamentals which informed the development of the water and sanitation infrastructure during colonial times. We argue that these historical fundamentals have neither been challenged nor have efforts been made to robustly address them in the post-colonial period. Examining the water and sanitation infrastructure development and services ab initio would help in understanding the nature, scale and possible solutions to the present challenges. Reference to both issues of historical inadequacies and current investments in the physical environment would in turn enhance our understanding of the issues of sustainability today.

## 2. Review approach

The review adopts a descriptive qualitative meta-analysis in the review of relevant literature. A meta-analysis uses qualitative findings reported in previous studies as building blocks for gaining deeper understanding of a phenomenon (see Chertok & Haile, 2018). We confined our searches to Scopus and google.com and used terms related to water and sanitation service provision. Using a line argument technique, we identified different aspects of the literature on water and sanitation services in cities, in order to come up with new interpretations.

Additional information on the current status on water and sanitation services in Mombasa was obtained during a meeting with the Department of Water, sanitation and Natural Resources and the Mombasa Water and Sewerage Company (MOWASCO) held in November 2019. Complementary information was obtained through direct observation of water and sanitation services in the city, in an exercise consistent with piloted ground truthing. The findings of

multiple qualitative information on water and sanitation has the benefit of providing insights into the reasons why interventions have succeeded or failed to succeed (Atkins, Lewin, Smith, et al., 2008). Hence, the review could inform the implementation of interventions and programmes on water and sanitation in the city county of Mombasa.

### 3. Pre-independence water and sanitation infrastructure and service provisioning

In this review the discussion on water and sanitation infrastructure development and service provisioning in Mombasa during colonial times is not uncritically based on the hegemonic dependency traditional theory, whereby the activities of colonial powers and colonial rule are viewed as an episode of the marginalisation of Africa (Njoh & Akiwumi, 2011). It is also not based on the liberal theorists' romanticised view that the African continent would have been worse off without colonialism (see Bauer, 1972; Gandy, 2006). Rather than concern ourselves with the worldviews expressed by these two theories, we adopted a pragmatic critical meta-analysis of the relevant literature on colonial experiences with the water and sanitation service provision in the city.

Mombasa has a very long history of settlement. By the time of British arrival in the east coast of Africa, a town of some size had stood on the island for hundreds of years (Wills, 1995). From the late 1880s Mombasa underwent an abrupt transformation becoming the main port and the administrative centre; first for the Imperial British East Africa Company (IBEAC), the administrator of Uganda protectorate and the British East Africa, and then of the British East Africa Protectorate. IBEAC had received the Royal charter to promote trade and commerce in areas of British control (Mazrui, 2017).

The construction of the Kenya-Uganda railway saw Mombasa become the principal port of the region, servicing the upcountry areas of the British East Africa (Wills, 1995). The effect of this on the local demand for water was quite dramatic in a city which had long relied on wells drawing on the coral rock of the island. While water from the wells was quite enough for a pre-colonial population which varied between 10,000–19,000 people, it was insufficient to cater for the increasing commercial and industrial demands associated with the railway line and the shipping activities, all of which were spearheaded by the British through IBEAC. The need to explore alternative sources of water was captured in a report by a committee formed in 1908 to look into the water problem in Mombasa. The committee found that the local wells were strained beyond their limits, as 120,000 gal of water were pumped from them each day (Radford, 1908). Earlier in 1906, a scheme to develop a deep-water pier at Mombasa's Kilindini harbour had been shelved due to the absence of a good supply of water (Minutes of a Meeting of Mombasa Water Committee, 1908). Alternative sources of water were necessary, not only to cater for commercial and industrial uses, but also because water from the wells was not considered safe. The quality of the water was so poor that it was reported to have damaged locomotive engines (Cribb, 1907). However, as Nilsson (2016) asserts when writing about the water supply situation in Kampala, while the development of the water infrastructure was mainly justified on grounds of commercial and industrial interests, it was also driven by the colonialists' quest for European-style modernisation to which water and sanitation systems was central.

The imperial government's response in addressing the water problem in Mombasa was to allocate a sum of £90,000. This funding was aimed at piping water to Mombasa Island, from Shimba Hills to the Southwest, which would supply 700,000 gal (2650 m<sup>3</sup>) per day. The biggest challenge was that the pipeline would cross about 25 km of broken roadless terrain to reach the Island. Consequently, the project required a large and steady supply of manual labour. The local population defied all efforts to recruit them for contract wage labour for two main reasons. First, they had been used to alternative means of earning cash through their involvement in the Indian Ocean networks of capital, started way back before British rule, and secondly, it was a means of

undermining colonial control. This led to the use of coercive force whereby local administrators recruited people to work on the pipeline by force. While the discussion on forced labour is beyond the scope of this paper, relevantly, this historical factor continues to influence the city officials' attitudes towards working in the water and sanitation sector to-date. During our meeting with the officials from the department of Water, Sanitation and Natural Resources and Mombasa Water and Sewerage Company (MOWASCO), we were informed of how officers who are moved to the department view their transfer as a form of punishment or a demotion. This is especially the case if the said officers are allocated sanitation management duties.

Despite initial setbacks, the pipeline reached the island around 1916 and by 1917 work had begun on the networks for the supply of pipes around the island, with water flowing from the domestic customer's taps in 1918 (Wills, 1995). In 1950s a 220 km gravity transmission line was built from 220 Mzima springs (World Bank report, 1999). The city's sewer system was constructed in early 1960's to serve the privileged few, but was already over congested and a source of annoyance by the 1990's (see Kithiia & Dowling, 2010). Furthermore, any technological consideration in developing the infrastructure was based on European practices of modernity, with little regard for local peculiarities.

Both the water supply and sewage systems were characterised by a series of inequalities in access, as colonial investment decisions were mostly driven by metropolitan capitalism concerns and interests. Racism was combined with economic interests to undermine efficiency of water and sanitation infrastructure as it was not in the best interest of the British to supply the locals with clean water and sewage systems. Access to services was skewed towards the master and any benefits which accrued to the residents were unintended. The skewed distribution perpetuated what Palmer and Parsons (1977) refer to as the 'dual economy', a situation that relegated locals to the informal less serviced areas, and the masters to formal well-planned and serviced neighbourhoods. However, Mazrui (2017) explains that the British used pyramidal racial structure in important economic, social and political domains. While the structure disadvantaged every colonial subject, it privileged Kenyans of Indian descent over other non-European Kenyans living in Mombasa.

The dual economy, as explained by Palmer and Parsons (1977), and the pyramidal racial structure used in the provision of services were captured in a letter written by C. Ojwando-Abour, a journalist who doubled as the Secretary to the then Mombasa African Traders Association (MATA) in May 1960. The letter, which was addressed to the then Town Clerk stated that the municipal authorities were complicit in the creation of urban economy whereby Arab traders were advantaged over Africans. It accused the council of standing by and watching the suffering of the Africans with great negligence (Smart, 2017). The letter pointed to the government's hypocrisy in how it demanded rigid sanitary requirements and charged high licensing fees while also having African vendors and hawkers operate in quite insanitary conditions at the municipal markets and canteens. In conclusion the scathing letter criticized the way Mombasa racialized class structure infused municipal politics (Ibid).

Colonial racism paved the way for post-colonial classism whereby poor people living in the informal settlements are disproportionately affected by the water and sanitation backlogs. This has further entrenched 'politicized ethnicity' that link the poor to the middle class up the chains of dependency that connect them to governing elites, which consequently sharpens the sense that liberation from underdevelopment comes through identity politics rather than the right to access services (see Ajulu, 2002).

### 4. Carry over of inertia from colonial to post-colonial period

The end of colonialism bequeathed to colonies huge inequalities in service delivery. After Kenya attained her independence in 1963, it was business as usual in water and sanitation service provision in Mombasa.

The colonial legacy of discrimination in the provision of the water services continued to linger. A good example of the continuing discrimination is found in the post-independent *Water Act* of 1972, where a subsidiary rule stipulated that the quantities allowed for domestic use would be 50 and 10 gal per day per head for non-Africans and Africans respectively (Shurie, Mwaniki, & Kamari-Mbote, 2017). With time, the pyramidal racist structure in the provision of services was replaced by class discrimination which continued to legitimise social inequalities through failure to address lack of access to poor informal settlements.

Successive national and Mombasa city authorities have directed no efforts in innovating and adapting the inherited colonial technological paradigms to better suit local and current social-economic contexts. Instead, they have continued to use the inherited large-scale systems. The dual economy phenomenon still persists, with old norms being preserved, and increasing informality leading to less and less access to water and sanitation services to the urban poor. The water and sanitation backlog underpin a growing disjuncture between the city as strategic international and regional hub and the dilapidated state of its water and sanitation infrastructure. Increased population and economic activities have changed the scale and scope of demand for these services, at one time bankrupting, the National Water Conservation and Pipeline Corporation (NWPC) (World Bank, 2011) then Kenya's premier peak body responsible for the provision, management and regulation of water prior to 2002 reforms.

Since independence in 1963, there have been promises, declaration and vision statements to provide water for all. For example, in 1977 Kenya's founding president, Mzee Jomo Kenya, promised water for all Kenyans. In 2014, the national Water Conservation and Pipeline promised that all Kenyans would have piped water by 2020 (see Daily Nation (Kenya), 1977, 2014). Despite efforts and declarations to improve services, these have not kept up with population growth and urbanisation. Thompson, Porras, Katui-Katua, Mujwahuzi, and Tumwine (2003) report that water service levels from large scale systems in East African cities, including Mombasa, had declined considerably between 1960s and the end of 1990s. An inherent feature of large-scale water and sewage systems is a certain amount of resistance to change inertia by decision makers. Consequently, the range of technical and policy options for today's decision makers is strongly influenced by decisions made earlier in time (see Nilsson, 2016).

The 1974 National water master plan aimed at ensuring the availability of portable water at reasonable distances to all households by the year 2000. However, even this water master plan did not live to its promise in as far as increasing the Mombasa water supply is concerned. Later, the government realised that due to funding shortfalls, it could not deliver water to all Kenyans by the year 2000 without involving other actors. This led to a process described as 'handing over', where the government handed over the water supply to other actors (Mumma, 2005), specifically the donor agencies. Those sector reforms of 1990s and 2000s proved unhelpful to the urban poor who still lack access to the large-scale piped water systems (see Collignon & Vézina, 2000; Dagdeviren & Robertson, 2009).

The water and sanitation backlog in Mombasa continue to provide some of the most striking manifestations of the city's worsening infrastructure. The available volume of water has remained quite low and requires costly transfer from its distance sources (see Fig. 1). Similarly, the city's sewage coverage is dismal and has remained so for a long time. Even residents and business with water connection must contend with high frequency of intermittent supply with water rationing being a permanent feature. This increases the chances of contamination. Like in many other cities in Africa, tap water is not safe for drinking. Hotels, restaurants, food kiosks and other eateries have long stopped providing customers with free drinking water. The general expectation is that customers will purchase bottled water. Many city residents depend on boreholes, water tanks, street vendors and various illegal connections. The informal settlements are the most affected by lack of water and sanitation services. They draw their water from polluted wells or rely

on street vendors whose source of water cannot be ascertained as there is no quality control. Where attempts to connect the informal settlements with piped water are made, these are usually sabotaged by cartels who benefit from the unequal distribution, but also by what Gandy (2006) calls 'micro-circuits' of exploitation, which characterise slum life.

The increase in funding for the urban water and sanitation services have not resulted into better services, quality and equity of distribution of these services. For example, a 2011 World Bank Ministers' Council on Water (AMCOW) country status overview, stated that financial allocations to the main sector ministry had increased 6-fold since 2003/2004 while development partners funding have quadrupled since 2006/2007. However, tangible increase in coverage, quality and equity of water supply and sanitation is yet to be realised in Mombasa. Earlier in 1999, a review of the implementation of the \$50.7 Million World Bank funded second Mombasa and coastal water supply Engineering & Rehabilitation project (1992–1996) stated that:

*"The likelihood of a follow-up water supply and sanitation project that would significantly improve the service in Mombasa and the Coastal Region and effectively use the technical feasibility studies financed by the Project is uncertain in the absence of a credible plan for improving National Water Conservation & Pipeline Corporation's (NWCP) performance, probably involving private sector participation in delivery of services."*

Successive municipal and county governments have ignored the effect of obsolescence in the city. To paraphrase Lemer (1996), the most important question was not addressed when the water and sanitation infrastructure was put in place, that is, how long should the infrastructure last?

The colonial era development of water resources was guided by colonial water ordinances of 1902 and 1929 as well as the water rules of 1903. The colonial state used these permitting rules to exert stricter control over water claims. Following independence, the 1974 national water master plan upgraded the department of water to a full ministry, and formulated cost recovery principles with a slogan water for all by the year 2000 (Nyanchaga & Ombongi, 2007). None of these cost recovery principles has ever been implemented in Mombasa. Budgetary constraints brought by debt crisis and the structural adjustment programmes of the 1980s led to the government shifting from constructing new infrastructure to rehabilitating and privatisation of services as a condition for future funding (Shurie et al., 2017). Consequently, the 1980s, waste resources development and access became aligned with international development agendas (Sambu & Tarhule, 2013), the current of which is the Sustainable Development Goals (SDGs), whose goal 6 is to ensure access to water and sanitation for all.

After missing the target of universal access to water by the year 2000-the *Water Act, 2002* was enacted in 2002. The aim of the Act was to effect fundamental changes to the water sector in order to meet the Millennium Development Goals (MDGs), the predecessor of SDGs. The measures included putting in place clear institutional frameworks. Among other institutions, the Act created the Water Regulatory Management Authority (WRMA) to regulate the management and use of water resources in Kenya. It further created the Water Regulatory Services Board (WRSB) to regulate water services provision. Later, the enactment of *Water Act 2016* put water service provision in the hands of regional Water Service Boards (WSB) in line with the Constitution of Kenya 2010. Ideally, the WSB contracts water service providers such local authorities, communities and so on, to provide water and sanitation services within their jurisdictions. The Water Trust Fund became the funding institution for water projects. In Mombasa, the city government provides water under the Mombasa Water and Sewerage Company (MOWASCO) (Shurie et al., 2017; *Water Act, 2002*). Through these changes, the national government removed itself from water provision, opting to assume responsibilities for regulation.

Changes in policies as well as structural changes over the years do



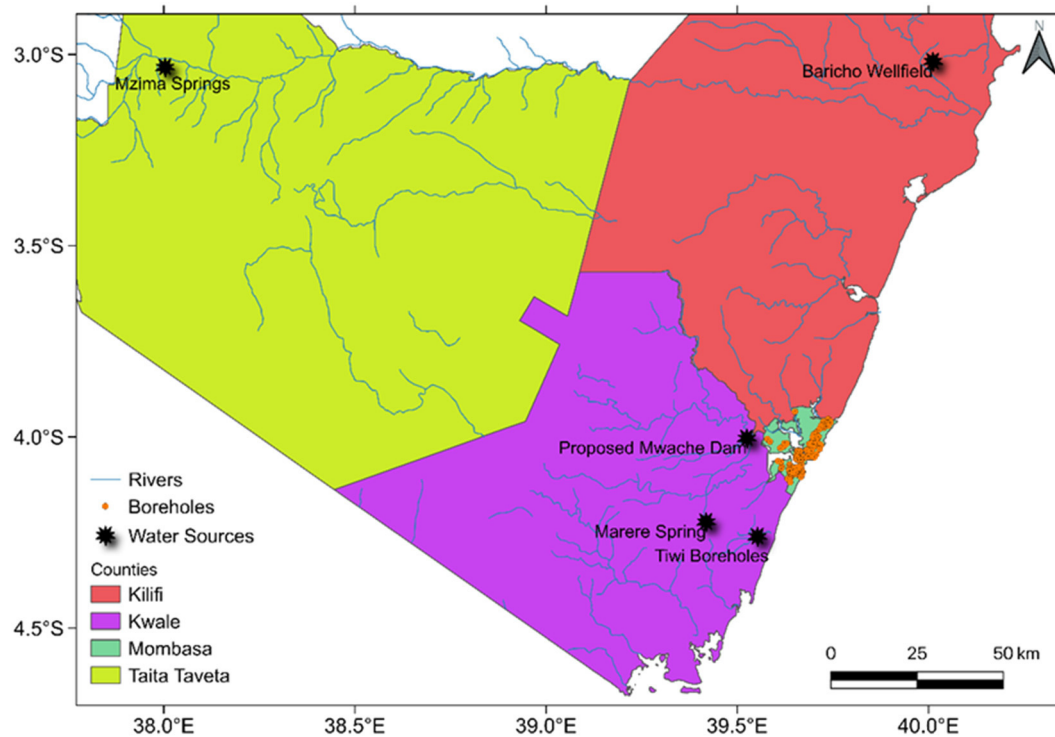


Fig. 1. Mombasa water sources: all main water sources are located in the neighbouring counties.

not seem to have yielded the desired results. In each case the after-the-fact assessments have invariably found that enthusiasm outpaced commitment to action or political will or a combination of factors (Sambu & Tarhule, 2013). Changes in governance, policies and structural framework in the water sector have failed to keep up with the demand for water and sanitation services in Mombasa, which reflects a general inability for adaptive management or inability to evolve at a pace that keeps up with the challenges of water and sanitation services facing the city. The reforms seem to have strengthened the dual economy whereby 'invisible hands' determine the outcomes of the market forces, with formal and legal transaction such as those now provided by MOWASCO; but also, informal arrangements underpinned by strong rent-seeking, illegal commercial activities and other governance dynamics. These informal arrangements serve to sabotage efforts geared towards improving access (see Rampa, 2011). A similar situation is reported by Cornelius and Matji (2015) who found that the standard water institutions, governance and infrastructure reform and policy prescription of 1990 and early 2000s, including restructuring, private-public partnerships, establishment of an independent regulator and so on, failed to yield positive results for South Africa. Millions of South Africans continued to experience lack of basic water and sanitation services. This shows that layered governance structured coupled with weak regulations only succeed in over-institutionalisation and lead to uncertainties about the implementation of reforms. The continuing water problems are a manifestation of governance and policy inefficiencies. Such inefficiencies lead to scarcity even in the presence of physical water abundance, especially where economic instruments are used to disenfranchise the poor.

#### a) The scope of water challenges

The actual statistics of the water access and coverage in Mombasa is contested. The figures are as different as their sources. However, recent information obtained from MOWASCO, the utility company responsible for water and sanitation supplies, shows that the demand for portable water per day in the city is 200000m<sup>3</sup>. A maximum of 50,000m<sup>3</sup> can be

supplied through the piped system, with the deficit being supplied by ground water through private boreholes. All the major water resources, serving the city, namely Marere and Mzima springs; Baricho wellfields and Tiwi borehole, are located outside the county's jurisdictional borders (see Fig. 1). This brings to into focus the potential challenges of dealing with the cross-boundary context, which are quite common in many jurisdictions around the world. As discussed in later in this paper, these cross-boundary conflicts are already starting to emerge between various counties within the republic of Kenya.

The actual volume of water supplied by private boreholes remains unknown, but it is unlikely that these can make up for the 75% deficit occasioned by lack of piped water. Due to inadequate supply from the city's water supply network, the scramble to access ground water resources is unprecedented (Fig. 2). The drilling of the boreholes has led to irreversible problems of saline incursion into boreholes and aquifers. A recent hydrogeochemical assessment by Idowu, Nyadawa, and K'Orwe (2017) found that 94% of the water samples tested from the city's north coast exceeded the WHO drinking water limit for all mineral contents, with the principle process influencing the geochemistry being sea water intrusion.

The Non-Revenue Water (NRW) stands at 47%, way beyond East Africa's levels of 41% and the international best practice levels of between 20 and 25% (see Van den Berg & Danilenko, 2017). This high level of NRW can be attributed to dilapidated infrastructure that create physical losses, poor metering and customer management systems that generate commercial losses. For example, the county and national government institution customers do not always pay their bills on time and there is reluctance to disconnect their supply, even though they account for about 50% of the billing amounts. These unpaid bills erode the financial viability of the local utility company (MOWASCO), further frustrating water service provision. The poor financial performance of the utility company disproportionately affects service provision to the poor households, as it seeks to minimize their losses by concentrating on providing services to and collecting revenues from more affluent customers. For example, a survey of 35 sub-Saharan African countries found that the poorest households are 6 times less likely to have water

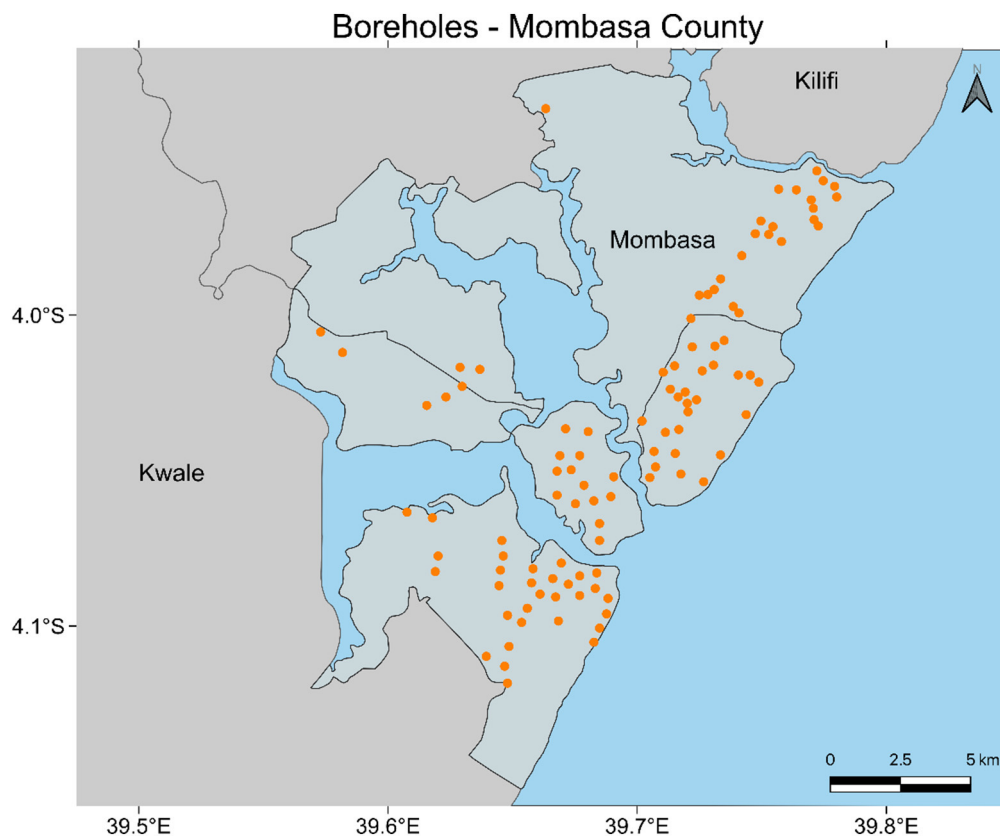


Fig. 2. Distribution of boreholes in Mombasa country.

access compared to the wealthiest households (WHO/UNICEF, 2013).

Since 2018 there has been plans to construct 2 desalination plants with a capacity of 100,000 cubic meters at Kenya shillings 16 Billion. This project is to be implemented through a Public Private Partnership (PPP). The plan was unveiled in Dec 2018 to start by June 2019, but by first quarter of 2020, no further action had been taken. The preselected companies were mandated to design, build and operate the plants for 25 years before handing them over to the country government. While plans to increase water sources by constructing desalination plants are impressive, there are no corresponding plans to rehabilitate and or expand the existing infrastructure to deliver services to residents. The current piped water system is contaminated from corrosion and dilapidation of the aging water distribution systems, resulting in dirty sewage and storm water entering the network through cracks and fissures. At the same time, it is impossible for engineers to carry out large-scale trunk lines rehabilitation and repairs because there are no alternative water distribution tunnels available to temporarily divert water and avoid extensive disruption. If not well planned and managed, attempts to rehabilitate or expand the current infrastructure to cater for increased volume of supply could easily cause minor problems to escalate into catastrophic systems failure. Examples abound where rehabilitation work has led to disastrous consequences including heavy financial losses. Examples include the 1988 water poisoning in Camelford, Britain, chemical plant at Bhopal, India in 1984; the Piper Alpha oil platform fire, North Sea in 1988; the explosion and fires at the Texaco refinery at Milford Haven, UK in 1994 among others. In the course of writing this paper, one of Kenya's media houses reported complaints by residents of VOK area in Mombasa, where raw sewage has been flowing along a road following the construction of a drainage system in the area (see Fig. 3). Residents were quoted saying that some of them had developed itchiness after coming into contact with the raw sewage.

None of the global water initiatives, including international



Fig. 3. Photo showing raw sewage flowing along the road in VOK area in Mombasa.

Photo courtesy - Citizen TV News, 22/02/2020 - available from - [https://www.youtube.com/watch?v=yTW\\_6iUQKSQ&t=240s](https://www.youtube.com/watch?v=yTW_6iUQKSQ&t=240s).

Hydrological Decade (IHD) 1965–1974, International Drinking Water Supply and Sanitation Decade (IDWSSD) 1981–1990 and International Decade for Action, Water for Life (IDAWL) 2005–2015, have had any significant positive impact in the provision of water in Mombasa. It is anybody's guess whether the current global water initiative, that is, SDG 6: ensuring access to water and sanitation for all, will be achieved by the target year, 2030.

#### b) The scope of sanitation systems challenges

The sewage story above is a microcosm of the sewage situation in the coastal city of Mombasa. The city's service areas with reticulated sewage systems are the west mainland and Mombasa Island (see Fig. 4 overleaf) constructed in 1952 and 1962 respectively. The sewage system has continued to deteriorate with minimal expansion and

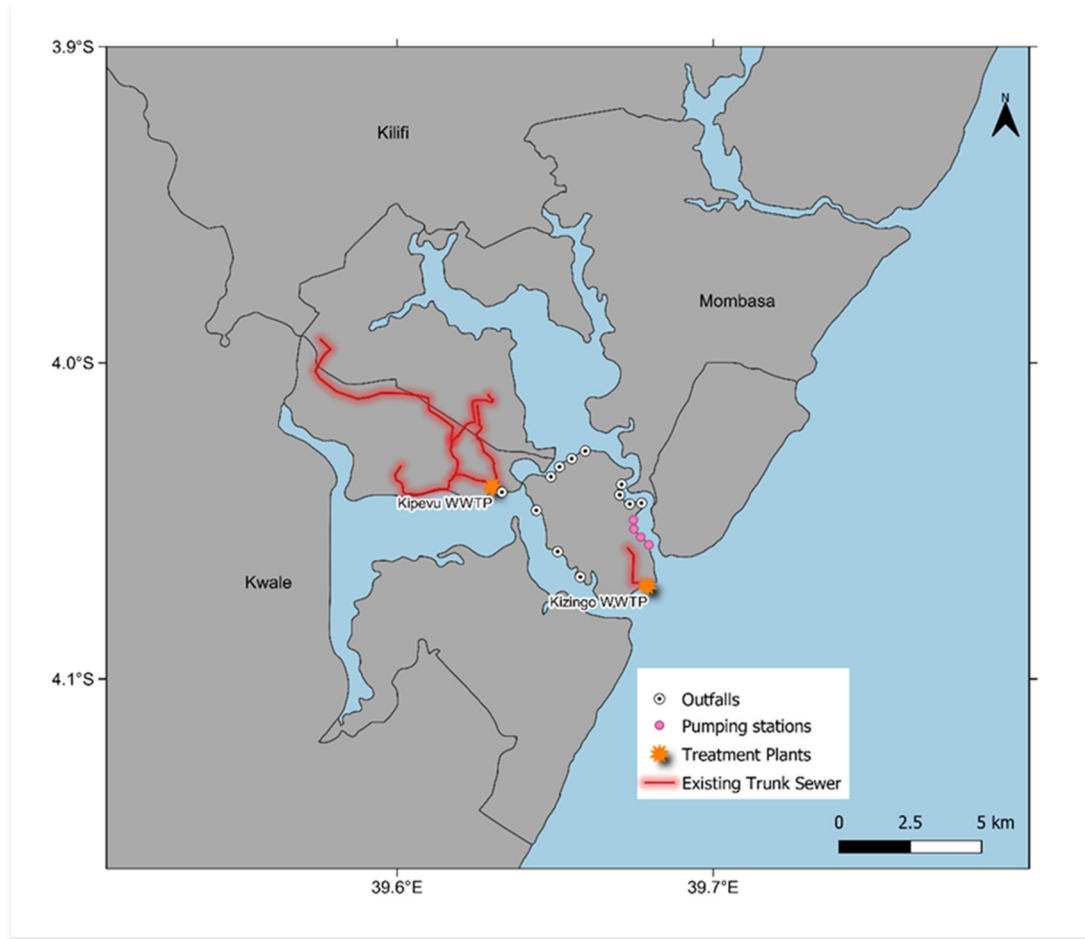


Fig. 4. Sewage trunk line, treatment plants and pumping stations in Mombasa.

operational maintenance. At the time of writing this review paper, both the Kizingo and Kipevu wastewater treatment plants, located on the Island and west mainland (Fig. 3) respectively, were not operational. Consequently, raw sewage is discharged into the ocean, with the discharge at Kizingo occurring from a short sea outfall pipe of about 18 m (Republic of Kenya. Coast Water Services Board, 2017). Clearly, the water channels surrounding the island have copped a lot of pollution based on the high number of outfalls discharging sewage water from the island (Fig. 4). The wastewater systems, built on historical design parameters such storm water capacity, become obsolete years ago, and reconstruction rather than rehabilitation is necessary.

The absence of functional waste water systems in Mombasa is perhaps the most striking indication of an emerging disjuncture between a pretentious show case of modernity, reflected in prestige projects such as the ongoing city greening, construction of waterfront public parks, ambitious rehabilitation of a 50 year old Kibarani dumpsite and the digitalisation of parking etc., and the city's continuing inability to provide basic infrastructure. There is an inverse relationship between the level of development and the availability of adequate waste management infrastructure, such that these are absent where the need is greatest. Mombasa city is growing at a rate the 3.29% (Republic of Kenya KNBS, 2019), with much of this growth underpinned by the urbanisation of poverty. This had led to disproportionately high number of slum dwellers who have no access to sanitation facilities. Yet, just like for water, equitable access to sanitation is an SDG to be achieved by the year 2030. If the population growth continues to outpace sanitation services, the prospects of increasing the wastewater treatment capacity in Mombasa city will remain gloomy as the volume of wastewater

continues to increase.

The cost implication of improving the wastewater treatment system is astronomical. For example, a consultancy report commissioned by the national government through the Coast Water Services Board found that the capital cost of installing a wastewater management scheme for Mombasa to serve a projected population of 1.6 million people by the year 2040 is at least \$251 Million (Republic of Kenya. Coast Water Services Board, 2017). This does not take into account the operation and maintenance costs which would run into millions of dollars, yet sanitation continues to be viewed as a free social service. This is not sustainable and will continue to pose challenges unless workable cost recover measures are introduced. Wastewater reuse is yet to be considered an important objective of the city's water and sanitation system. This can be attributed to the continued use of conventional technology. According to Bahri, Dreschsel, and Brissaud (2008), treatment plants made using conventional technology tend to exclude reuse provisions in their design. This seems to be the case in Mombasa, where inherited large-scale systems still dominate what is left of the sanitation infrastructure.

Despite the increase in the overall budgetary allocation over the years to the departments concerned with sanitation, there is no evidence of substantial funding from the consolidated fund either to expand this infrastructure or to undertake comprehensive feasibility studies in Mombasa. So far, funding has been secured through credit from the World Bank and the International Development Assistance (IDA). However, such funding has been targeted towards conducting feasibility studies rather than expanding or rehabilitating the infrastructure (see for example World Bank reports (1999, 2011) and the Republic

Kenya - Coast Water Services Board reports (2017)).

The laws and regulations governing effluent disposal are unambiguous. For example, according to the constitution of Kenya 2010, each person is entitled to a clean and healthy environment and has duty to safeguard and enhance the environment (Republic of Kenya, Kenya Law Reports, 2010). The *Environmental Management and Co-ordination (Water Quality) Regulation 2006*, prohibits discharge of effluence into the environment contrary to established standard, while the *Water Act 2016* prohibits the discharge of trade effluent from any trade premises. None of these requirements have been enforced in the case of Mombasa. While city authorities can and do punish breaches of bylaws by residents e.g. those engaging in indiscriminate waste disposal, similar punishment is not applied to city officials who breach national regulations. The conventional reasoning is that enforcing national regulations concerning effluent disposal would create a crisis in a city which lacks alternative disposal systems. This double application of the law points to weak regulations which perpetuate impunity and lack of accountability.

## 5. Factors influencing sustainable interventions

Climate change, population growth, unsustainable water extraction, release of untreated sewage and wastewater all add very significant pressures on water supply systems, while further investments are needed to improve access to sanitation. The social, economic and environmental impacts of inadequate access to water and sanitation services remain very high. Addressing this challenge requires targeted focus at the chosen scale in order to define and implement the most sustainable interventions (see Hutton & Chase, 2016).

The goal of addressing water and sanitation challenges in Mombasa has been highlighted in all planning and vision documents. However, one of the most sobering realities is the difficulty in translating these intelligible proposals into tangible actions, revealing the gap in policy-as-designed and policy-as-executed (see Kay, 2010). Failure to implement proposals can be attributed to several factors, not least those associated with politics, rent seeking and other hidden goals. Pal (1989) defines hidden goals as those which in practice usually influence policy decisions and are designed to benefit third parties who are neither government nor general public. In the absence of these barriers, the implementation gap could be addressed by embracing change management which inculcates sustainability thinking into the decision-making culture.

The usual response to water and sanitation challenges has been to try and fix the existing large-scale systems without due consideration of alternative systems which are both equitable and sustainable. The social, economic and ecological rationality of a uniform infrastructure in which water and sewage system comes through a single network, that is, water is flushed away into the wastewater system and send onto the sea in a city where water scarcity is the norm, need to be rethought. The possibilities for achieving universal uniform networked access to services, for example water recycling, are yet to be recognised, leave alone implemented. Like many other cities in Africa, Mombasa city remains caught in the ideological desire for modern water and infrastructure and a practical awareness of an inability to achieve universal access (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2017).

Policy makers are yet to find plausible solutions to water and sanitation infrastructure development other than those from the global north, which are not well suited for urban areas in Africa (see Silver, 2016). Drangert et al. (2002) postulate that in low and middle-income nations, small-scale solutions which have proven to be sustainable have been neglected in favour of the usual large-scale capital-intensive solutions. For example, at an estimated cost of US\$50,200 a decentralized wastewater treatment system (DEWATS) was put up in Trapeang Sab Commune in Cambodia. The system serves 250 households and small businesses with a capacity of 100 cubic meters per day (International Water Association, 2012). Such innovation technologies could help

Mombasa to address the dual problem of diminishing water supply and the discharge of raw sewage into the sea.

### a) Water and sanitation infrastructure funding options

Despite popular believe, the problem of deteriorating water and sanitation services is not solely attributable to lack funding. An extensive World Bank study in 2011 identified no relation between levels of public spending and the levels of access to water supply and sanitation in different countries of Africa (see Baptista, 2019). The problem could be in the funding models which have been used over the years. At least, the persistent backlogs in Mombasa are a testament that the old funding models have not succeeded in addressing the sector's problems. Hence, new models are needed to either replace or supplement the existing funding ones.

A survey examining water and sanitation services of member nations of the OECD and G20 found that, regardless of the ownership of the model (public or private) the commercialisation and corporatisation of local government water and sanitation services improves transparency, accountability and business management. However, there was a prevalence of local government ownership and often management, but full privatisation, though trailed in numerous jurisdictions over the last three decades, had sustained success recorded in only a small number of cases. It remains relatively rare in the OECD and G20 countries (see Lobina, Kishimoto, & Petitjean, 2014; Ouda, Al-Waked, & Alshehri, 2014; Swyngedouw, 2009; Vidal, 2015). This is surprising given the World Bank's International Finance Corporation's consistent advice to developing economies to embrace privatisation of key sectors, including water and sanitation (World Bank, 2011). Despite the large number of academic studies benchmarking the efficiency of different models, there is no universally accepted best-practice model for water and sanitation. What is not in contention is the need for data availability irrespective of the choice of model.

The plan to implement water desalination in Mombasa through public private partnership involving two international profit seeking enterprises is seemingly a good idea. However, it is a puzzle how the resulting portable water will be distributed given the already overburdened, poorly maintained and obsolete trunk infrastructure. The potential impact of the investment on households with limited capacities to pay, both for the initial investment and running costs, has not received much consideration. Similarly, outsourcing such a critical infrastructure poses a real risk of loss of control over the supplier companies.

Various studies have found the involvement of private public partnership in funding water project to have limited impacts on improving access. For example, a study of Latin American PPPs involved in water provision revealed no statistically significant deviations in water connections and coverage from the counterfactual (Trebilcock & Rosenstock, 2015). In many occasions, the obligation to increase coverage and connections is a function of the terms of the contract between the private investor and the governing authority. In general, while PPPs have been successful in certain jurisdictions, there are numerous examples of places where they have been trailed but failed or subsequently been reversed. Literature on PPPs in developing countries shows that benefits tend to be skewed heavily towards the private sector party. The consensus is that barriers to the provision of water and sanitation in poor settlements will persist whether utilities are publicly or privately operated (see Budds & McGranahan, 2003).

Private players perceive infrastructural investment in the water and sanitation sector both as high risk and requiring extensive upfront costs, which costs take long to recoup. For example, private funding to developing countries' water and sanitation sector only received 7% of the total private financing in the decade to 2017, while Information, Communication and Technology (ICT) and energy soaked up 67% (Tyson, 2018). One of the challenges which private investors in the water and sanitation sector tend to avoid is the difficulty in collecting



payment for service in urban environments where users have low incomes. However, contrary to conventional belief both by the government and private sector, that poor residents have low propensity to pay for services, numerous studies have demonstrated poor people's willingness to pay for water services, and that individuals and households in informal sector almost always pay higher rates than residents of the developed parts of the city (see [Dos Santos et al., 2017](#); [Pierce, 2017](#)).

Full cost recovery for water and sanitation provision, which is a sustainable option, remain a mirage mainly because there is little political will or taxpayer support. This is despite the express provision in the s77 of the Water Act, 2002, that:

*'A licensee may, in consultation with the Regulatory Board and with the Approval of the Minister, fix and impose a sewage services levy on all water services within the limits of supply of the licensee, to cover a reasonable part of the cost of disposing of the water supplied within those limits' (Water Act, 2002).*

Yet, public infrastructure investment can only be made if taxes and user fees are substantially increased to recover costs. There is a reasonable argument that any subsidised water tariffs are likely to disproportionately benefit the wealthy. Wealthy customers are connected to piped network, while the poor tend to purchase their water from private vendors who, as a matter of common practice, rarely pass the benefits of reduced tariffs to customers. Subsidising the poor has been found to be quite successful where block tariffs have been used, but mostly in areas with universal access to services. Block tariffs link price to volume, with low "lifeline" rate for the first part of consumption and higher rates for additional "blocks" of water ([World Bank, 1994](#)). The approach provides an opportunity for the subsidies to low consuming poor household to be financed by the high volume consuming wealthy households and businesses. The objective is to balance between revenues from customers and the cost of supply.

Most countries in the developed world have devised frameworks whereby budgetary allocations for large-scale systems are accumulated over a period to cater for the replacement of those infrastructure systems as they age. Mombasa city government could employ such provisioning over several budget cycles in order to avail substantial resources to address major water and sanitation issues. Such internal funding frameworks would be more sustainable than relying on external donors, or skewed PPPs arrangements, to undertake major water and sanitation infrastructure rehabilitation and/or development.

#### b) The city as the focus of decision-making

Under Kenya's constitutional change 2010, county governments are mandated to provide water and sanitation services. This provides an opportunity for counties such as Mombasa to rethink their service provision strategies in order to address the woefully inefficient investment in the water and sanitation. The powers inherent in the devolved system of government could be leveraged to address water and sanitation challenges through a holistic approach which takes into account the social, economic and environmental realities. Previous change inertia that has seen new policies and governance structures being ignored in preference to established habits, of mismanagement, corruption, loss of focus and so on can be effectively addressed. Furthermore, local decision-making can help set effective targets for service provision, rather than adopt the unworkable top-down solutions, which serve to disadvantage the vulnerable. For example, the city government can set its own minimum acceptable standards for drinking water. That is, a state of service delivery below which the government would consider unacceptable. This is important because there have been questions on whether WHO guidelines could be realistically applied across all region of the world regardless of local peculiarities. In any event, neither the current WHO guidelines on drinking water nor the previous ones have been met. To maintain consistency in quality and safety of the water provided to Mombasa city residents, there is need to formulate local

standards and adopt an effective monitoring and evaluation mechanism to help ensure adherence to these standards.

Locally driven initiatives can deliver significant improvements for large numbers without the need for large-scale external funding. For example, in Dhaka, Mumbai and Chittagong, locally designed and built toilet blocks were found to cost less, their quality was better, and had systems in place to ensure maintenance and to cover running costs when compared to contract toilets ([IIED editorial, 2003](#)). The degree of freedom provided by decentralisation helps in faster and flexible response in service delivery. Hence, universal water and sanitation provision can be met by local actions alone since their benefits play out locally. For example, within local basins, aquifers, neighbourhoods and so on. [Nilsson \(2007\)](#) found that growth-related planning issues are better handled during day-to-day planning at the appropriate local scale, since issues can be dealt with quickly as they arise, creating flexibility and freedom of action. This approach to governing the water and sanitation sector is already in place albeit to varying extents. In order to define the most costs affective water and sanitation policies, it is critical to identify and implement those interventions that work at the appropriate scale. Sustainable interventions in Mombasa should therefore involve rethinking the large-scale systems to embrace localised innovative and affordable technologies, whether these be for water and sewage treatment or energy production.

#### c) Continuous research, education and outreach

From colonial days to date, the water system in Mombasa has been dominated by supply-oriented engineering approaches with water conservation efforts being of minimal concern. No attempts have been made to create education and outreach programmes to educate residents on the need to conserve water. Innovative approaches such as rainwater harvesting, which could improve water supply and access to sanitation have not been tried, yet these constitute some of the sustainable initiatives (see [Gandy, 2006](#)). In addition to rainwater harvesting, storm water, greywater and even wastewater are the other potential sources which need to be trailed. For example, In Windhoek, Namibia, 26% of the water supply comes from wastewater re-use, a system which has stood the city in good stead for decades ([Menge, 2010](#)) Research need to rethink the one-source, one system and one discharge approach. It is neither necessary nor economical to treat all water to the drinking water standard regardless of its purpose. The concept of research that is fit for purpose has been implemented in the city of Durban, South Africa, to respond to a conflict between water demand for domestic use and economic development under conditions of water scarcity ([Jacobsen et al., 2012](#)).

Data is needed for planning and performance tracking, however, it is not just the availability of the data, but the quality of the data, and whether the collected data is used to inform decisions. There are significant data gaps on water and sanitation in Mombasa. For example, there is no data on ground water, and the impacts of climate change on watershed are not well known. Similarly, there is limited data sets on the disparities between populations subgroups such as ethnic groups, women, elderly, people living with disabilities, slum populations and so on. Furthermore, the lack of climate data, poor hydrometeorological networks and the fact that there is no mechanism for data sharing among departments and agencies makes it difficult to undertake accurate analysis and to come up with sustainable solutions.

#### d) Water and sanitation services as a rights issue

On 28th July 2010, the United Nation General Assembly through resolution A/RES/64/292 declared safe and clean drinking water and sanitation a human right essential to the full enjoyment of life and all other human rights ([United Nations, 2010a, 2010b](#)). This implies access to sufficient, safe, acceptable, physically accessible and affordable water for personal domestic use. Furthermore, Sustainable

Development Goal 6 (SDG6) envisages access to water for all. The Kenyan government has not only signed the declaration of human right for access to water, but also the country's progressive 2010 constitution, and *Water Act, 2002* support the right of access to clean safe drinking water. Article 43 of the constitution of Kenya 2010 states:

*Every Kenyan has a right to clean and safe water in adequate quantities and to reasonable standards of sanitation.*<sup>1</sup>

Despite this constitutional requirement there remains a disjuncture between the formal rights, as set out in law, and material realities of social injustices experienced by the urban poor. Failure to facilitate the enjoyment of this right compromises the government's role as an arbiter of a putative public interest. This is likely to give rise to litigation to enforce the observance of the citizen's right to clean and safe water and to a reasonable standard of sanitation.

There are arguments that since the UN, the constitution of Kenya 2010 and other statutes recognise access to water as a human right, water management should not be subjected to the laws of the market. There is validity in the call for social equity that would ensure the poor have access to safe clean water and sanitation. This is the case in South Africa where the *Water Services Act of 1997* and *National water Act of 1998* established the right of all citizens to free water and basic sanitation as part of strategy to fight poverty. Consequently, cities such as Durban, came up with initiatives to provide free basic supply of water of at least 6000 l per household per month and free sustainable basic sanitation (Bond, 2019). No income-based discounts of any type exist in Mombasa. Noticeably, the usual approach in delivering water to the urban poor in Mombasa, but also in Durban, whose municipal water leadership is world-renowned, is to have common toilets and public standpipes (water kiosks). This begs the question as to why poor households should settled for community toilets and public standpipes when middle- and upper-class groups have piped water and sewer connections to their homes, often provided at less than their real costs (IIED editorial, 2003). Failure to ensure equity in the provision of water and sanitation services impinges on the social wellbeing of the residents, which is a one of the dimensions of sustainability.

It is generally accepted as reasonable and rational that cross-jurisdictional water allocation conflicts exist as jurisdictions and communities assert their right to use and protect their water resources. In Kenya, recent water conflicts between the counties of Nairobi & Muranga on the one hand, and Kajiado and Makueni on the other (Odote, 2018) have laid bare the extent to which these conflicts can go as the demand for water grows. Mombasa city draws its water from neighbouring counties, namely Kilifi, Kwale and Taita Taveta. All the water resources in Kenya are owned by the public under the trusteeship of the national government pursuant to article 62 of the Constitution of Kenya, 2010.<sup>2</sup> Hence, any potential problem is unlikely to be over ownership. However, conflicts are bound to occur over benefit sharing between jurisdictions on the one hand; and communities on whose land the water resources are found and authorities on the other. Barring investments in water infrastructure systems that would increase water accessibility, and as the demand for water in Mombasa continues to outstrip supply, conflicts over water allocations will escalate as jurisdictions and communities demand their rightful share. For example, communities might argue that it is unconscionable for them to have no access to water when the water resources used to supply far away populations are found in their region.

State or privately regulated water systems have been shown to fail when resource use reaches an intensity that the systems can no longer sustain. Rowland (2000) cites an example of a case where population

increase led to ground water withdrawals in Tampa Bay (Central coast of Florida), leading to destruction of aquifers. State managed resources systems were plagued by disputes among counties and cities leaving them with no sustainable solutions to the problem. This shows the need to put in place a system for resolving potential conflicts in order to protect the sustainability of water resources and the welfare of residents (Rowland, 2005). In the case of Mombasa, although there are opportunities to negotiate amicable solutions, such efforts must not insist on the historical water use practices, as these have invariably favoured Mombasa city. Devolution has resulted in marked changes in the land cover land use patterns of the surrounding counties, and their demand for water and sanitation services are also bound to grow to unprecedented levels. This is likely to increase conflict/tensions in the sharing of the water resources. Hence, from a sustainability standpoint, Mombasa cannot afford to solve its water problems unilaterally, without consulting its neighbours.

## 6. Conclusion

The challenges of water and sanitation in the coastal city of Mombasa are not unique to the city. They are a microcosm of the disparities in access to water and sanitation in most cities in Africa. What is unique is each city's history, location and governance. Even within the same country, the magnitude of the challenges often differ depending on the hydrology, water resources, user types and so on.

In Mombasa, the water and sanitation challenges are rooted in the pre-independence design and operation of the infrastructure, all of which have received little attention to date. The combination of lack of technical skill capacities, political good will and insufficient resource allocation make it difficult to meet water supply deficits, and to expand sewage coverage amidst the rapid population growth in the city.

The colonial period saw the provision of services follow a pyramidal racial structure characterised by inequalities in access. After independence, this colonial racism transitioned into post-colonial classism, perpetuating the inequalities in access to water and sanitation services, with the urban poor being disproportionately affected. Neither the occasional sectoral reforms of 1970s, 1990s and 2000s nor the increased budgetary allocations to the sector have been helpful to the poor residents in informal settlement who still lack access to large-scale piped water systems and sanitation services. Furthermore, the poor financial performance of the city's water and sanitation utility company affects service provision to the poor households as it seeks to minimize their losses by concentrating on providing services and collecting revenues from the more affluent customers.

Sustainable solutions to water and sanitation challenges in Mombasa would require rethinking the current business-as usual approaches to embrace innovative and affordable initiatives. This would require a re-evaluation of the current funding models; a phased transition from large-scale infrastructure systems to localised interventions that are not only affordable but work at the appropriate scale; a focus on potential water conflicts; efforts aimed enhancing equity of distribution of services and a commitment to evidence based decision making underpinned by research, education and outreach. Given the current spread of Covid-19 pandemic, whereby the number one preventive measure is handwashing, the need to address water accessibility to city residents, regardless of their location, social or economic status, has never been so urgent.

## Author statement

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<sup>1</sup> Republic of Kenya (2010) Laws of Kenya: The Constitution of Kenya, article 43(1)(a)(b).

<sup>2</sup> Republic of Kenya (2010) Laws of Kenya: The Constitution of Kenya, article 62(1)(g)(i);(3).

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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