



Working paper

Waste management in Africa

A review of cities' experiences

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Key messages

Waste management is of critical importance in Africa for reasons related to public health, human dignity, climate resilience and environmental preservation. But cities have limited budgets and face increasing demands as urban populations and economies grow.

Low-cost, locally appropriate approaches to waste management are imperative. There is experimentation and innovation in many African cities – with waste collection, recycling and transaction systems that reduce the leakage of revenues – and significant potential for city administrations to learn from each other.

Composting and recycling are two high-priority areas for innovation and investment. Such initiatives reduce the amount of waste going to landfill and maximise the economic benefits from the waste value chain that the city controls.

The job creation potential across the entire waste management cycle is impressive. Strategies can be highly inclusive by design, building on the livelihood strategies of informal waste workers. There is a real opportunity to scale up and support inclusive employment and entrepreneurship if cities have adequate financing and appropriate partners.

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Acronyms/Glossary

CBC	community-based contractor
CBD	Central Business District
CBE	community-based enterprise
CDM	Clean Development Mechanism
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DigiFI	Digital Identification and Finance Initiative
ESO	environment and sanitation officer (Freetown)
ESU	Environment and Sanitation Unit (Kanifing)
EU	European Union
FCC	Freetown City Council
FCDO	Foreign, Commonwealth & Development Office
GBoS	Gambia Bureau of Statistics
GHG	greenhouse gas
IDS	Institute of Development Studies
IOM	International Organization for Migration
JICA	Japan International Cooperation Agency
KMC	Kanifing Municipal Council
LGA	Local Government Act (Sierra Leone)
MMC	Mayor's Migration Council
MOPA	Monitoria Participativa Maputo
PPP	public-private partnership
SDC	Swiss Agency for Development and Cooperation
SPV	special purpose vehicle
UK	United Kingdom
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UN-Habitat	UN Human Settlements Programme
WBCSD	World Business Council for Sustainable Development

WCT Wildlands Conservation Trust

WIEGO Women in Informal Employment: Globalizing and Organizing

WtE waste-to-energy

Executive summary

Waste management is of critical importance in Africa for reasons related to public health, human dignity, climate resilience and environmental preservation. Effective waste management systems are often the direct responsibility of local governments – but many cities have struggled to put these in place. Lack of national investment, insufficient delegation of powers and constrained municipal budgets present large limitations.

This working paper looks at waste management systems in African cities. Its main aim is to document in depth the experiences of two cities: Freetown in Sierra Leone and Kanifing in The Gambia. It has been produced under the Africa-Europe Mayors' Dialogue platform, a city-led initiative bringing together over 20 cities across Africa and Europe to work on shared challenges related to sustainable urban development.

Waste management in Africa

Although high-income countries are responsible for the largest generation of waste per capita, sub-Saharan Africa is the world's fastest-growing region in this regard. Across sub-Saharan Africa only 44% of waste is collected; North Africa's collection rates are higher. Collection rates vary enormously between urban and rural locations, as well as across urban settings. Informal settlements are often largely excluded from waste collection services, owing to their inaccessibility and/or residents' inability to pay fees. Poorer areas in African cities also suffer most from the public health and environmental impacts of inadequate waste collection, treatment and disposal. Formal recycling systems are not commonplace. Even when waste is collected, it often ends up in open (and very overburdened) dumpsites. However, more attention than ever is being paid to opportunities for a circular economy and particularly for composting, given Africa's high percentage of organic waste.

The role of informal waste pickers is critical, and the livelihoods of large numbers of the urban poor depend on collecting, sorting and recycling waste. These workers provide a vital service and also lessen the cost burden on municipalities enormously. The experience of African cities shows that city administrations can work successfully with informal waste pickers, via cooperative models or through contractual arrangements with community-based organisations, to improve the coverage of waste collection and to achieve a low-cost expansion of recycling systems. A great deal more could be done to harness the benefits the informal sector provides and support job creation in this area.

Given the investment required to create modern sanitary landfills, there is a major deficit in this area. Some governments are experimenting with simpler approaches, such as the low-cost (semi-aerobic) Fukuoka method. This approach rapidly removes leachate and reduces methane emissions in landfills, with the added benefit that local materials such as waste drums, tyres and

bamboo can be used. This technology originates in Japan, is in use in China and Malaysia and has been applied in Ethiopia and Kenya. Some African cities have also experimented with waste-to-energy (WtE) initiatives, though, overall, use of these technologies is quite rare. Apart from the financial feasibility challenges this large-scale investment involves, WtE is approached with caution as it discourages waste prevention and recycling and can have negative impacts on the livelihoods of informal waste pickers.

While responsibility for waste management is usually decentralised, budgets allocated by central governments rarely correspond to the level of capital investment required and the operational costs involved. Full cost recovery remains rare, and there is still a clear need for public subsidy and public investment to ensure low-income areas are properly served and to produce modern sanitary landfills and recycling systems that function at scale. The search for locally appropriate solutions – that will function in resource-constrained environments – remains imperative.

Waste management in Freetown

Freetown faces major waste management challenges. It has very difficult topography for waste collection services to navigate, particularly in the city's hillside communities. Its two official dumpsites are both operating beyond capacity, and there are 46 major illegal dumpsites across the city. The level of waste collection is low and collection services are distributed inequitably across rich and poor neighbourhoods. Just over 30% of the waste generated is properly reaching the legal dumpsites. Recycling systems are lacking and waste management infrastructure is underdeveloped. The city council has limited ability to act, given delays in legislation and a critical lack of financing. However, waste management is a major priority, and one in six staff employed by Freetown City Council (FCC) work in the sector. With the support of donors, and through a range of innovative interventions and partnerships, FCC is managing to make progress.

The council's flagship Local Microenterprise Development Project, launched in June 2019, provides for waste collection by tricycle, which enables easier access to informal settlements and has successfully expanded a low-cost model of household waste collection. Under this project, groups are supported to start their business and access equipment and training, including on financial management aspects.

This initiative has created 1,200 jobs, and 70% of these have gone to rural migrants living in informal settlements. It has resulted in a quadrupling of the number of households served by waste collection services. FCC has also constructed six transfer stations across the city, which – when fully operational – will reduce the distances tricyclists have to cover to dump waste and enable further expansion in terms of the number of households served. Another major focus for the city has been clearing illegal dumpsites and targeting these sites with urban greening efforts to dissuade residents from further dumping. Major public education efforts have accompanied this, informing residents about the negative impacts of burning waste, the content of sanitation bylaws and how to register for waste collection services.

With donor support, FCC has also invested in a new faecal sludge plant, which means faeces are no longer emptied directly onto the open dumpsite. The city has experimented with a cashless system for fee paying after monitoring showed a major loss of revenue from tipping fees at various points in the chain. A new voucher system is in place, with payments collected at a bank. As of February 2022, this has increased revenue by a factor of five. The city expects to reach full cost recovery for this plant for the end of 2022 and plans to replicate this cashless approach throughout the entire waste value chain. A remaining, major challenge is the low level of tipping fees charged at the dumpsites. Rates are overly beneficial to the private sector – with the biggest private waste company paying a monthly fee that is a tiny fraction of what they receive from commercial and household customers. This imbalance between public sector revenue and private sector profit urgently needs to be corrected for.

The city currently has a major focus on trialling and scaling up composting and recycling initiatives. It is expanding the treatment of faecal sludge to include conversion into compost and cooking briquettes, with a technical pilot well underway. It is also in negotiations with private companies about plastic recycling and small-scale WtE initiatives (small biodigester models that can plug into local mini grids). It has also launched a Plastic 2 Build scheme – looking at how plastic can be recycled into building materials – but has struggled to progress, given the lack of enabling legislation. The mayor's efforts to set robust criteria for private sector partners, in relation to clean energy, improved conditions for informal recyclers and the employment of women, youth and minorities, are notable. The potential for inclusive job creation to flow from these partnerships that support a transformation of the waste management sector is a central concern guiding all of FCC's planning in this area.

Waste management in Kanifing

Kanifing Municipal Council (KMC) also faces significant waste management challenges. The council's biggest concern is the old open dumpsite, which is hugely overburdened with waste. As a result of its central location, this presents a major public health and environmental hazard to the densely populated surrounding communities. The city has also faced problems as a consequence of widespread illegal dumping, particularly in riverine areas, and the lack of waste management infrastructure is notable. The city has no transfer stations, and there are no official systems or facilities for waste separation and recycling.

Under the tenure of the current mayor, the city has adopted waste management as the number one priority for the administration. This has led to a number of new initiatives, including the city's flagship Mbalit project, which focuses on expanding household waste collection. The city has purchased 23 modern waste compactor trucks for door-to-door collection services across its 19 wards. This has enabled an expansion of coverage from a very low base to 55–60% of residential households. KMC also works in partnership with informal waste collectors, who use donkey carts to collect household waste in difficult-to-access areas. Given the city's limited resources, the

procurement of compactor trucks has been financed under a public–private partnership (PPP), under which the city agreed to a three-year repayment term. At the time of writing, the city had just made the last installment to successfully repay this loan.

This effort to build a commercial service has led to rapid increases in revenue from fees for the council. However, the council is still far from full cost recovery, given a decision to apply a very low fee rate to household collection to enable inclusive access. (The fee rate is set at 40% of the previous rate charged by private companies.) The city has also paid careful attention to its fee collection system and has instituted reforms to address underpayment by agents. Ticket sellers, who accompany the trucks, now use handheld devices that print tickets at the point of payment and feed directly into a digital system. This allows KMC to keep track of the amount of rubbish and fees being collected and has successfully increased revenue.

Other major public initiatives carried out in recent years include operations to clear illegal dumps and waste dumped in drains, with strong community education components and local clean-up exercises. This, combined with the creation of 10 communal dumping sites across the city and the large expansion of household collections, has led to a significant reduction in illegal dumping (of around 65 illegal dump sites 17 sites are now left). KMC has also made major efforts to improve the Bakoteh dumpsite, renovating access roads, constructing sanitation facilities and a safety fence, and planting around 500 trees to act as a green zone, filtering out odours and the smoke from frequent dumpsite fires.

Given that recent waste characterisation studies have shown 60% of market waste to be organic, KMC is currently prioritising separation of organic waste at source in the city’s markets. Two pilot projects are underway, with organic waste delivered to women-led associations for composting in community vegetable gardens. New grant financing is also enabling KMC to expand its work to support business development with youth-led businesses in relation to recycling tyres and plastics. New financing will also allow KMC to put in place 16 community transfer stations with sorting for recyclable materials and to set up a centralised call centre to respond to residents’ concerns around waste management. The call centre model was inspired by KMC’s exchange with FCC in 2021. Ultimately, the municipality is planning to relocate the dumpsite – and has identified a suitable area to develop a fully engineered, sanitary modern landfill – as well as to invest in composting and recycling facilities at scale. KMC is actively looking for a partner that can offer the technical expertise and financial capital necessary for these kinds of investments.

Conclusion

While challenges delivering waste management services are significant, there is experimentation and innovation across the continent, and some city administrations have found their own low-cost solutions. As Freetown and Kanifing’s experiences demonstrate, cities can rapidly increase household collection and reduce illegal dumping. Cities also have a real opportunity to scale up and support inclusive job creation and entrepreneurship linked to composting, reuse, recycling

and the development of the circular economy. However, the right partnerships are required to access appropriate technologies and reach the desired scale. This is a sector that offers significant opportunities for practical learning between African cities. Based on the findings from this research exercise, particular areas that should be prioritised for learning include the following:

1. large-scale composting, recycling and circular economy initiatives

- building and managing fair partnerships that prioritise inclusive job creation
- creating and shaping markets for composting and recycling
- building an enabling environment for the circular economy to flourish

2. appropriate technical innovations

- learning in areas that are of the highest priority to the most financially constrained African cities – such as tyre recycling, composting options, use of small-scale biodigesters and the Fukuoka method

3. new financial models and enhancing revenue for cities

- the potential for municipally owned companies or PPPs that can leverage private finance for cities' waste management investments
- tools and approaches, such as digital or cashless systems, that improve revenue generation and help cities tackle revenue leakage.

1 Introduction

Waste management is of critical importance in Africa for reasons related to public health, human dignity, climate resilience and environmental preservation. However, delivering waste management services requires adequate funding, which has generally been lacking in a context where the generation of waste is outpacing the development of waste management infrastructure in most cities (UNEP, 2018). The sector represents a growing percentage of cities' greenhouse gas (GHG) emissions, and some of the African cities profiled in this study are now designing waste management strategies with emission reduction in mind.

While waste collection is a relatively straightforward, non-technical task, the treatment and disposal of waste is a more challenging area. Effective waste management systems are often the direct responsibility of local governments – but many cities have struggled to put these in place. Lack of national investment, insufficient delegation of powers and constrained municipal budgets present large limitations; cities often find themselves with inadequate financing for the, often sizeable, investments required. The high visibility of waste management services with city residents also contributes to the political importance, and politicisation, of the sector. Many African cities are prioritising the expansion of household waste collection and investing more in recycling and composting or exploring waste-to-energy (WtE) options. The significant job creation potential, through the entire waste management cycle, also creates opportunities for inclusive strategy design within the sector; this is often a key aspect of cities' strategies.

This working paper looks at the experiences of African cities' waste management systems. It has been produced under the auspices of the Africa-Europe Mayors' Dialogue platform. This platform is a city-led initiative, bringing together over 20 cities across Africa and Europe to work on shared challenges related to sustainable urban development (ODI, 2020). ODI coordinates the platform and provides support to cities to enable knowledge-sharing, technical exchange and partnership development. This working paper is part of a series of knowledge products produced for the platform. It looks at the waste management sector, given that many African cities within the Mayors' Dialogue have expressed an interest in learning from others' experiences in this area.¹

The main aim of this working paper is to document in depth two cities' experiences of waste management: Freetown in Sierra Leone and Kanifing in The Gambia. These city case studies provide an overview of how waste collection, treatment and disposal are currently being

1 The African city members of the Mayors' Dialogue platform that contributed – or are referenced – in this paper are Freetown, Kanifing, Monrovia, Accra, eThekweni (Durban), Dakar, Rwanda and Maputo. Freetown, Kanifing and Monrovia participated in a series of interviews as part of the information-gathering for this paper. Information provided on these three cities relies largely on these interviews unless a source is provided.

managed, the key challenges these cities are facing and new initiatives they are seeking to put in place. The case studies are based on a series of interviews with the cities' technical teams (see Appendix 2 for details). This fills a gap in the available literature because in-depth studies on African cities' waste management strategies – particularly when it comes to 'least developed countries'² such as The Gambia and Sierra Leone – are rarely available (Bundhoo, 2018). Both of these cities provide an interesting context for exploration, as both are led by opposition party mayors and receive little support from their central governments – a common challenge for Africa's urban leaders (Resnick, 2014). Both cities have also adopted special delivery mechanisms to enhance their implementation capacity (Muthama et al., 2021).³ As such, they provide examples of city-led innovations in highly resource-constrained environments.

The paper starts with an overview of waste management in Africa, providing some brief context and laying out the key challenges for the sector (Section 2). Sections 3 and 4 provide the in-depth case studies of Freetown and Kanifing. Section 5 then offers some additional information on innovations across Africa in relation to composting, recycling, sanitary landfill management and WtE initiatives (see Box 1 for definitions of key technical terms and classifications used in the sector). The paper then ends with conclusions and a discussion of opportunities and priorities for cities' learning.

Box 1 Definitions and the waste hierarchy

Anaerobic digestion: the decomposition of organic matter through microorganisms, which occurs naturally under oxygen-deprived conditions and can be used to produce biogas.

Circular economy: an approach that aims to stop waste being produced, whereby waste is eliminated as products and materials are recirculated.

Composting: the decomposition of organic materials to produce a high-nutrient compost that can be used as fertiliser or cooking briquettes.

Landfill gas capture: a type of waste-to-energy technology that seeks to capture methane gas emitted from landfills and that helps reduce the greenhouse gas emissions from landfill sites.

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- 2 'Least developed country' is a category used across the UN system and in much development literature. This term is used here because it is the term used in the report cited. However, the authors would like to acknowledge current debates that question the use of this terminology and its ahistorical framing.
 - 3 In Freetown, the Mayor's Delivery Unit was established to drive forward work in four priority areas under the Transform Freetown agenda. In Kanifing, the mayor receives delivery support from external advisors, supported by the Tony Blair Institute, oriented around key priorities such as property tax reform and international relations, with particular attention to bridging the gap between the council and development partners (Muthama et al., 2021).

Recycling: the recovery of materials from waste and their transformation into new products.

Sanitary landfill: the discarding of waste in a professionally engineered disposal site with environmental protection measures in place.

Waste-to-energy: a process that generates energy in the form of electricity, heat or fuels such as biogas; the term encompasses a wide range of technologies, including incineration, landfill gas collection and anaerobic digestion.

The waste hierarchy

‘The ‘waste hierarchy’ is a well-established conceptual framework that governments use to promote good practices in waste management among public bodies and businesses. It ranks waste management options according to what is best for the environment, giving top priority to actions that prevent waste in the first place. When waste is created, the waste hierarchy gives priority to preparing it for reuse, then recycling (where waste is transformed into a secondary raw material), then recovery (where waste is converted to energy) and, last of all, disposal (e.g. using landfill). While this is considered a useful concept in enabling a transition to modern waste management practices, thinking is starting to move beyond the traditional waste hierarchy towards a ‘zero waste hierarchy’. This focuses more on ‘designing waste out of the system by influencing consumption habits, rethinking business models and making them waste-free by design’, which is seen as more conducive to circular economy principles (Simon, 2019).

Sources: Ellen MacArthur Foundation (n.d.); DEFRA (2011); Mutz et al. (2017); Bundhoo (2018); Simon (2019).

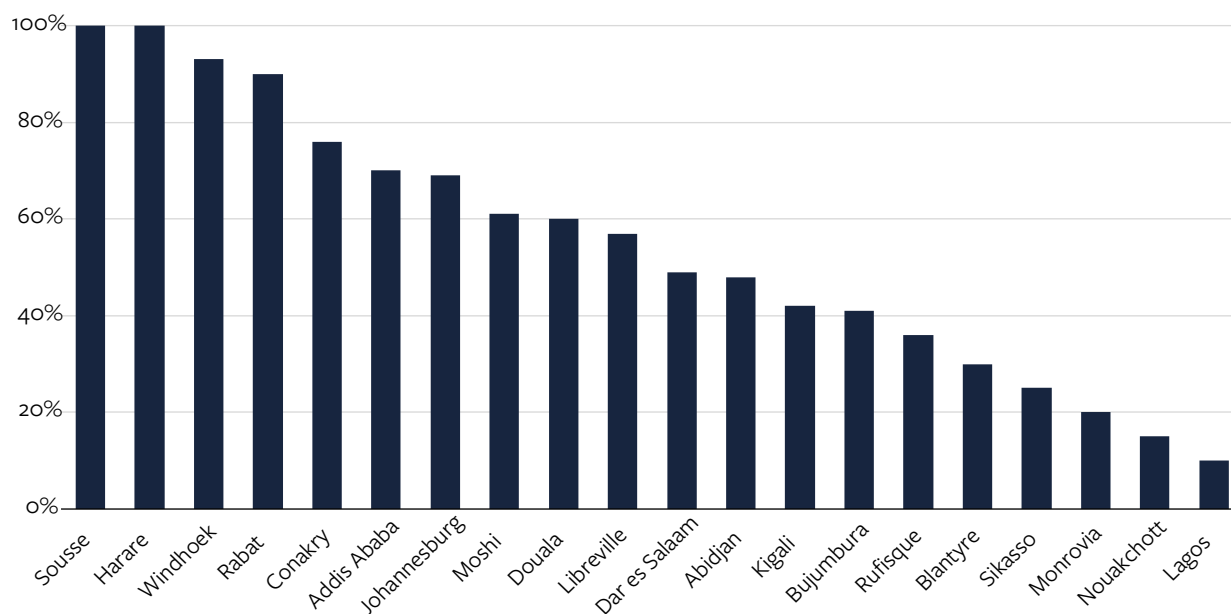
2 An overview of waste management in Africa

Introduction

High-income countries are responsible for the largest generation of waste per capita but sub-Saharan Africa is the world's fastest-growing region in this regard, with its total generation expected to triple by 2050 (Kaza et al., 2018). This increase is being driven largely by the growth in consumption and changing production and consumption trends that have accompanied rapid urbanisation (UNEP, 2018).

Waste collection services are significantly less comprehensive in Africa than in other regions. While collection rates are higher in North Africa, across sub-Saharan Africa only 44% of waste is collected; this can be compared with an estimated collection rate of 71% in East Asia and the Pacific and 84% in Latin America and the Caribbean (Kaza et al., 2018). Figure 1 illustrates the varying collection rates across a selection of African cities.

Figure 1 Waste collection rates in African cities



Source: Kaza et al. (2018)

In Africa, most waste collection takes place in urban areas and very little is undertaken in rural areas; there is also significant variation across urban neighbourhoods, with city centres and wealthy neighbourhoods receiving much greater waste collection coverage than poorer

neighbourhoods, with significant negative impacts, as discussed below (UNEP, 2018; Le Picard, 2020). Comprehensive and reliable data on waste generation, collection rates and the composition of waste is generally lacking, and this is well recognised as a major challenge for the sector (UNEP, 2018).

The treatment of waste collected also varies and, despite the growing importance of recycling, composting and WtE schemes, many African cities still largely follow a traditional waste management approach focused on collection and disposal (Ikhlayel and Nguyen, 2017; Kaza et al., 2018). Formal recycling systems are, therefore, not commonplace; in many locations, informal workers undertake the majority of separation and recycling (van Niekerk and Wegmann, 2019). As such, the waste municipalities collect is often dumped without treatment or separation. This means that, even when waste collection rates are high, such as in Dakar, which has 84% collection rates, waste simply ends up in the city's large, open dumpsite (Banna, 2019).

Many cities have only one official dumpsite, which is often completely overburdened, having received far more waste than it was originally designed for. This is the case in Monrovia, Freetown and Kanifing. Sanitary landfills in sub-Saharan Africa are not common, though some cities, such as Kigali and Dar es Salaam, are making progress in sanitary landfill construction (Bundhoo, 2018). While attention to this area is increasing (Kaza et al., 2018), it is important to note that sanitary landfills remain a low priority according to the waste hierarchy. Fortunately, increasing importance is being placed on adopting an integrated waste management approach that prioritises waste prevention, reuse and recycling to reduce waste generation and the significant economic burden of waste management on municipalities (Ikhlayel and Nguyen, 2017).

Many African countries have a high percentage of organic waste among the waste generated, as is common for low- and lower-middle-income countries (Kaza et al., 2018; van Niekerk and Wegmann, 2019). In contrast, in high-income countries, dry, recyclable waste such as plastic and paper represents approximately 51% of the waste generated; by comparison, in Africa, an estimated 13% of municipal waste is plastic (van Niekerk and Wegmann, 2019). This variation in the composition of waste means waste management strategies that high-income countries use are not always appropriate for Africa. For example, the high levels of organic waste in Africa create much greater opportunities for composting initiatives than is the case in high-income countries.

Increasing attention is being paid to circular economy principles, and countries such as Ghana, Nigeria, Rwanda and South Africa are part of the growing Africa Circular Economy Alliance. Priorities include converting food waste to organic fertiliser to increase circularity in food systems, recycling plastic packaging to increase circularity within the packaging industry and the promotion of e-waste collection and recycling to increase circularity in the growing electronics sector (Schroeder and Tilkanen, 2021). The city of Cape Town is in the process of developing a circular economy action plan, the first example of its kind from an African city (ibid.).

There is significant potential in Africa to extend the informal strategies already in place to deliver more effective waste management strategies on a larger scale. The sector offers opportunities for job creation across all aspects of the waste management cycle, particularly collection, recycling and treatment initiatives (Bundhoo, 2018). This is well illustrated by experience in Pune, India, where informal waste collectors created a 9,000-member union, which led to the formation of a cooperative that partnered with the local city administration to deliver waste management services (WIEGO, 2019). Under contract with the city, the waste collectors are paid door-to-door collection fees directly and are able to separate and sell recyclable materials, generating additional income. The city covers only the cooperative's administrative costs and procurement costs (for carts and gloves) and supports access to health insurance, a minor burden on the municipality's budget compared with previous private contracting arrangements (Dias, 2016). The cooperative has achieved both impressive city coverage with this model and large-scale job creation; it also has one of the best recycling and segregation rates in India (SWaCH, n.d.; WIEGO, 2019). As profiled throughout this study, African cities are experimenting with their own models to work with informal waste pickers, cooperatives and community-based organisations to deliver waste management services. However, there is significant opportunity to expand cities' action in this area.

Community engagement is also important for the waste management sector, given that public participation is key to waste reduction, separation and recycling initiatives. African cities are increasingly looking at public education and strategies for citizen participation, including how to receive feedback and complaints about waste management services. For example, Maputo City Council, in cooperation with a private Mozambican company, has designed a communications platform (Monitoria Participativa Maputo (MOPA)) targeted at low-income areas that allows residents to report waste or sanitation problems to the council. Complaints are passed on to one of the large waste management companies or micro-enterprises to resolve (Making All Voices Count, 2017). The average response time is 90 minutes and, as a result of this platform, 186 informal dumpsites across the city have been removed (World Bank, 2018a; MOPA, 2022). Consultation with citizens regarding the construction of waste management infrastructure is also important, given that the absence of consultation may result in opposition to the construction of landfills and WtE plants (van Niekerk and Wegmann, 2019). Generally, stakeholder mapping and consultation is considered vital for the design of new waste management strategies (C4o, 2016b).

Waste, the environment and health

The low levels of waste collection in many African countries, and the high levels of open dumping, the burning of waste and the lack of adequate treatment of waste, have severe environmental and health impacts. Burning of waste releases pollutants, particulate matter and toxins that pollute the air and can cause respiratory and neurological diseases (Thompson, 2014). It is often informal settlements and poorer areas in African cities that suffer most from these effects, as they are least likely to benefit from waste collection services (Kaza et al., 2018). Residents without formal

waste collection services have been found to suffer from high incidence of respiratory diseases, with women and children, who carry out the burning of waste, likely to suffer most (van Niekerk and Wegmann, 2019). Deaths resulting from air pollution are becoming an increasing problem in Africa, particularly in urban areas, with a 36% increase in deaths resulting from air pollution in Africa between 1990 and 2013 (Roy, 2016).

Dumping of waste in water bodies and waterways also poses major health and environmental challenges. In cities such as Freetown and Kampala, where informal settlements are located near to bodies of water, a frequent coping mechanism of residents who do not receive formal waste collection services is to dump their waste in the water (van Niekerk and Wegmann, 2019; see Freetown case study). This causes water pollution and urban flooding (UNEP, 2018). Even when city administrations collect waste problems occur, as untreated waste often piles up in dumpsites and, depending on the location of the site, this can lead to problems with water pollution.

The climate crisis ‘is adding a new layer to the challenges of urban Africa’, and many cities are already experiencing negative impacts such as extreme temperatures, sea level rises, coastal erosion and flooding (Lwasa et al., 2018). This has widespread implications for critical infrastructure and the wellbeing of urban residents, and can also directly affect waste management infrastructure. For example, the Mbeubeuss dumpsite in Dakar is located near the sea – and in a flood-prone area – posing huge risks to human health in the context of more severe storms, flooding and sea level rise (Banna, 2019).

Untreated waste at dumpsites poses health risks directly to workers, including informal workers, who often work in unhealthy conditions, without personal protection equipment. It can also result in the creation of leachate, a toxic liquid waste formed from the movement of water through waste (Espinoza, 2020). Leachate often leaks into bodies of water and the soil, polluting the environment, causing a range of health disorders and risking the health of residents who depend on these water supplies (Le Picard, 2020). Proximity to dumpsites has also been linked to the prevalence of cholera cases (UNEP, 2018).

In addition, waste left untreated in landfill sites can lead to the release of methane gas, given its decomposition in an oxygen-limited environment. Methane is highly flammable and can lead to explosions, and its inhalation can result in headaches and at high concentrations in respiratory arrest (Macklin et al., 2011). Methane is also ‘the solid waste sector’s largest contributor to GHG emissions. It is many times more potent than CO₂’, implying additional environmental challenges around the treatment and disposal of waste (Kaza et al., 2018: 118).

A variety of strategies can be used to combat these negative environmental and health impacts. The separation and recycling of waste collected is essential to reduce the volume of waste going to landfill. Composting initiatives are particularly useful in reducing the amount of waste going to landfill in Africa, and various methods are available for cities interested in composting at scale.

WtE initiatives are also increasingly popular, though such projects are complex and expensive. Sanitary landfill management is critical to deal directly with the potentially negative environmental impact of waste at the point of final disposal. Section 5 discusses innovations in this area further.

Waste management and informal settlements

Residents of informal settlements are most likely to be excluded from formal waste management services, and therefore to suffer from the negative health and environmental impacts of poor waste management (Jones et al., 2014). As a consequence of this exclusion, they are forced to use open burning or indiscriminate dumping, increasing local rates of air and water pollution (Mudu et al., 2021). According to the UN Human Settlements Programme (UN-Habitat), urban areas underserved by waste management services typically have ‘twice as high diarrhoea rates and six times higher prevalence of acute respiratory infections, compared to areas in the same cities where waste is collected regularly’ (UN-Habitat, 2010: 88). Landfills and dumpsites are often located near to low-income neighbourhoods, exposing residents to the corresponding increase in pollution (World Bank, 2018b; see Kanifing case study). Residents of these communities often work informally on dumpsites, without protective equipment, collecting, sorting and selling waste for recycling (van Niekerk and Wegmann, 2019). Those working on and residing close to dumpsites have been shown to suffer from higher cancer and mortality risks, increased cases of birth defects, congenital anomalies and respiratory diseases (Mudu et al., 2021).

Often, wealthier parts of African cities have their waste collected by trucks, and in a more consistent manner than is the case for informal settlements, which are often served by tricycles or carts (World Bank, 2018b). When waste collection is privatised, it is common for this to exclude poorer areas, owing to an inability to pay (Jones et al., 2014). Even when schemes are put in place to cross-subsidise collection in informal settlements with higher fees collected from wealthier neighbourhoods, these initiatives can have poor results if companies fail to collect or introduce improper additional charges of some kind (ibid.).

Throughout Africa, projects have emerged that directly integrate the residents of informal settlements into local government-led waste management programmes (van Niekerk and Wegmann, 2019; see Box 2). This integration is crucial to meet the needs of these citizens in an effective manner and for waste management to function efficiently.

Box 2 Low-cost, inclusive waste management in Zanzibar, Tanzania

More than 80% of Zanzibar's waste is wet organic waste, making it an ideal material for composting. A recent initiative seeks to compost wet waste while sorting and recycling dry waste, with the aim of making Zanzibar a zero-waste island. This project is being led by Zanzibar's Urban Municipal Council, working in partnership with the Zanzibar Environmental Management Authority and the Centre for Science and Environment, under a decentralised pilot programme launched in 2017. The project is implemented in Shaurimoyo, a low-income area. One-third of the households in this neighbourhood are employed as part of this project, with households chosen by the Shaurimoyo Waste Management Society, a local informal group. The workers separate the waste, composting the wet waste for sale and selling dry waste separately to recyclers. In addition to the money they make from this, they are paid monthly by the council. The council has employed eight members of the Shaurimoyo Waste Management Society to educate the rest of the community on waste segregation and the selling of compost. These workers receive \$35 a month and can earn extra money through the sale of recyclables. This waste management programme effectively combines low-cost methods with an inclusive design that benefits the residents of informal settlements.

Sources: Henam (2018); van Niekerk and Wegmann (2019).

Informal waste workers

Informal workers are central to the collection, sorting and recycling of waste in Africa (UNEP, 2018). UN-Habitat has reported that informal waste pickers collect 50–100% of waste in cities in low-income countries, at no cost to municipalities (UN-Habitat, 2010). However, city administrations often ignore informal waste pickers, despite the vital services they provide (Dias, 2016). At the same time, the waste management sector is critical to waste pickers' livelihoods; they generate their income through the sale of recyclable materials to private enterprises and individuals, in addition to other activities such as composting (ibid.). As such, any reform efforts will directly affect their income generation strategies.

A common focus of reforms involves efforts to formalise waste workers. This can bring benefits, though it can also imply significant costs to the community. Benefits include enabling workers to access protective equipment; reducing their exposure to hazardous materials; helping combat social exclusion; supporting workers by ensuring fair prices from brokers; and providing them with medical insurance, holiday and sick pay (van Niekerk and Wegmann, 2019; see Box 3).

Box 3 Informal waste workers' cooperatives in Moroccan cities

In Morocco, informal waste workers have formed cooperatives to ensure their fair employment after the privatisation of landfills. Informal waste workers created the cooperative At-tawafouk in 2010 in Rabat after the government closed the dump and replaced it with the Oum Azza landfill. This landfill is managed by a French company called Pizzorno Environment. The workers At-tawafouk represents are formally responsible for recycling; they receive a salary of around \$265 a month, as well as additional benefits such as health insurance and access to protective equipment. Cooperative workers can also access a bank account and a low-cost mortgage.

Meknès city administration also replaced its dump with a modern waste disposal centre managed by a private company, SUEZ, which was awarded the contract in 2014. Informal waste sorters who worked on the old dumpsite formed a cooperative called Attadamoun. This cooperative ensured the provision of training and protective equipment for the workers. SUEZ formalised and employed 180 informal workers. A major focus of the company's efforts was reducing the social stigma around waste collection and providing the workers with a more elevated position within society.

Sources: van Niekerk and Wegmann (2019); SUEZ (2022).

However, formalising informal workers also risks disrupting successful income generation strategies. For example, when waste management services are formalised, and local authorities or private companies take over landfill sites or collection services, informal workers can lose out on work opportunities if employed in lower numbers; they may also find themselves earning less in their new occupation as a result of these reforms (van Niekerk and Wegmann, 2019). This happened in Dakar when a youth movement that had been cleaning neighbourhoods was incorporated into the formal system with lower pay. Further problems occurred in Dakar when the government attempted to close down the Mbeubeuss landfill. The estimated 3,500 workers who make a living from salvaging and selling materials from this dumpsite strongly opposed this measure (ibid.). Problems also occurred in Lagos when a private company took over the Olusosun dumpsite, with waste pickers able to sell their recyclables directly to the private company, Revive, for only around half the price they used to receive for the sale of their materials (Sesan, 2018). See also Box 4 for an overview of the experience over the past two decades of informal workers in Cairo's waste management sector.

Box 4 Informal waste workers in Cairo

Cairo is home to a large community of informal waste workers, known as the Zabbaleen, who collect 50–60% of the megacity's waste. Of the waste collected, approximately 80% is recycled; for comparison, the UK's recycling rate in 2020 was 44%. The Zabbaleen offer a door-to-door waste collection service around Cairo, collecting fees from households for this. They then take the waste back to their communities to sort, with recyclables separated and sold. There are an estimated 50,000 waste processors from this community and approximately 150,000 people additionally working as collectors, sorters, traders and truck drivers.

This community has a history of tension with the government as a result of the latter's efforts to privatise the waste collection and recycling sector. In the early 2000s, the government allowed private companies to engage in waste collection, with charges for customers added onto electricity bills. This meant all residents were paying the charge, despite many preferring to continue with the Zabbaleen's services. After citizens complained about irregular collection and inadequate street cleaning, the private companies involved incurred heavy municipal fines. Subsequently, the government did not renew their contracts. Hundreds of Cairo residents also filed lawsuits against the government, arguing that the automatic charge for the private companies' waste collection services on their electricity bills without the option to opt out was unconstitutional. During this period, the Zabbaleen witnessed losses of up to 75% on their revenue from waste collection, separation and recycling services. However, while the city government may have been slow to engage with the Zabbaleen, these informal workers offer a very cost-effective service. Analysis has shown that they save the city around €12 million per year in avoided collection costs.

The Zabbaleen are facing a renewed threat to their livelihood. On 13 October 2020, the government passed a new Waste Management Law. This aims to incentivise the waste management business sector and to encourage investment in waste management services, including treatment and recycling services. Under this scheme, the government hopes to encourage the Zabbaleen to take up employment with private companies, to collect and recycle waste for them. There is concern that this will result in significant financial losses for the Zabbaleen given that their income comes from household service fees and tips and the sale of recyclable materials.

Sources: Anheier et al. (2004); Gunsilius et al. (2011); van Niekerk and Wegmann (2019); Shalakany (2020); Enterprise (2021); Iskander (2021); DEFRA (2022).

Some cities have also developed contractual arrangements with micro and small enterprises for waste collection. For example, in Monrovia, the city has worked since 2007 with a community-based enterprise (CBE) model created as part of the city's urban sanitation project that was

supported by the World Bank. CBEs are responsible for door-to-door waste collection services, paying the council for their licences and then charging households for the service. In Monrovia, the council has also in the past paid disadvantaged young people, including ex-combatants, to collect plastic waste from the streets of the city. However, inadequate city financing has prevented the continuation of this project. In eThekweni, the council works with community-based contractors (CBCs), hired particularly to collect waste in low-income, high-density settlements, given their more limited road access (eThekweni Municipality, 2016). As detailed in Section 3, Freetown has similar arrangements with its tricycle microenterprise groups.

Costs and financing challenges

It is estimated that in low-income countries waste management takes up nearly 20% of municipal budgets, compared with around 10% in middle-income countries and only 4% in high-income countries (Kaza et al., 2018). In some African cities the rate is significantly higher than 20% and, for many, solid waste management can be the single largest item of the municipal budget (UNEP, 2018). For example, Monrovia city uses more than 50% of the income it receives from central government for waste management. One reason for this is a very low own source revenue collection in the city, which, unusually, does not collect or receive any revenue from property tax, as the central government collects and does not redistribute this tax to the city administration.

Responsibility for waste management is usually decentralised and placed on city councils and local government. This has additional financial implications, as budgets allocated from central governments do not always correspond to the level of capital investment and the operational costs involved (van Niekerk and Wegmann, 2019). The financial constraints of city administrations can also result in understaffing in local waste management departments (C40, 2016b).

An overall lack of funding – both limited municipal revenues and low revenue generation from waste management fees – has major implications. Countries in sub-Saharan Africa often rely on donor funding to build sanitary landfills, which means that, despite sanitary landfills being a basic necessity for effective waste management, they are still relatively rare (Chisholm et al., 2021). The lack of funding also often translates to a lack of vehicles for collection, difficulties providing receptacles for households to separate and store waste for collection, and an inability to invest in appropriate recycling and treatment systems at scale (see Freetown and Kanifing case studies). This is one of the key reasons for caution around seeking to replicate the more expensive waste management models of higher-income countries; financial (as well as capacity) constraints mean locally appropriate solutions are encouraged (World Bank, 2018b).

Revenue can be generated from waste management services, not only from fees for collecting waste but also from recycling and WtE initiatives. Ideally, revenue generated from waste management would cover the costs of operating the service. However, while full cost recovery is common in high-income countries, this is far from the case in low-income countries (Kaza et al., 2018). African cities

are certainly generating some revenue from fees, but few generate sufficient income to cover all of the costs associated with the full solid waste management cycle (from waste collection through treatment to disposal) (Jones et al., 2014; UNEP, 2018).

At the same time, care needs to be taken setting fees, as low-income households can easily be excluded from collection if fees are set too high (Jones et al., 2014; see Freetown and Kanifing case studies). Some cities set graduated fee rates. For example, in eThekweni municipality, households pay for waste collection via their monthly metro bills, with the charge dependent on property values (and no charge for properties with a value up to R250,000) (equivalent to \$15,718 on 27 April 2022) (eThekweni Municipality, 2016). The municipality has managed to reach a high waste collection rate with its tariffs.

For certain types of initiatives, particularly for WtE plants, investment costs are high. Although these projects generate income from the energy for sale, high capital and running costs mean revenue is rarely sufficient to cover all costs, and financial risks for cities involved in these projects are usually high (Mutz et al., 2017). The higher costs of electricity production using this technique, instead of other existing electricity generators, can also make it an unsuitable option for the electricity sector (Le Picard, 2020). WtE schemes also have numerous impacts, including on informal waste pickers and recycling strategies. In particular, they can lock cities into high waste demand instead of encouraging recycling and reuse of waste (Corvellec et al., 2013). Section 5 discusses these aspects in more depth. Across many African cities, financial constraints mean there will continue to be a need for government subsidy and investment, both to ensure that low-income areas are properly served and for there to be the required investments in proper treatment and disposal systems.

Securing private finance for the waste management sector is also seen as a difficult area for cities. The sector is seen as a high-risk investment in Africa (UNEP, 2018). Nevertheless, some cities are exploring feasibility and preparing projects that can attract investment to the sector (see Box 5).

Box 5 Riverine management in eThekweni, South Africa

eThekweni municipality stands out from other local governments internationally for its focus on adopting early adaptation measures to tackle the climate crisis and deliver development objectives. Riverine management has become a key part of eThekweni's climate response and waste management strategy, given that a high percentage of uncollected waste ends up in its many waterways. The municipality contains 18 major river systems, with many informal settlements constructed in flood plains and extremely vulnerable to the effects of river pollution and increasingly frequent flooding.

Since 2010, the municipality has been making serious efforts to improve riverine management, including by investing in the removal of litter and waste from stream areas to reduce blockages and working with community cooperatives to clean 300 km of stream banks and culverts. A special purpose vehicle (Green Corridors NPC) has also been created, with the city working in partnership with other stakeholders and employing local communities for riverine management (and including upcycling of the waste collected), as well as supporting community-based ecotourism.

The municipality is currently building a business case for transformative, large-scale urban riverine management, in collaboration with the C40 Cities' Finance Facility.⁴ Demonstrating the financial value of ecological infrastructure to reduce flooding risk has been a key part of building this business case, as has demonstrating the job creation potential for low-income communities that are directly involved in delivering riverine management and ecosystem restoration services.

Sources: Roberts (2010); World Bank (2016); C40 Cities' Finance Facility (2019).

The limited finances available for waste management have led many cities in Africa to contract out services to private operators, which then collect fees directly from households and businesses. This has generally translated into the provision of services in richer neighbourhoods to the neglect of low-income areas (van Niekerk and Wegmann, 2019). Numerous privatisation failures in the sector have been documented in cities in Egypt as well as in Dar es Salaam and Lagos, with companies often performing poorly, resulting in low coverage of collection services as well as negative impacts on the livelihoods of informal waste workers (ibid.). City governments can struggle to supervise private contractors and enforce contracts, which may result in less efficient service provision; appropriate incentives and enforcement mechanisms are considered key (Kaza et al., 2018; World Bank, 2018b). However, many cities are seeking new forms of private sector partnerships, particularly to advance composting, recycling and WtE initiatives (see Freetown and Kanifing case studies and Section 5). In Freetown, the mayor's efforts to set robust criteria for private sector partners, to maximise the benefits that can flow from public-private partnerships (PPPs), are notable.

4 The CFF provides technical support to cities to prepare 'finance-ready' projects in relation to climate mitigation and resilience initiatives, as a key step towards accessing private finance opportunities.

3 Case study: Freetown City Council

Context

Freetown, the capital city of Sierra Leone, is a peninsula with an estimated population of 1.27 million (World Population Review, 2022). This population has doubled in size in the past 30 years, partly because of the climate crisis and the 10-year civil war (1991–2002), which resulted in the migration of people from rural areas in Sierra Leone to the capital (Aminu et al., 2019). This expanding population has caused the city to sprawl beyond municipal boundaries, with settlements in the hillside, along the coast and inland. This has led to deforestation and land reclamation, resulting in increased flooding, landslides and extreme weather conditions. The lack of devolved funding in Sierra Leone has left Freetown City Council (FCC) struggling to provide effective waste management to the increasing city population.⁵

The city is still suffering from the legacy of the civil war, which destroyed waste infrastructure such as skips and skip trucks (Sood, 2004). It has two official dumpsites, Kingtom in the west and Kissy (Granville Brook) in the east, both of which have now reached capacity. However, a great deal of waste generated in the city never reaches these dumpsites, with solid waste commonly dumped on the streets and in rivers, blocking drains and increasing flood risk and air pollution. FCC reports that there are 46 major illegal dumpsites across the city. A major focus of the council's initiatives has been clearing illegal dumpsites and expanding household waste collection services.

The Local Government Act (LGA) of 2004 provides FCC with a mandate to take direct responsibility for waste management in the city. It also provides for grants from the national government for local councils in accordance with their need for additional income to provide necessary services. The Act was reviewed in 2019 with the aim of decentralising public services to enable greater local accountability (Thomas, 2019). It is currently with the Ministry of Local Government and is waiting for parliamentary approval. FCC's mayor is advocating the powers in the LGA be delegated as soon as possible, as this delay is significantly constraining her capacity to deliver not only waste management services but also building planning and regulation, the lack of which exacerbates the waste problem. Currently, the council operates with limited ability to reform services, inadequate resources for waste management, heavy reliance on donor funding and technical assistance, and very little support – and sometimes active obstruction – from central government.

FCC's waste management workforce and programme

The Sanitation and Environment Department within FCC is responsible for the management of municipal waste and is headed by the environment and sanitation officer (ESO). The ESO's

5 All information here that is not sourced comes from interviews with the technical team working on waste management in Freetown. Information on the series of interviews is provided in Appendix 2.

assistant is responsible for the sanitary inspectors – employees of FCC who go out into the community with the aim of engaging residents on sanitation laws and ensuring compliance with them. Of the 600 staff FCC employs, 100 work on waste management.

FCC divides its waste management strategy into disposal of solid waste generated in public areas such as markets, streets, drains and open areas across the city and disposal of the solid waste generated by households and businesses (see Figure 2 for a visual representation of the workforce and programme). The council directly supervises and manages cleaning and waste collection in public spaces. It hires youth groups that it supports to conduct twice-daily street sweeping and removal of waste. The city is divided up into eight blocks, and six-person groups are assigned specific areas within each block. They have an additional support team of 47, using eight trucks and five tricycles, whose sole responsibility is to clean and dispose of the waste from the city's 42 markets. Block coordinators are responsible for monitoring the groups to ensure they are working effectively and collecting data on the amount of waste generated (see Box 6 for a discussion of the volume of waste generated in the city). Once a month, the FCC sanitation department and the tricycle groups undertake extensive cleaning, such as shrub removal, of major roads.

Box 6 Waste generation in Freetown

Every day in Freetown, an estimated 550 tonnes of solid waste is generated. The city's two official dumpsites, Kingtom in the west and Kissy (Granville Brook) in the east, each receives around 90 tonnes of waste per day. As such, just over 30% of the waste generated in the city is properly reaching the legal dumpsites. FCC aims to increase this figure to 60% within the next year with its new investments in a number of transfer stations across the city. Waste characterisation studies show that the solid waste in Freetown largely comprises organic waste (66%), followed by paper/card (8%), metal (2%) and plastics (16%). The council is currently constructing a weighbridge at the Kingtom dumpsite to monitor the volume of waste going into the dumpsite in order to improve its waste management data systems.

Sources: FCC (2021); Hydrophil (2021); interview material.

Household waste collection is carried out by private waste collection service providers that consist of tricycle youth groups, waste collection companies and manual operators.⁶ The household waste collection that the private waste collection companies carry out takes place mainly in wealthier areas of the city, with companies charging between LE30,000 and LE75,000 (\$2.30–5.80 as of 26 May 2022) per household per month (FCC, 2016). For commercial properties, companies charge between LE1.5 million and LE4 million per month (\$115–308 as of 26 May 2022) (ibid.).

6 'Manual operators' push a cart to collect waste from households and are not registered with the council.

Figure 2 FCC's solid waste management workforce and programme



Collection of waste by tricycle is one of the flagship initiatives launched by FCC as part of its Local Microenterprise Development Project in June 2019. Through this programme, microenterprises, run largely by youth groups, collect household waste using tricycles, which enable easier access to informal settlements. This programme was initially set up with 80 tricycle carts (funded by a European Union (EU) grant and the International Organization for Migration (IOM)), and later expanded with an additional 40 tricycles (funded by the Mayor's Migration Council from February 2021) (MMC, 2022). Under this programme, FCC supports the registration of tricycle groups, provides them with tricycle equipment and trains the young people on how to start their own waste collection businesses. This training includes support to set up bank accounts and to understand unionisation and insurance aspects. The council also has a fund that the tricycle operators can access for the maintenance of their equipment.

With this preparation, these groups can then market themselves to households as a waste collection service, operating twice weekly and collecting fees directly from households that use their services. They charge an average of LE25,000 (\$1.90 as of 26 May 2022) per household per month (FCC, 2016). On top of its inclusive job creation aspects, this programme was conceived of as a way to improve household waste collection in low-income areas where people often could not afford to pay larger companies to collect their waste, or where large companies' waste collection trucks were unable to effectively navigate the challenging topography.

This scheme has been very successful, particularly in its contribution to tackling youth unemployment. In total, it has created 1,200 jobs, with 70% of these going to rural migrants living in informal settlements (FCC, 2021). And there is evidence that these jobs are sustainable, with 78 out of the 80 microenterprises registered under the scheme initially having been evaluated as turning a profit (*ibid.*). In addition, the programme has greatly increased the coverage of household waste collection services. When the initiative was launched, the number of households registered for waste collection in the city was 8,000; this number has now climbed to 35,000.

To further strengthen its waste collection programme, the city has completed six transfer stations.⁷ These consist of a gated compound into which the tricycles ride. They can then proceed up a ramp located next to the trailers into which the tricycle drivers dump their waste. Tractors tow these trailers to the nearest dumpsite. FCC undertook this investment after conducting a transfer station pilot at the end of 2020. This pilot showed that tricyclists could double the number of their trips while reducing wear and tear to their tricycles. The six new transfer stations will reduce the distance waste collection service providers have to travel, thereby discouraging the dumping of waste by tricycle groups attempting to cut down their travel times so they can reach more households and generate a greater income. While the transfer stations are ready, they are not yet operational, as FCC still needs to buy the necessary vehicles to make the system fully

7 Freetown is divided into eight blocks. The dumpsites are located in two of these and these new transfer stations are located across the other six blocks.

functional. At the time of writing, procurement of the tractor/trailers is underway. This initiative has also been subject to some challenges, with one transfer station shut down after it was closed off by the Ministry of Lands.⁸

Under its waste management programme, the council has also focused heavily on trying to change residents' attitudes towards the illegal dumping of waste, as well as promoting community engagement in the maintenance of local areas. In areas previously used for illegal dumping, FCC has been planting trees and flowers to prevent further dumping. The scheme has identified 69 sites, with 16 cleared and four greened. These urban greening efforts are supported by the ambitious Freetown the Treetown programme, under which FCC aims to plant a million trees (Fisseha et al., 2021). This approach is inspiring replication elsewhere: Monrovia City Council is planning to implement a similar model, paying citizens to plant trees in areas formerly used for illegal dumpsites, to prevent further dumping.

FCC also runs media campaigns informing people about waste management, the negative impacts of burning waste and the legal repercussions of incineration and illegal dumping. The council has community engagement teams that patrol Freetown three days per week, trying to educate residents on good hygiene practices, sanitation laws and how to register for waste collection. In 2021, the council increased its enforcement capacity by 50%, expanding and reforming the city's Metropolitan Police, which enforces sanitation bylaws, educates communities and encourages behaviour change. An additional 50 officers were recruited, and the force was retrained and reorganised to improve its operational efficiency, accountability and transparency. A complaints hotline has also been created through which residents can anonymously report violations of sanitation bylaws, and increased numbers of metropolitan police have been posted around Freetown to enforce laws. This approach in Freetown has inspired similar action in Kanifing, which is planning to set up a call centre (see Kanifing case study). Monrovia's council plans to set up a regional sanitation and information centre, which will also house a call centre for residents to report illegal dumping.

FCC also runs the Cleanest Zone Competition, which awards prizes to the community that has shown the largest behavioural shift in its management of waste – for example increased numbers of residents signed up to waste collection services. Jalloh Terrace residents won the 2019–2020 competition and were awarded 10 solar streetlights, one 10,000 litre water tank, scholarships for 10 children and LE50 million (\$3,845 as of 26 May 2022) to undertake a development project based on community priorities (FCC, 2021).

8 The minister took the position that FCC did not have the legal authority to construct a transfer station on the land, leading to its dismantling and closure.

Liquid waste management in Freetown

Given historic infrastructure investments – and as the waste management infrastructure in the city has not expanded in line with population growth – only the Central Business District (CBD) in Freetown possesses a sewage system. This system is antiquated and discharges raw sewage into the ocean, polluting the water. The population residing outside the CBD is served largely by pit and bucket latrines (60–70%); septic tanks serve a wealthier minority (approximately 25%) (Komba, 2021). This pattern is reflected in other African cities, such as Dar es Salaam, and stems from colonial era decisions, when sanitation services were constructed in wealthy neighbourhoods to serve the ruling elite (Pastore, 2015).

Before the operationalisation of a faecal sludge plant in 2021, it was largely private companies that collected liquid waste, using slurry trucks and pumps to drain septic tanks and pit latrines. The faeces were then transferred to the landfill located in Kingtom, emptied directly into drainage ditches or straight onto the dumpsite. Fortunately, the city's first faecal management plant is now in operation at the Kingtom dumpsite. Faecal sludge is transferred to this plant from the mainly wealthier households and institutions that have septic tanks. It is deposited into a mixing tank and filtered through geobags, removing and filtering the liquid to be deposited into the ocean (FCC, 2021). This investment by the UK's Foreign, Commonwealth & Development Office (FCDO) was supported by GOAL, which delivered the project and, at the time of writing, is working in coordination with FCC to train technical staff. In addition, the Bill and Melinda Gates Foundation has donated a vacuum truck for the collection of liquid waste, which FCC will lease to a private company for household collection.

FCDO and GOAL are also donating two trucks to help ensure the increased provision of mechanised services for the emptying of pit latrines in hard-to-reach areas, as opposed to reliance on manual pit emptiers, who are unregulated and dump waste illegally (Hydrophil, 2021). Similarly, under Freetown's Blue Peace Initiative, supported by the United Nations Capital Development Fund (UNCDF) and the Swiss Agency for Development and Cooperation (SDC), vacuum trucks will be procured and leased to private operators, in an attempt to increase the effective collection of liquid waste from hard-to-reach areas.

The city receives revenue from the faecal sludge plant. Private companies offloading liquid waste at the new plant pay LE90,000 for smaller trucks and LE110,000 for larger trucks (\$7 and \$8.50, respectively, as of 26 May 2022). This payment uses a cashless system, whereby the private operators can buy a book of vouchers from the council banking facility and present the vouchers when they drop off the waste. This system was implemented over a period of three months in the last quarter of 2021. It followed a baseline exercise that indicated that potential revenue from tipping fees was being lost at multiple points in the value chain, largely because of poor monitoring, enforcement and accounting, combined with fraudulent and/or irregular practice. Implementation of a voucher system, requiring operators to pre-purchase tickets at a bank, has both improved data collection and transparency and removed the need for cash to pass

hands elsewhere in the value chain. As of February 2022, it is estimated that the intervention has increased revenue by a factor of five. FCC is now designing a model to replicate this system across the entire waste value chain.

FCC and GOAL are currently jointly developing a business and operating model that aims to cover the costs of the faecal sludge plant, such that it can run sustainably into the future without reliance on third party donor funding. This will rely not only on sound financial systems (such as cashless payments) but also on maximising the potential for monetising the compost that results from the treatment process; FCC is working with public and private institutions to research potential income streams from the agriculture and energy sectors, and from innovations such as clean cooking briquettes. At the time of writing, indicators suggest that the plant will be in a position to cover its costs by the end of 2022.

Challenges

Freetown is facing a multitude of challenges that obstruct effective and sustainable waste management for the city. Illegal dumping is a key issue, resulting from a lack of waste depository sites and waste collection service providers relative to the size of the rapidly expanding population. Additionally, the two major landfill sites have reached capacity, and plans for the creation of a new landfill site have made slow progress because of difficulties in locating suitable land for the new dumpsite and the subsequent purchasing of this land. However, FCC is currently finalising the deal to buy the land and plans are in progress for construction of a new sanitary landfill.

One of the most critical challenges the city is facing is inequality in access to waste collection services. In wealthier areas such as Signal Hill and Lumley, residents and business owners have the capital to afford house-to-house waste collection. However, waste management services still exclude many of the residents of informal settlements. While access has increased thanks to the investment in tricycles and the Local Microenterprise Development Programme, not all households in the informal settlements served can access these services: the fees charged still leave the service out of reach for some. In addition, some informal settlements are located in areas with a topography that renders them inaccessible by tricycles, and are therefore without waste collection services. An earlier project (implemented by FCC, in conjunction with Concern Worldwide) aimed at remedying this exclusion. This built platforms in three mountainside informal communities and extended the track from the city centre to this platform, enabling tricycles to reach the area and collect waste that community members delivered to the platform. However, this project ran out of funding before platforms could be built in other hard-to-reach areas, leaving many informal communities still unserved by waste collection services.

Enabling equitable access to official skips across the city is also a challenge. While there is a high distribution of skips in the west and centre of the city (in areas such as Lumley), few official skips are found near the informal settlements located in the hillsides and in low-lying coastal areas

(Aminu et al., 2019). As it is largely women and children who dispose of waste, the location of collection sites far from informal communities, and in isolated areas, represents a risk to their security (Hydrophil, 2021). It also results in reliance on burning waste and the dumping of waste in waterways, which in turn increases the risk of flooding and has health impacts: Freetown's hillside communities, and those adjacent to the city's main dumpsite, have reported an increased prevalence of respiratory illnesses believed to be linked to the burning and dumping of waste (Macarthy et al., 2018).

As noted above, the council has focused on enforcement, including an increased police presence and the threat of fines and imprisonment, to change community behaviour around the dumping of waste. Residents are given three days to clean their surroundings after being handed a notice by council employees; if they do not comply, they are charged LE500,000 (\$38.50 as of 26 May 2022) (more than a month's salary for many informal residents) or six months in prison. Between January 2020 and January 2021, 210 arrests were made for non-compliance and LE44 million (\$3,384 as of 26 May 2022) was levied in fines. This provides much needed revenue for the council and is a strong deterrent to those who abuse sanitation bylaws, by for example dumping in waterways or disposing of faecal sludge inappropriately.

However, these measures can have a negative impact on the lives and livelihoods of those involved, and have been criticised for criminalising the 'coping mechanisms employed by residents of informal settlements', who are unable to easily access official waste management services (Aminu et al., 2019: 3). Additionally, while the complaints hotline has been effective in targeting scarce assets to where they are required, it has inevitably encouraged some level of social division: neighbours are reporting on neighbours. There is also the risk that, without proper control mechanisms, council-endorsed sanctions and fines can lead to small-scale corruption, whereby police officers extort bribes from low-income residents. FCC is aware of these risks and is working to mitigate them through increased transparency, capacity-building and professional development in the FCC Sanitation and Environment Department and the police.⁹

The lack of recycling is also a major issue. Although FCC has made efforts in collaboration with partners such as the United Nations Development Programme (UNDP), IOM and the EU to fund programmes providing training and support for microenterprises working in upcycling in informal settlements, these schemes have been limited by a lack of funding, resulting mainly in small-scale and short-term projects (Aminu et al., 2019). Political interference from the national government has also prevented FCC's attempts to launch several plastic recycling initiatives. For example, in 2019, the Plastic 2 Build scheme – which planned to recycle plastic into materials to build houses – was unable to progress. This owed in part to the lack of any national regulation or legislation encouraging the use of recycled materials in the construction

9 Examples include professional development courses for police officers and sanitation inspectors and the establishment of a computerised complaints management system that aims to track sanitation complaints and breaches from first report to conclusion.

and corporate sectors and the absence of interventions by national ministries (such as the Ministry of Environment) to encourage a circular economy. This demonstrates that, without central government support – and incentives or policies to support recycling as part of a circular economy and to build know-how in governing bodies – initiatives such as Plastic 2 Build will struggle to gain momentum. FCC recognises this as an area where reform could have transformative effects and is working with national (e.g. Ministry of Environment) and international (e.g. World Bank) partners to address this issue.

FCC's financial constraints are also a major challenge, including the low levels of revenue generated through its waste management programme. The next section discusses these constraints further.

Costs and financing

FCC spends around LE8–10 billion (\$615,000–769,000) a year on waste management. The five major expenditures for waste management in Freetown are fuel for waste collection vehicles and the heavy machinery in operation at dumpsites; staff costs for the council sanitation team; equipment maintenance; policing the dumpsites; and finally community engagement and awareness campaigns.

The budget for waste management depends on FCC's own source revenue, including revenue generated from the waste management system, as well as a variety of donor grants. FCC's own source revenue originates from three main categories: property tax, market fees and business taxes, as well as a range of other small local fee categories. There is no specific tax applied for waste management services. As with many African cities, own source revenue collection is limited. However, Freetown has had notable successes improving its property tax system. In 2018, it introduced a pilot for a new property tax system that was extended to the whole city in 2019. By April 2020, FCC had doubled the number of properties in the register (reaching 95% of all properties) and addressed the systematic undervaluation of high-end properties, resulting in the tax payable on the top quintile of properties more than tripling (IDS, 2021). Overall, this new system is expected to increase the revenue raised by property tax fivefold (Bakarr Kamara, 2020).

While the achievements with the property tax system are impressive, the city is still struggling to meet all of its investment needs; this is evidenced in the insufficient funding available for waste management projects. The council remains strongly reliant on its general tax revenue to fund waste management service provision, reducing its budgetary capacity for other essential local services. Waste management revenue comes mainly from tipping fees. As already noted, a nominal amount of revenue is raised through charging of fines to residents and revenue from the faecal sludge plant.

A major problem is the low level of tipping fees. While tricycles are typically able to dump their waste for free, large trucks pay LE80,000 (\$6.20 as of 26 May 2022) to drop one load at the

dumpsites, and the biggest private waste collector, a company called Masada, pays a flat rate of LE3 million per month (\$231 as of 26 May 2022). FCC considers these rates to be overly beneficial for the private sector. This is demonstrably the case given that Masada charges just one commercial property \$115–300 a month for collection. The council has declared that it intends to recalculate fees in the near future, in an attempt to make solid waste management in the city more financially sustainable. FCC is also planning to introduce the same voucher system it uses at the faecal sludge treatment plant for the dumping of solid waste, with the aim of similarly reducing leaking from the current cash-based system. These will be important improvements that will help improve cost recovery within the waste management system.

Given the council's limited financial resources, and the need for significant capital investments, donor partners fund most of the waste management projects in Freetown. For example, the council received an LE3.2 billion (\$246,000 as of 26 May 2022) grant from the EU for the Local Microenterprise Development Project, with further funding from the MMC as part of its Global Cities Fund for Inclusive Pandemic Response. GOAL – with funding from FCDO and technical assistance from Water-Share Ireland – developed the faecal sludge plant in Freetown. SDC and UNCDF have provided funding for water and sanitation projects in Freetown as part of the Freetown Blue Peace Initiative.

In order to counter this unsustainable reliance on donors, the mayor of Freetown has focused on ensuring the endurance of these projects after funding ends. As already noted, the vast majority of the microenterprises set up to deliver household waste collection services are turning a profit. The city is also experimenting under the Freetown Blue Peace Initiative with a new form of capital mobilisation, through the creation of a municipally owned special purpose vehicle (SPV). The SPV will issue a bond that will raise funds for investment in water and sanitation initiatives according to business models developed for different facilities (water kiosks, public toilets and liquid waste trucks) (UNCDF and SDC, 2022). These business models are centred around community engagement, with interventions designed in dialogue with community stakeholders to respond to residents' needs and interests and to ensure full cooperation and support from residents (*ibid.*).

The city is also working on creating a profit-sharing model with private companies. This shift to a PPP model is driven by concerns about the financial sustainability of programmes initiated with donor support. It is also based on a vision of the city's waste as an economic resource. The private sector will benefit from reliable and consistent access to the council's waste value chain, and the council can demand a profit-share from activities such as recycling and WtE programmes. This strategy seeks both to reduce the burden on the city's waste management system (and budget) by reducing waste in landfills and to leverage private finance for investment in an area where the city's resources are constrained. FCC has already created a procurement system to identify private sector partners to work with in all areas of sanitation. Calls for proposals were put out this year (2022) and the council is currently progressing talks with a number of private sector actors to take forward its new initiatives. Within these negotiations, FCC has made clear that robust criteria will apply to all private sector partners, particularly in relation to clean energy, improved

conditions for informal recyclers and the employment of youth, women and minorities (including people with disabilities). The potential for inclusive job creation to flow from these partnerships is a central concern guiding all of FCC's decision-making, alongside a strong focus on environmental and climate-related aspects.

New initiatives and future aims

The council and the national government are working in coordination with the World Bank to construct a new sanitary landfill located outside of Freetown to support the two landfill sites currently in use, while working on a long-term closing plan for Kissy dumpsite and upgrading of Kingtom dumpsite. The new sanitary landfill will be fenced off and will have easy access routes for waste collection vehicles, a drainage and leachate treatment system and space for separation and recycling. The national government's aim is to complete this landfill within five to 10 years.

There is also a need for planning around what will happen to the micro-economy surrounding the two current dumpsites when they are eventually put out of use. Currently, waste pickers residing close to the landfill sites recycle and upcycle rubbish for their income, so it is vital for FCC to include these actors in future recycling projects to ensure their livelihoods can be sustained. FCC is committed to supporting the formalisation of these workers, and the improvement of their working conditions will be central to any agreement made with private companies that wish to access the waste for recycling.

The council is also planning to expand the treatment of faecal sludge to include conversion into compost and cooking briquettes. The compost being produced is currently being sampled and tested through a project run by GOAL in partnership with Fourah Bay College in Sierra Leone. If the compost is of high quality, it will be used to help cultivate vegetable crops; if it is of low quality, it will be used by the agriculture sector but for products not intended for human consumption. A pilot, implemented by GOAL in partnership with FCC, is currently underway to produce cooking briquettes. The compost is mixed with sawdust and then placed into a compression device to make the bricks. This initiative would not only improve rates of recycling and generate revenue but also reduce reliance on the burning of charcoal in informal settlements for cooking, which contributes to deforestation and is linked to high incidence of respiratory disease. Using faecal sludge to create briquettes for cooking is already underway in Kenya, is safe and emits a neutral smell (Government of the Netherlands, 2021).

Recycling is a key focus for future initiatives: FCC is also exploring strategies for the sorting of waste at a household level. The only separation and recycling of waste currently being conducted in the city is carried out by informal workers, with waste collected and sold on to third parties. This includes, for example, companies based in Guinea that have the necessary facilities to convert plastic bottles into pellets that they can then sell onwards for the creation of new products. However, the council is in ongoing talks with a UK-based company called Crimson Gray to set up a recycling company in Freetown. FCC is also working with PROBLUE, a World Bank-

administered project focused primarily on reduction of plastics in the ocean (World Bank, n.d.). This aims to establish strategies to reduce plastic consumption, enhance recycling initiatives and improve waste management systems. As part of this work, PROBLUE is addressing the current organisational, regulatory and legislative framework for solid waste management in Freetown with recommendations to enhance disposal, sorting, recycling and reduced plastic generation.

Finally, the council is looking at WtE schemes. It has been suggested that Freetown would hugely benefit from such initiatives, because of its low level of access to grid electricity, the revenue this could generate for the council and the fact that it would reduce waste going to overburdened dumpsites (with knock-on effects in terms of reducing harmful emissions) (Ngegba and Bertin, 2020). However, creating the infrastructure necessary to implement WtE programmes would involve the establishment of a formal recycling and waste separation programme and implies high start-up costs.

Currently, FCC is in discussions with three organisations about potential WtE initiatives. In one case, a small biodigester model, created by a private firm, called Freetown Waste Transformers, has already secured \$3.9 million from investors and permission from FCC to access its waste value chain. This initiative will create around five waste-to-electricity conversion sites across the city (Thomas, 2022). The company is already running a pilot biodigester, which is providing power to the Aberdeen Women's Centre in Freetown. In this case, the pilot biodigester is run off organic waste, which the company buys from local people. The electricity generated from these biodigesters will be plugged into local mini grids. Ensuring that the WtE solutions are environmentally sustainable is a top priority for FCC. It is currently looking for more private companies to partner with.

4 Case study: Kanifing Municipal Council

Context

Kanifing Municipal Council (KMC) is one of eight local government areas in The Gambia. The city lies to the west of Banjul, the capital of The Gambia, and includes Serrekunda, the largest urban area in the country. Kanifing's population was recorded in the country's last census in 2013 at around 383,000 (20% of the country's population) and is projected to have passed half a million inhabitants by 2021 (GBoS, n.d.; KMC, 2016). The municipality has the largest population, and is the most densely populated, of any administrative district in the country (GBoS, n.d.; UN-Habitat, 2011). Faced with a rapidly growing population, largely as a result of the high rate of internal migration, and a high concentration of the country's industry and businesses, KMC faces significant challenges with the increasing volume of solid waste produced.¹⁰

Under The Gambia's Local Government Act 2002, municipalities have the responsibility for waste management. Work is taken forward under the priorities established in KMC's five-year waste management plan (2017–2021), developed based on community engagement and consultation with the private sector. In addition to having its own plan, the municipality operates under a well-developed national policy framework, which includes key policies such as the National Environmental Management Act (1994), the National Solid Waste Management Strategy (1997), the Environmental Quality Standards Regulations (1999), the National Waste Management Bill (2007) and Anti-Littering Regulations (2008), among others. The country also has had a national ban on plastic bags since 2015. However, while the policy framework is comprehensive, there is a lack of financing and capacity for robust implementation in practice.

Under KMC's waste management plan, the municipality is focusing on a number of different priorities, including improved public education and awareness-raising around waste management, new strategies for the segregation of waste and a large expansion of household waste collection. In addition, it is pursuing more efficient partnerships between the municipality and the private sector, including with informal waste pickers, for more effective waste management.

A major recent innovation in Kanifing is the city's introduction of household waste collection, which had not been undertaken in the country before. KMC has undertaken a significant investment, procuring modern waste compactor trucks and expanding collection services across

¹⁰ As noted in the introduction, this case study is based primarily on interviews with the technical team working on waste management in Kanifing. All information here that is not sourced comes from these interviews. Information on the series of interviews conducted is provided in Appendix 2.

the municipality, under its flagship ‘Mbalit’¹¹ waste collection project. This investment came after the city adopted waste management as the number one priority for the administration under the tenure of the current mayor (Mayor Bensouda elected in 2018).

A major challenge facing the city is the management of the Bakoteh dumpsite. This is the largest landfill site in the country, serving around 1.2 million residents of the Greater Banjul Area (KMC, 2021). It is an old dumpsite without any modern waste disposal systems and is significantly overburdened with waste. Moreover, its very central location means the environmental hazards it creates have direct impacts on the city residents living in surrounding communities. The city’s aim is to relocate the dumpsite entirely. KMC is also prioritising the development of waste management approaches that have strong social inclusion and job creation elements. This is important given that there are many people currently earning a living through informal recycling activities. Many of these waste collectors live in the immediate neighbourhood of the dumpsite, though some are migrants from Guinea-Bissau, Mali and Senegal who also depend on the dumpsite for their livelihoods (SOS Gambia, 2020).

KMC’s waste management workforce and programme

KMC’s waste management activities are managed by the Environment and Sanitation Unit (ESU), which is responsible for waste collection, transportation and disposal, as well as other environmental health and hygiene issues. The ESU sits under the council’s Directorate of Services. Alongside the ESU, the council also manages waste collection through its Mbalit project, which has its own structure and staff. Liquid waste management is not fully under the responsibility of the council, although it is tasked with the management of liquid waste from markets (relying on only one septic tank, which makes this a considerable challenge). Estimates of the volume and nature of the waste generated in the city are not precise (see Box 7).

11 ‘Mbalit’ means ‘waste’ in the local language, Wolof.

Box 7 Waste generation in Kanifing

In 2016, the waste generated in Kanifing municipality was estimated at around 300 tons per day. More recent estimates from KMC are that approximately 460 tons of waste are generated on a daily basis. This estimate is based on the capacity of the garbage trucks and other collection vehicles and the monitoring of their entry into the dumpsite, as the dumpsite does not as yet have a weighing scale. Updated and precise data is not available, and no full waste characterisation survey has taken place. However, in the past the council has estimated that household waste constitutes 57.5% of total waste generated in the municipality and – based on results of a survey by the National Environment Agency in 2015 – it is estimated that 46% of Kanifing’s waste is organic, with 22% paper and 6% plastic (and 22% made up of materials such as stone, gravel, metal cans, woods, sand, etc.). This data is considered outdated, given population growth and changes in consumption trends. Recent, small-scale waste characterisation studies carried out to look at the city’s markets have found that 60% of market waste is organic, spurring interest in composting activities and larger-scale plans in this area.

Sources: KMC (2016); interview material.

The total workforce dedicated to waste management in the city is 370, with 227 workers employed by the ESU and 143 under the Mbalit project. The ESU is responsible for collecting waste from streets, markets and other public facilities such as schools, hospitals and health clinics, as well as for the removal of liquid waste from markets. Market waste collection and street cleaning is carried out every day. The ESU is also responsible for the clearing of illegal dumps around the city. The unit’s staff is made up of 173 labourers, 17 drivers, 16 drainage maintenance workers, 12 mechanics and nine tricycle riders.

Household waste collection is managed under the Mbalit project. To expand collection services, in 2019 the city invested in the procurement of 23 waste collection vehicles to introduce a commercial service across the municipality (see more on the financial aspects of this investment below). The municipality is divided into 19 wards; each one is assigned a waste compactor truck that collects on a daily basis. Route maps were created for the collection service across households from Monday to Friday, with Saturday established as a catch-up day for any missed collections, enabling very systematic waste collection on a weekly basis.

Under the Mbalit project, each ward has a workforce made up of one driver, three janitors, two ticket agents and one secretary. The project also employs 10 skip attendants, who manage the skip bins that are stationed at the 10 communal dumpsites located across the city. These are places that residents can legally dump waste and from where all the waste is picked up and transported to the official Bakoteh landfill on a daily basis.

A large part of the Mbalit workforce is dedicated to the household collection service. The drivers, janitors and ticket agents accompany each truck during the collection round. The ticket sellers walk in front of and behind the vehicle, to ensure that households are able to buy a ticket (and to monitor the trucks to make sure nothing is thrown in without payment). Residents buy a ticket from the ticketing agent and hand their trash to the janitors. The drivers and janitors receive a fixed salary, though the ticket sellers receive a payment based on sales. While no system is error free, the view of KMC is that most households are compliant and do properly pay the fee to get access to the service.

The move from a paper-based (printed ticket) system to a more digital system has also helped KMC with monitoring and to reduce the potential for leakage of revenue. Ticket sellers now use a handheld device that prints the ticket at the point of payment. This feeds directly into a digital system that enables KMC to keep track of the amount of rubbish (and fees) being collected. Though this digital element is in place, there is no mobile payment option, and households must still pay cash during collection rounds. The most obvious drawback of this is that every household has to have someone at home to pay and have their waste collected. This is considered a major shortcoming of the system. However, there is still increasing demand from households for this service, with more and more households subscribing and complaints regularly raised with the city if vehicles miss collection in any area. KMC estimates it now has a coverage of 55–60% of residential households with its door-to-door collection service.

Even with this new, relatively comprehensive household collection service, KMC still works in partnership with informal waste collectors, who use donkey carts to collect household waste. It was considered important to maintain these relationships, even after equipment upgrades, to continue to provide livelihoods to informal workers and to ensure the most difficult-to-access areas still had a waste collection service. In order to deter these workers from creating illegal dumps within the community, the council has an arrangement with them whereby they collect waste and can dump it inside the garbage trucks in certain areas of the city (paying the same tariff as they would if they dumped at Bakoteh dumpsite itself). The household collections, communal dumpsites and waste collection work by the ESU are complemented by other efforts by the anti-littering team and ward environment committees, which work to sensitise communities and deter people from dumping illegally.

Other major public initiatives carried out in recent years include two operations: 'Clear Illegal Dumps' and 'Clear the Drains'. The municipality has conducted widespread community education on the problems with dumping waste on the street and in drains and has provided tools and materials to communities to support clean-up exercises. This, combined with the creation of 10 communal dumping sites across the city and a large expansion of household collections, has led to a significant reduction in illegal dumping: from around 65 illegal dump sites that existed previously, there are now around 17 sites left (although this does not count the small dumps around the riverine areas separately). The advances in this area have created a significant boost to the public image of the council, which is seen to have acted effectively in this area.

Challenges

The biggest challenge facing KMC is its reliance on only one, old and unsuitable, official dumpsite. Bakoteh dumpsite occupies an area of just under 18 hectares and has been in use for over 30 years. All of the waste from the municipality, and the Greater Banjul Area, is being dumped there despite the site already being overburdened. KMC's success in installing more efficient household waste collection has resulted in unprecedented levels of waste being delivered to this location, creating even more challenges for landfill management. Furthermore, the dumpsite's location, which is very close to the densely populated centre of town, means that the (around 70,000) residents living in the surrounding communities (Bakoteh, Dippa Kunda and Manjai Kunda) suffer significant impacts. Frequent fires – that start as a result of the release of methane that originates from the organic waste in the dumpsite – mean smoke often covers residential areas, greatly increasing levels of air pollution. Local water sources are contaminated and living conditions are generally very unhygienic and unpleasant, including because of the strong stench from the dumpsite. A study carried out by SOS Children's Villages, which is located directly opposite Bakoteh, has found that children in the surrounding area often suffer from breathing difficulties, diarrhoea and skin diseases (SOS Gambia, 2020). The dumpsite is also the site of a great deal of precarious work by people scavenging for waste.

The physical management of the waste at the dumpsite is very difficult. The city does not own heavy duty machinery, nor have the resources, to easily move existing waste and to manage waste disposal properly. Currently, bulldozers are frequently hired (at a very high cost of around \$500 per vehicle per day) to separate and move waste. The dumpsite is also often waterlogged, especially during the rainy season. Vehicles are sometimes not able to access the site at all, or they frequently get stuck within the dumpsite itself. Apart from the costs to excavate and channel water to maintain accessibility, and to rescue vehicles, there are additional knock-on impacts on collection services' schedules when trucks are not available. Managing the frequent outbreaks of fire at the dumpsite, especially during the dry summer season, is also difficult. More extreme heat and heavy precipitation as a result of the climate crisis will only exacerbate these challenges.

Another major challenge that KMC faces is that there is no official system and there are no facilities for waste separation and for recycling, reprocessing or reusing waste. Currently, the municipality does not have any transfer stations (facilities to separate waste before transferring non-recyclables to landfill). There is also no waste separation in the dumpsite itself. Installing transfer stations to enable recycling and to reduce the waste sent to landfill is a major priority alongside professional landfill management itself. The municipality is working on a pilot project looking at organic waste in the market area. Organic waste is collected and delivered by tricycle to women's garden associations for composting that will support women's vegetable production. The aim is to construct a composting plant to support this work over the longer term.

Recent measures taken to improve the dumpsite include renovations of access roads for vehicles, the provision of fire hydrants and the construction of two sanitary facilities. In addition, around

500 trees have been planted in front of the dumpsite, to operate as a Green Zone where the trees are able to filter smoke and odours, as well as construction of a chain link fence for safety purposes – to keep residents (particularly children) away from the hazardous site. Efforts have also been made to continue waste filling in areas of the site that are furthest from communities. The municipality has also collected old tyres and stored these separately at the dumpsite, to lower the risk of these being engulfed in the frequent fires.

Ultimately, the municipality is planning to relocate the dumpsite and to turn Bakoteh into a transfer station. The city has identified an area for the new site, and its goal is to develop a fully engineered, sanitary modern landfill (with a weighbridge to measure waste coming in), at the same time as investing in composting and recycling facilities to reduce waste going to landfill. KMC is actively looking for a partner that can offer the technical expertise and financial capital necessary for these kinds of investments.

While illegal dumping has been reduced significantly in recent years, illegal dumpsites still create environmental and health hazards for the city. Within the Kanifing area, these sites are often situated along water ways, drainage areas or gullies, and can interfere with the flow of runoff water, hence they have high or severe flood potential. The illegal dumping that takes place in riverine areas is a particular challenge, as it contributes to ground and water pollution and exacerbates the risk of flooding in areas close to human settlements. Children and domesticated animals have unrestricted access to illegal dumps, implying additional health and safety hazards.

Other challenges regarding equipment and maintenance are common. The ESU operates with very old and quite limited equipment for waste collection (two trucks, two tractors and eight tricycles only) and often faces mechanical challenges. While there is a strategy to share access to the new compactor trucks from the Mbalit project, this simply takes away household waste collection from one of the wards, which is increasingly a challenge as services have become very popular. The council is also finding its maintenance costs are high, including as a result of the wear and tear on the newly purchased vehicles. Financial constraints affect both the operational budget and the ability to make the necessary capital investments. KMC is currently even without the financial resources to mobilise technical assistance to develop its new waste management plan. The next section explores costs and financing aspects fully.

Costs and financing

The central government does not fund any waste management activities undertaken by the city, and their financing relies mainly on KMC's own source revenue collection as well as on income from the city's investments and any grants it may receive. The city's main revenue sources are property and business taxes, as well as fees generated from markets, licence and car parking operations, as well as other small fee/licence categories. Currently, 25% of the municipal budget goes towards waste management activities, with this budget spent on managing the dumpsite, waste collection, training for staff, public education and awareness-raising, and operations to clear

illegal dumps, as well as other initiatives. Generally, investment by the city in the sector has been increasing, as it is one of the administration's top priorities, and the upgrading of equipment and expansion of services has translated into much higher expenditure levels.

Financing of the procurement of waste compactor trucks was not possible from the city's budget. The city explored borrowing directly from a commercial bank to make this purchase but was not allowed to do so by the Ministry of Lands and Regional Government. A decision was taken to use a PPP model with a company called QGroup. This company advanced 135 million Gambian dalasi (\$2.5 million as of 13 May 2022) to a specialist supplier firm (Espace Motors) to procure 23 compactor trucks under contract to KMC. The trucks purchased were Foton waste compactor trucks, which were sourced and imported from China in 2019.¹² As KMC was unable to secure a duty waiver, it had to pay substantial import duties on the trucks. This transaction was overseen by the Gambia Procurement Authorities, the agency charged with approving the procurement process.

Under the PPP model, a three-year agreement was put in place, with QGroup financing the purchase and import of the vehicles. Under the agreement, KMC has been able to operate the trucks from the beginning and has been obliged to pay the company 45 million dalasi annually (\$839,550 as of 13 May 2022) before taking ownership of these assets after the end of the three-year payment period. The final payment was scheduled for June 2022 and the city has now successfully completed all of its repayments under this agreement.

Given the purchase of these significant new public assets, the city has maintained a careful focus on vehicle maintenance. Within the PPP agreement, the supplier firm was tasked to provide mechanical servicing over the three-year period. In addition, the supplier – who had longstanding partnerships with firms in China – secured the expertise of Chinese mechanics to support the Mbalit project. These mechanics came to Kanifing to train local mechanics and drivers on the operation and maintenance of the waste compactor trucks. Going forward, under KMC's sustainability plan, revenue generated from household waste collection will go towards maintenance of the vehicles and a fund that will be used to replace and expand the fleet.

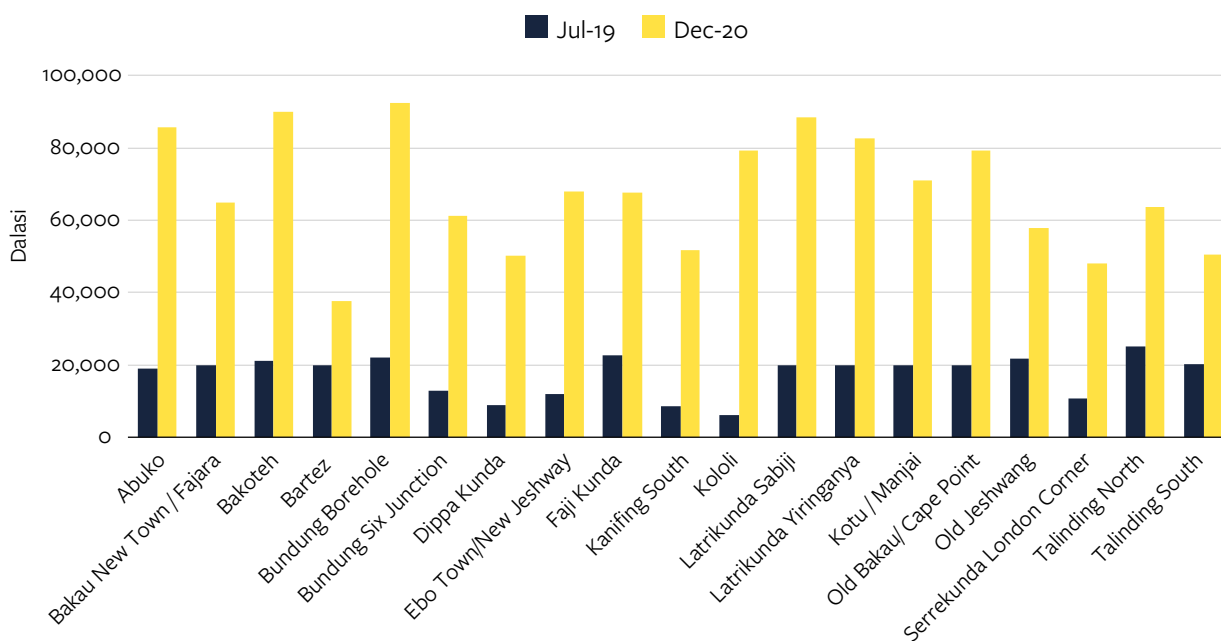
The overall aim of this investment has been to establish a commercial service for waste collection. Households are charged fees for waste collection, set at 10 dalasi (\$0.19 as of 13 May 2022) per rice bag. This is substantially lower than the earlier fees charged by private operators (25 dalasi) (\$0.47 as of 13 May 2022) before KMC created this city-wide service. However, the administration's surveys showed that a proposed 25 dalasi fee would mean that many people would not be able to pay for the service. KMC took the decision to reduce the price to a minimal

12 The trucks had a 20-ton capacity and cost around 5 million dalasi each (\$93,280 as of 13 May 2022).

fee, effectively introducing a subsidy, to help expand coverage of the waste collection service and to enable the highest number of people possible to access the service. The council also receives other revenues from waste, as Bakoteh dumpsite also charges a range of fees for waste disposal.¹³

As already noted, demand for household waste collection has been increasing. This is reflected clearly in the increasing fees collected from this service (see Figure 3). KMC reports that, on a monthly basis, household collections were generating around 1.6 million dalasi (\$29,850 as of 13 May 2022) per month in early 2021, up from around 1 million dalasi (\$18,650 as of 13 May 2022) in January 2020, for example. And this has increased further, with the move from manual ticketing to e-ticketing increasing revenue to around 2 million dalasi (\$37,300 as of 13 May 2022) monthly, with the digital system helping ensure there is no underpayment by agents for the revenue being collected. Any increased amount beyond 1.6 million dalasi is shared between the council and the private company that provides and manages the e-ticketing system.¹⁴

Figure 3 Growth in revenue from household waste collection, by ward



Source: Information provided directly by KMC.

Given the low level of the fees charged for the service, the revenue generated is not enough to cover the annual payment for the trucks. However, the Mbalit project revenue has covered around

13 Fees charged include the following: 50 dalasi (\$0.93 as of 13 May 2022) for one tricycle or a donkey cart, 100 dalasi (\$1.87) for a pickup truck and 200 dalasi (\$3.73) for a larger truck.
 14 The council signed a contract with a company called Ecotech in January 2021. The contract stipulates that any amount on top of 1.6 million dalasi is shared in profit between the council (60%) and the company (40%).

40% of the PPP payments, with the rest coming from the council budget. Overall, the decision to undertake a PPP to procure compactor trucks has been evaluated positively by the council, not only because of the long-term revenue-generating potential but also because of the significant impact it has had on the environment of the city and directly on the health and wellbeing of residents. However, this initiative has also implied significant costs, most notably in the high level of import duties but also in finance costs, given the need to work through a PPP model rather than purchasing directly. This illustrates the potential cost burden borne by local governments as a result particularly of national fiscal choices.

One of the main aims of the current administration is to ensure the sustainability of the new waste collection service. This means maintaining the small fee for collection and resisting efforts to make trash collection free (which is particularly a concern as this could be a strategy used to appeal to voters in future). Free trash collection is considered impossible for the city to offer and would likely just run down the service. Ultimately, the city's goal is to build waste collection fees into property tax rates. KMC believes that such a move would make the service more sustainable over the long term and less politically vulnerable.

New initiatives and future aims

Alongside its ambitions to relocate the Bakoteh dumpsite in future, the city is focusing particularly on both WtE and waste-to-compost initiatives, as well as generally expanding its recycling facilities. It has very recently secured a bottle processing unit that has been procured from the US.¹⁵ This unit will soon be installed at the dumpsite, after some other infrastructure construction is completed. The unit will crush and shred glass bottles into small (sand-like) particles that can be sold to construction companies to make cement. All revenue from the operation of this unit will flow to KMC. In addition, the municipality is exploring what can be done with the 6,000 old tyres currently at the back of the dumpsite, as part of its recycling efforts – important given that these are considered a significant hazard in terms of disposal.

KMC has also signed a memorandum of understanding with a plastic recycling facility. Their long-term aim is to locate plastic recycling facilities at Bakoteh dumpsite, which will continue to function in the future when the dumpsite becomes a transfer station. While still some way off this plan, they are working with a young entrepreneur whose teams collect and sort plastics for recycling, with the municipality providing support in terms of transporting plastic between locations. The company generally exports plastics to Senegal, where plastic recycling takes place (though facilities do exist in The Gambia, though these often offer less attractive prices). While there is interest in

15 The bulk of the purchasing cost was covered by a local bottle processing company that had recently closed and left a high volume of bottles without proper disposal. The company was ordered by the National Environment Agency to make a significant payment towards the purchase of the unit to help resolve the problems created.

scaling up plastic recycling by the council, there are no plans currently to do separation at source because KMC lacks the revenues to procure and supply waste containers for each household and to increase transportation services to manage household collections of separated waste.

As recent waste characterisation studies have shown 60% of market waste to be organic, KMC is currently prioritising separation at source in the city's markets. Currently, two pilot projects are underway with the support of development partners (one with UNDP funding and another with newly secured EU funding, as discussed further below). Under these pilots, in two markets, separation at source is taking place and organic waste is delivered to different women-led associations that maintain community vegetable gardens. Training on small composting techniques is provided to the women involved, so that they can use compost at home or at the gardens. There is great interest in scaling this up to the 19 markets across the city, though this would require a large-scale composting plant: the waste from two markets already exceeds the composting capacity of the community gardens.

KMC will also be exploring electronic payment systems for household waste collection, to enable people to pay by mobile phone app to have their waste collected. This requires a digital system that would show whether a household has paid, allowing residents to leave their waste outside to be picked up on the collection round. The city is looking at a system of QR codes on each property that could be scanned to indicate whether the household has paid in advance. A key benefit from this would be that trash collection could occur even in the absence of the occupants of the household. It would also make payment easier for residents and reduce opportunities for leakage, as cash transactions would reduce.

The council is committed to piloting some of these elements in the coming year, efforts that will be facilitated by some new grant financing it has secured. At the end of 2021, KMC successfully raised €3 million from the EU for its Kanifing Environmental Transformation Programme (KMC, 2021). This is funded under the EU's Local Authorities: Partnerships for Sustainable Cities 2021 programme, which supports decentralised cooperation and peer-to-peer exchanges of local authorities; Kanifing is working in collaboration with Peterborough City Council on this project.

This successful grant application will entail a significant budget increase for waste management activities. It will support residents in the three communities surrounding the dumpsite, including people who collect waste and the donkey cart operators, who will benefit from support to formalise their collection and recycling activities, as well as women's garden association members and woman vendors in the cities' markets, who will be involved in using organic waste and improving composting practices. KMC will also be expanding work with youth-led businesses that are recycling tyres and plastics as part of its efforts to expand entrepreneurship in this area; it plans to develop a learning hub and incubator space to support business development. In addition, this new financing will support waste collection by establishing a digital fleet management platform for the cities' waste collection vehicles, putting in place 16 community transfer stations with sorting for recyclable materials and procuring a weighbridge for the dumpsite.

The new grant financing will also help KMC set up a centralised call centre to respond to residents' needs and concerns around waste management. This particular model was inspired after KMC conducted an exchange with Freetown City Council in 2021.¹⁶ Since this visit, there has been particular interest in replicating Freetown's strategy around complaint management with residents as a good example of responsive city governance. Some work is already underway to set up a similar team in Kanifing. The vision is also to integrate the QR code system, identifying properties and their payment status, with the new call centre operations so that it can also manage payment and billing aspects. To date, it has proved difficult to invest in these additional elements, particularly given the subsidy provided to household waste collection, but this additional financing will support progress in this area during 2022/23.

Finally, KMC is also interested in pursuing some experimental research to study the impact of potential reforms and, in particular, how the city can use digital tools to support revenue collection and improve the council's administration. The Digital Identification and Finance Initiative (DigiFI) Africa initiative has accepted a preliminary proposal¹⁷ to design a research pilot that will explore a number of areas, including the impact of variations in property tax administration across wards and how this affects tax compliance, as well as the various options for designing an electronic payment system for trash collection. This is part of KMC's research agenda, looking at how digital solutions can support revenue generation and the connections between improved service delivery and tax compliance in Kanifing. Ultimately, this work also aims to support the long-term vision to fold waste management fees into property tax rates to build towards a more sustainable waste management system in the city.

16 Both Freetown and Kanifing are members of the Africa-Europe Mayors' Dialogue initiative and there is an established history of technical exchange and collaboration between the two cities. Both cities are also supported by advisors from the Tony Blair Institute.

17 DigiFI Africa is an initiative of the Abdul Latif Jameel Poverty Action Lab, based at the Massachusetts Institute of Technology. It aims to generate rigorous evidence on how African governments, private companies and non-governmental organisations can leverage digital payments and identification systems to improve lives through better public service delivery, governance and financial inclusion. DigiFI Africa provides financing for research that supports governments and other implementers to monitor and evaluate relevant reforms.

5 Beyond waste collection

Introduction

Over the past two decades, there has been an expansion of initiatives across Africa to improve waste management and reduce environmental harms and health risks, while promoting citizen engagement and inclusive job creation. This paper has already given many examples. This section focuses particularly on experiences regarding the development of a circular economy, particularly composting and recycling initiatives. It also looks at sanitary landfill management and the creation of WtE plants. These are all areas that are of particular interest and relevance to city members of the Africa-Europe Mayors' Dialogue.

Composting and recycling initiatives

Composting and recycling projects can have a major positive impact by reducing the amount of waste that ends up in landfill. They are some of the most appropriate waste management solutions, with composting particularly appropriate, given the composition of waste generated in Africa. Various composting methods are available, including the Windrow method,¹⁸ which is the simplest (and cheapest) process for cities to adopt (Kaza and Bhada-Tata, 2018).

For a city to undertake composting, it must secure a consistent supply of properly separated organic waste, which in itself is considered challenging (Mutz et al., 2017; Kaza and Bhada Tata, 2018). An advisable strategy is to start by targeting strategic collections of organic waste in areas such as produce markets, restaurants and hotels (a strategy adopted by KMC, as discussed in Section 4). This approach is much cheaper than investing in separation initiatives at household level, which can be inaccessible for many cities (though see Box 8 for an example of a household initiative in Accra). Also advisable is to investigate the local market for compost and for cities to seek to build demand for this product among potential buyers, including via the creation of certification systems that can help build confidence in the quality of the product (Kaza and Bhada-Tata, 2018).

18 Windrow composting is when organic waste is placed in a row and turned periodically to introduce oxygen and promote microbial activity. A more expensive option is to invest in in-vessel composting, which speeds up the process of decomposition as temperature and oxygen levels inside the vessel, and turning of the material, can be controlled (Kaza and Bhada-Tata, 2018).

Box 8 Community composting in Accra, Ghana

Waste management is a critical issue for the city of Accra, given the city's rapid population growth. According to data collected in 2015 as part of Accra's first GHG inventory, the waste sector emits the highest share (44%) of GHG emissions in the city. As a result, the city's Climate Action Plan (2020–2025) prioritises actions for the waste management sector, including the separation of wet and dry waste at source, the diversion of organic waste from landfills and the construction of a new engineered sanitary landfill with gas capture.

As part of its efforts to address waste separation and organic waste disposal, the Accra Metropolitan Assembly conducted a solid waste characterisation study. Results indicate a daily (per capita) waste generation rate of 0.7 kg, with organic waste making up the majority (53% by weight) and with plastic waste the second most important category (16%) identified. A priority of the city administration is to reduce the quantity of organic waste that ends up in landfill.

As part of the Waste Management Department's 2021/22 annual action plan, the city is implementing a pilot community waste source separation and compost project in selected communities, in collaboration with informal waste workers. Selected households are provided with suitable boxes to store organic and plastic waste prior to collection, and informal waste collectors are assigned by zone to collect separated waste. This is then delivered to existing compost facilities and to both formal and informal plastics' recyclers.

The pilot also envisages the creation of compost facilities in each of the selected communities. These would receive a small proportion of the separated organic waste to produce compost for local use. Training is provided to community members in composting and efforts are linked up to community greening programmes. The objective of the project is to divert at least 40% of waste collected from the project area away from landfills through these composting and recycling activities. Ultimately, the plan is to test locally appropriate interventions for organic waste composting and plastics recycling and to learn from all aspects of the pilot's implementation, before scaling up similar activities across the Accra Metropolitan Area.

Sources: Accra Metropolitan Assembly (n.d.); Accra Metropolitan Assembly and C40 Cities (2020).

Cities struggle with various aspects of recycling, including facilitating household separation at source, collecting separated waste and managing sorting and processing facilities. (See Box 9 for an overview of the challenges in this area in eThekweni, in particular in relation to separation at source.) There are some good examples of overcoming the challenges of collecting separated waste. In Lagos, for example, a for-profit social enterprise, Wecyclers, uses cargo bicycles

to provide a collection service for recyclable waste from houses and businesses. This small company is now providing a reliable stream of waste to recycling firms in the city, which have often operated at 50–60% below capacity and struggled to secure a consistent supply of waste (UNEP, 2018).

Box 9 Challenges establishing recycling systems in eThekweni

eThekweni (also known as Durban) is one of four major urban industrial centres in South Africa, located in the densely populated province of KwaZulu-Natal. Around 25% of the population of the municipality reside in informal settlements and the municipality combines pockets of high-density settlements with rural areas in a relatively fragmented and poorly integrated layout, which poses a variety of challenges for waste management. The municipality operates a household waste collection service, with kerb-side collections taking place on a weekly basis. It owns and operates its own waste collection vehicles, as well as contracting community-based contractors (CBCs) to collect waste in low-income, high-density settlements, given the latter's more limited road access. The waste collection rate (by the municipality and its private contractors combined) is high, reaching 86% of households.

While waste collection rates are generally high, recycling is not well advanced, and it remains a major strategic priority for the municipality to increase recycling rates. The Cleansing and Solid Waste Unit has been working to increase recycling across the city and has instituted waste separation and recycling systems in some locations. A coloured bag system has been developed, with orange bags supplied to households for their cardboard, paper and plastic, clear bags for glass bottles and cans, and blue bags for garden green waste. After some experimentation with this using private contractors, the municipality's waste management plan (developed for the 2016–2021 period) committed to scaling up the multi-bag separation at source system, including to the CBCs. However, this initiative has faltered because of problems tendering and contracting for the supply and collection of recycling bags. Residents' frustrations have grown as service provision has become more interrupted, and corruption scandals related to waste management have emerged, leading to calls to re-prioritise this service.

While collections of separated waste for recycling have not yet been implemented successfully, the municipality does have drop-off centres and buy-back centres, where individuals can bring their waste for recycling. Drop-off centres have been set up across the city; they are often combined with the 14 garden refuse stations, which receive garden waste from households. The municipality has also put in place seven buy-back centres, where people are paid for the recyclable waste they bring in. These are seen as important for providing employment and income generation opportunities. The aim of the municipality is also to build more, and better-equipped, recycling facilities that can enable further processing of materials, as well as to create composting facilities that can handle and process large amounts of organic waste.

Sources: eThekweni Municipality (2016); eThekweni Municipality (2017); Xulu (2018); Democratic Alliance (2021).

Where recycling is achieved, it is often the informal sector taking the lead in recovering waste and recycling it. Some cities have achieved high recycling rates with this approach, including Cairo (see Box 4), but a great deal more could be done to harness the benefits the informal sector provides in this area. Municipalities can also make significant budget savings by working with the informal sector and supporting their recycling initiatives (UNEP, 2018). As such, this presents a ‘win-win’ situation, with waste pickers able to access a more secure livelihood and better and healthier working conditions, while local governments can have lower-cost waste collection and sorting services.

The job creation potential linked to recycling is significant, as waste collection, sorting, processing and manufacturing are labour-intensive activities (much more so than landfill management) (UNEP, 2018). There are multiple examples of this across Africa, often involving social enterprises and small and microenterprises manufacturing products from plastic waste, rubber tyres or aluminium (see UNEP, 2018 for a broad range of case studies). Many are highly inclusive by design. A recent example is a new municipal recycling programme being set up in Arua, Uganda, which will create employment opportunities for migrants and refugees. This recycling programme has received support from the Global Cities Fund for Inclusive Climate Action, an initiative of the MMC (MMC, n.d.).

Tyre recycling is a particular challenge for many cities. In Kanifing, as already noted, the municipality is actively looking for options for the reuse and recycling of the 6,000 old tyres currently at the back of the dumpsite. The disposal of waste tyres at open dumpsites is particularly problematic given the fire risk they pose, as well as the fact that stockpiles create breeding grounds for mosquitos (WBCSD, 2008). Tyres can also be deliberately burnt to recover the copper or brass or bronze wires inside them, a major cause of smoke and fire at dumpsites. Various options exist for tyre recycling, including using tyres as a low-cost source of fuel instead of fossil fuels, for example in cement kilns. There is an example of this in Nigeria: a leading

cement manufacturer adapted its plant to use shredded tyres to replace fossil fuels (UNEP, 2018). Waste tyres are also well suited for reuse in certain types of civil engineering projects, for example to create embankments, structures for erosion control, crash barriers, coastal protection or artificial reefs (WBCSD, 2008; UNEP, 2016). In addition, tyres can be recycled through conversion into ground rubber and used in multiple ways including for walkways, athletic surfaces, sealants, carpet padding, rubber tiles and many more (UNEP, 2016). There are several examples of experimentation with tyre recycling plants in Nigeria and more developed experiences in South Africa (Sebola et al., 2018; Arthur et al., 2020; Sakshi, 2021). Small businesses are also often involved in upcycling waste tyres across Africa, with great potential for inclusive job creation (see Box 10).

Box 10 Upcycling of waste tyres in Africa

In Ghana, upcycling companies are producing jewellery, furniture, waste bins, plant pots and even sound speakers. Similarly, in Ouagadougou, in Burkina Faso, informal businesses are increasingly generating income from waste tyre upcycling, making furniture and handicrafts. In Ethiopia, footwear manufacturers have traditionally used waste tyres to produce shoe soles; this method enabled an innovative start-up to gain access to high-value international footwear markets and to become one of Africa's fastest-growing footwear brands. In Freetown, the city council has used its own funding to reuse tyres from the dumpsite by making standalone bins around the city. These bins are made of three to four stacked tyres, with a plastic or wooden base, a lid and a bin liner. They were set up both to discourage burning of tyres and to reduce littering. In addition, Freetown launched an urban farming scheme in informal settlements, providing residents with tyres filled with soil, gardening equipment and seeds for staple foods, as part of its Covid-19 emergency interventions.

Sources: Rice (2010); Tessema (2017); UNEP (2018); Arthur et al. (2020); interview material.

There are also some large-scale successful programmes, such as the Eco-Lef recycling programme in Tunisia, launched in 1997. This incentivises waste collectors to collect and sort plastic and metal packaging and to deliver it to one of the 221 Eco-Lef centres across the country by providing preferential rates for the packaging waste collected; for example, plastic packaging waste obtains \$290 per tonne at Eco-Lef centres compared with \$208 on the local market (Kaza et al., 2018). The programme is funded in part by a 5% tax on the net value of locally produced or imported plastic polymers. Since 2001, the centres have received more than 150,000 tonnes of plastic packaging, with between 70% and 90% of the waste received being recycled. With financing from the National Employment Fund, this scheme has helped create approximately 18,000 jobs and 2,000 micro-enterprises (ibid.).

Sanitary landfills

Sanitary landfills are critical for the safe disposal of waste that cannot be reused or recycled. As previously discussed, the majority of landfills in Africa are not sanitary landfills but open dumps, given the high outlay costs. The situations in Freetown and Kanifing are very similar in this regard, with both cities struggling with overburdened, old, open dump sites. While Freetown has plans to open a modern sanitary landfill, with World Bank support, Kanifing has no funder and technical partner to support its plans in this area at the present time. Some cities, particularly in South Africa, are far more advanced. eThekweni municipality has several decades of experience of modern landfill management, including in combination with urban greening projects (see Box 11).

Given the investment required to create a modern, sanitary landfill, some African governments are experimenting with simpler and lower-cost sanitary landfill approaches. In particular, the Fukuoka method has been applied. This is a low-cost (semi-aerobic) approach developed originally in Japan in a collaboration between Fukuoka University and Fukuoka city government. This method requires the installation of a large leachate collection pipe, which is constructed along the bottom of the landfill, and a series of gas venting pipes, which together enable air flow through the landfill to maintain aerobic conditions and promote the decomposition of waste (JICA, 2007).¹⁹ This approach rapidly removes leachate and reduces methane emissions, with the added benefit that local materials such as waste drums, tyres and bamboo can be used. For example, when the Japan International Cooperation Agency (JICA) supported the transfer of this technology to Malaysia, bamboo was used in the construction; in other countries, tyres have been used to construct both the leachate pipes and the gas vents (*ibid.*). It is possible to apply this method when constructing a new landfill, or to rehabilitate an existing dumpsite, or even to safely convert an old, completed site (UN-Habitat, 2020).

The technology is in use in China, Malaysia and Mexico, and is increasingly being applied in Africa. In Ethiopia, the city of Hawassa recently launched its new development plan, which includes rehabilitation of the existing overburdened dumpsite (which has no leachate or landfill gas collection systems) using the Fukuoka method (UN-Habitat, 2021). This follows the previous successful experience of two other cities in Ethiopia (Addis Ababa and Bahir Dar) that have used this approach (*ibid.*). This technology has also been applied to a new landfill construction in Kiambu, Kenya (UN-Habitat, 2015).

19 The supply of air to the waste layer to maintain the landfill in an aerobic state is an essential aspect of the Fukuoka method. This requires the leachate collection pipe to always be open (and not fully buried at the bottom of the dumpsite) and for the gas venting pipes to be properly installed at appropriate intervals. Often, the use of the gas venting pipes in promoting air supply has not been well understood, and this has sometimes been a challenge in the transfer of this technology.

Box 11 Buffelsdraai Landfill Management Project, eThekweni

eThekweni's original landfill site was established at Bisasar Road, with another three landfills developed over the past three decades (Mariannahill, Lovu and Buffelsdraai). Bisasar Road Landfill has now reached capacity and is no longer accepting general or household waste. The municipality opened a new landfill – Buffelsdraai – in 2008. This is now the main destination for the municipality's waste and is a large-scale site, covering 100 hectares. It is well engineered and designed, to include a weigh bridge, with data capture linked to head office to enable instant tracking of the quantity of waste coming into the site. Leachate collection and treatment prevents this leaking into the soil and polluting the surrounding environment.

Buffelsdraai operates a 'closed loop system', which means that nothing entering the site can leave it, and 'the emissions from decomposing waste are collected/extracted and treated before being used or released into the environment' (eThekweni Municipality, 2016: 10). This process is expected to reduce carbon dioxide emissions by 10 million tons over approximately 50 years, as well as providing other benefits, including employment opportunities for local residents.

In addition, the city has undertaken a significant reforestation project in the buffer zone surrounding the landfill site. The municipality, working in partnership with local non-governmental organisation Wildlands Conservation Trust (WCT), has launched an urban greening programme Indigenous Trees for Life. This aims to create a carbon sink through the creation of city forests at two main sites: Buffelsdraai Landfill and Inanda Mountain. The reforestation project relies heavily on local community participation, with community members ('trepreneurs') given seedlings and provided with training to grow the trees. Once the trees reach a certain height, they can be returned to the landfill site in exchange for vouchers that can be used at 'tree stores' run by the WCT. These give people access to items such as food, bicycles or building materials or can be used to pay school fees. Apart from the environmental benefits of creating this buffer zone, the WCT has reported decreasing levels of food insecurity in participating households and increases in disposable income. Funding from the municipality covers the entire programme, and it is anticipated that 521 hectares will be reforested at the site, sequestering around 40,000 tonnes of carbon dioxide equivalent.

Sources: Pather-Elias et al. (n.d.); Midgeley et al. (2012); C40 (2016a); eThekweni Municipality (2016).

Waste-to-energy initiatives

Globally, two of the most common strategies for WtE initiatives are burning waste in incinerators to generate energy and landfill gas recovery systems (Ram et al., 2021). Generally, the technology is complex and not easy to implement, and the successful projects in Africa relate mainly to landfill gas recovery systems (Mutz et al., 2017).²⁰ The more accessible WtE technologies include anaerobic digestion. Small-scale anaerobic digesters have been used frequently in agriculture and are now being explored by municipalities, including in Africa. As with composting at scale across a city, anaerobic digestors require a consistent supply of properly separated organic waste, which brings its own challenges. While there are some suitable options, overall, WtE technologies are quite rarely used in Africa (UNEP, 2018).

Initiatives using technology to capture methane and convert it into electricity or thermal energy have attracted the attention of donors and investors in Africa (van Niekerk and Wegmann, 2019). However, many regard these initiatives with caution, as they can discourage reduction and recycling strategies (Gaia, 2021) and can directly affect the livelihoods of informal waste pickers and informal recyclers who find WtE companies competing for access to waste (Kaza and Bhada-Tata, 2018). They also depend on securing the right quantity and type of waste, and African cities often lack data on this, preventing them from exploring project feasibility properly (Kaza et al., 2018).

There are also challenges with the financial feasibility of WtE initiatives. These projects require significant financial resources to invest in and operate WtE plants (as well as skilled staff to run them). The electricity produced will generally amount to only a very small percentage of the demand of a city, and the revenue generated from this small-scale energy generation initiative will generally not cover the costs of the entire investment (Mutz et al., 2017). However, the implementation of landfill gas collection systems and WtE initiatives has been widely supported under the Clean Development Mechanism (CDM) of the Kyoto Protocol,²¹ given their contribution to emissions reduction, and this has provided critical economic support to these types of projects. There have been 38 CDM-supported projects in Africa, including multiple projects across South Africa and initiatives in Côte d'Ivoire (see Box 12), Ethiopia, Ghana, Morocco, Nigeria and Uganda (see Appendix 1 for a full list of Africa's CDM-registered projects in relation to waste handling and disposal).

20 Burning waste in incinerators can generate energy but will also generate toxic pollution unless advanced technology is included to capture the harmful substances that result. This technology remains expensive and is rarely used, except in high-income countries (Kaza and Bhada-Tata, 2018).

21 The Kyoto Protocol created a robust and legitimate system for carbon trading, whereby 'developing countries' could gain certification for cutting emissions and then sell them, generating a stream of income. The CDM was the certification system. Since then, numerous other credible certification schemes have emerged, whether national/supranational schemes or voluntary schemes.

Box 12 Abidjan municipal solid WtE project

The Abidjan municipal solid WtE project involves a treatment plant to process solid waste using anaerobic fermentation to produce biogas. This initiative was successfully registered with the CDM in 2009, meaning it receives a revenue stream in line with its emissions reduction. The biogas is sold to the state-owned energy company under a long-term power purchase agreement, and residual waste is transformed into compost for local farmers. The project is led by a private company in Abidjan, with the technology provided by an Italian company, PROMECO Spa, which specialises in the planning and building of industrial waste treatment plants. This project was designed to manage 200,000 tons of solid waste per year (80,000 projected for year 1), with two digesters installed to begin with and additional units added thereafter. It contributes to emissions reductions, produces clean energy, reduces waste going into landfill and also provides composting. This was the first project of its kind in West Africa.

Source: CDM (n.d.a).

However, while there are a number of successes, it is notable that, out of the CDM's entire portfolio for 'waste handling and disposal', African projects make up only 3.7% of approved projects (CDM, n.d.b.).²² The lack of CDM waste-related projects from Africa has been noted as 'alarming' and indicative of missed opportunities for the sector (Strachan and Pass, n.d.). One of the contributing factors is likely to be the fact that accessing the CDM has been very complex. In particular, it has created significant difficulties for city administrations, which is well illustrated by the experience of eThekweni (see Box 13 for information on this experience).

Box 13 WtE initiatives in eThekweni municipality

eThekweni became the first municipality in South Africa – and in all of Africa – to successfully generate energy from municipal solid waste. Integrating climate mitigation into its waste management practices is seen as a priority, given that, as a coastal municipality, eThekweni faces high risks from sea level rises. The city has also experienced increasingly frequent and devastating flooding, including as recently as April 2022.

22 This is based on the authors' calculations, which are in reference to approved projects only. As such, this figure does not take into account projects that were registered and later withdrawn or rejected. See Appendix 1 for a full list of all approved African projects under the waste handling and disposal classification of the CDM's portfolio.

As noted above, the municipality's original landfill site was established at Bisasar Road, with another three landfills developed over the past three decades (Mariannahill, Lovu and Buffelsdraai). Both Bisasar Road and Mariannahill Landfills were part of the Durban Landfill Gas to Electricity Project, taken forward in 2003/04 with support from South Africa's Department of Trade and Industry and the World Bank, and with loan financing from the French Development Agency. These WtE projects were registered in 2006 with the CDM, meaning they are able to raise revenue from the sale of certified carbon credits, as well as from the sale of the electricity that is generated.

Bisasar Road's WtE facility, the largest of the two, has been assessed as having made particularly important contributions to reducing electricity shortages in the city, as well as reducing GHG emissions from coal-fired power stations and improving air quality in nearby communities. Both WtE initiatives have together prevented the emission of approximately 20,000 tons of carbon dioxide equivalent each month. While Bisasar Road is now closed, it will continue to generate gas until 2030.

While the initiatives have achieved multiple positive impacts, the financial benefits that were expected through carbon offsetting have not fully materialised. The price of carbon was high at the time of project development but collapsed soon after (from €15 to only a few cents per ton of carbon dioxide), reducing substantially the expected revenues and affecting the financial viability of the projects.

In addition, developing these WtE projects as CDM-registered initiatives substantially increased their complexity, implying sizeable teams, including in-house management, national departments, financing agencies, environmental consultants and external auditors, as well as lengthy environmental impact assessment processes. Ongoing monitoring of emissions reductions also implied data collection every few seconds, requiring specialist software, and an onerous compliance process to meet CDM verification standards. Both the financial risks and these additional complexities led to the municipality's decision not to replicate this CDM registration approach at other landfills and instead to pursue GHG emissions reductions without accessing certified carbon credits.

The municipality is currently focusing on the more modern Buffelsdraai Landfill, opened in 2008. As noted in Box 11, this operates a 'closed loop system'. In this case, the municipality has constructed a flaring system for landfill gas, thereby eliminating methane emissions. It is, however, planning to move to electricity generation in future at this site.

Sources: Pather-Elias et al. (n.d.); Strachan and Pass (n.d.); Gumbo (2014); eThekweni Municipality (2016); World Bank (2016); BBC (2022).

The CDM architecture – established under the Kyoto Protocol – has now been superseded by the Paris Agreement. As such, there will be new mechanisms for cities to access carbon credits for these types of initiative in future. In general, the growing market for credible carbon offsets means that this is now a viable financing source for certain types of low-carbon investments in the waste management sector. However, much more could (and should) be done to make these mechanisms and revenue streams more accessible to cities (Tyson, 2022).

6 Conclusions

There are generally low levels of waste collection, few formal recycling systems and major deficits when it comes to sanitary landfills across Africa. This has resulted in significant, negative public health and environmental impacts in urban areas. Fortunately, there is experimentation and innovation across the continent, particularly in relation to household waste collection, but also with composting and recycling, which are two of the highest priority areas for innovation and investment for many cities.

As this paper illustrates, some city administrations have found their own low-cost solutions, which are appropriate to the nature of their waste, their cities' topography, settlement accessibility and highly constrained budgets. Clearly, careful consideration needs to be given to the informal sector and its role in waste collection – and particularly within recycling systems; with proper planning and consultation these workers can be successfully incorporated into municipal operations.

As the experiences of Freetown and Kanifing illustrate, cities experiencing major waste management challenges can increase household collections rapidly and reduce illegal dumping effectively. Cities also have a real opportunity to scale up and support inclusive job creation and entrepreneurship linked to composting, reuse, recycling and the development of the circular economy. However, the right partnerships are required to access appropriate technologies and reach the desired scale.

The proper delegation of powers, to give cities the freedom to operate within an agreed regulatory environment, and a sufficient transfer of resources from the national government are both critical aspects. Financial constraints, in particular, are a central part of the challenge. As the case studies for this paper highlight, cities network well, form effective partnerships and alliances (including internationally) and have been successful in mobilising resources to make productive investments. This is enabling the expansion of service provision and helping build more sustainable waste management systems over the long term.

Learning opportunities for cities

This is a sector that offers significant opportunities for practical learning between African cities. Indeed, this is a central concern for the cities that are members of the Africa-Europe Mayors' Dialogue platform that have prioritised this theme for exchange. Based on the findings from this research exercise, particular areas that should be prioritised for learning include the following:

1. **large-scale composting, recycling and circular economy initiatives**

- building and managing fair partnerships that prioritise inclusive job creation
- creating and shaping markets for composting and recycling
- building an enabling environment for the circular economy to flourish

2. **appropriate technical innovations**

- learning in areas that are of the highest priority to the most financially constrained African cities – such as tyre recycling, composting options, the use of small-scale biodigesters and the Fukuoka method

3. **new financial models and enhancing revenue streams for cities**

- the potential for municipally owned companies or PPPs, that can leverage private finance for cities' waste management investments
- tools and approaches, such as digital or cashless systems, that improve revenue generation and help cities tackle revenue leakage.

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Appendix 1 African waste initiatives under the CDM

Host country	Project title	Date registered	Emissions reduced per annum (metric tonnes of CO ₂ equivalent)
Cameroon	Nkolfoulou Landfill Gas Recovery Project	25/02/2010	130,099
Cameroon	Douala Landfill Gas Recovery and Flaring Project	19/01/2011	63,363
Côte d'Ivoire	Abidjan Municipal Solid Waste-to-Energy Project	24/06/2009	71,760
Côte d'Ivoire	Akouedo Landfill Gas Recovery and Flaring Project	12/02/2011	522,329
Democratic Republic of Congo	Kinshasa Landfill Gas Recovery and Flaring Project	16/03/2011	124,819
Egypt	Onyx Alexandria Landfill Gas Capture and Flaring Project	15/12/2006	370,903
Egypt	Land Filling and Processing Services for Southern Zone in Cairo	29/10/2012	25,053
Ethiopia	Methane Capture and Flaring from Addis Ababa Repi Open Dump Fill	23/05/2013	96,884
Ethiopia	GHG Emissions Reduction through Modjo Common Effluent Treatment Plant	29/02/2016	142,602
Ghana	ZOOMLION GHANA LTD Composting of Municipal Solid Waste in Accra Area	23/03/2012	68,902
Ghana	Oblogo 1 Landfill Gas Recovery and Flaring Project	01/04/2016	7,302
Liberia	Whein Town Landfill Gas Recovery Project	25/12/2010	93,635
Mauritius	Mare Chicose Landfill Gas Project	30/03/2012	81,601
Morocco	OULJA Landfill gas recovery and flaring	06/11/2007	32,481
Morocco	Marrakesh Wastewater Treatment Plant with Biogas Recovery for Cogeneration	11/12/2012	62,488
Morocco	Fes New Landfill Gas Recovery Reuse and Flaring Project	13/03/2014	118,553
Morocco	Biogas Recovery and Electricity Generation from M'zar Wastewater Treatment Plant	30/06/2016	44,296
Namibia	Methane Recovery and Power Generation at the Kupferberg Landfill	05/12/2012	9,341

(table continued over page)

Host country	Project title	Date registered	Emissions reduced per annum (metric tonnes of CO ₂ equivalent)
Namibia	Power Generation from Biogas in Windhoek	30/12/2012	7,869
Nigeria	Municipal Solid Waste Composting Project in Ikorodu, Lagos State	15/12/2010	281,781
Nigeria	Landfill Gas Recovery Project	12/07/2012	129,932
South Africa	Durban Landfill-Gas-to-Electricity Project – Mariannhill and La Mercy Landfills	15/12/2006	68,833
South Africa	EnviroServ Chloorkop Landfill Gas Recovery Project	27/04/2007	188,390
South Africa	Kanhym Farm Manure to Energy Project	18/07/2008	32,660
South Africa	Durban Landfill-Gas Bisasar Road	26/03/2009	342,705
South Africa	Alton Landfill Gas to Energy Project	24/08/2009	25,893
South Africa	Ekurhuleni Landfill Gas Recovery Project	26/10/2010	282,349
South Africa	Nelson Mandela Bay Metropolitan's Landfill Gas Project	24/05/2012	109,473
South Africa	Joburg Landfill Gas to Energy Project	12/11/2012	542,495
South Africa	Dundee Biogas Power (Pty) Ltd	15/11/2012	25,431
South Africa	Manufacture and Utilisation of Bio-Coal Briquettes in Stutterheim	22/05/2014	131,270
Sudan	Omdurman Landfill Municipal Solid Waste Composting Project	18/12/2014	46,789
Tunisia	Djebel Chekir Landfill Gas Recovery and Flaring Project	06/10/2006	369,664
Tunisia	Landfill Gas Recovery and Flaring for 9 Bundled Landfills	23/11/2006	317,909
Uganda	Mpererwe Landfill Gas Project	20/01/2012	18,261
Uganda	Anaerobic Digestion and Heat Generation at Sugar Corporation of Uganda Limited	06/11/2013	46,974
Uganda	Nakivubo Wastewater Treatment Plant Methane Capture and Utilisation Project	19/05/2015	27,591
United Republic of Tanzania	Landfill Gas Recovery and Electricity Generation at Mtoni Dumpsite, Dar Es Salaam	02/06/2007	202,271

Note: This information has been extracted from the CDM project search facility under the classification of 'waste handling and disposal'.

Source: CDM (n.d.b).

Appendix 2 Interviews

Interviewee	Interviewers	Date
Eugenia Kargbo, Sanitation Team Lead, Mayors Delivery Unit, Freetown	Nandini Sharma Olive Leonard	01/09/21
Eugenia Kargbo, Sanitation Team Lead, Mayors Delivery Unit, Freetown	Kato Kimbugwe	17/03/22
Martin Travers, Tony Blair Institute Advisor, Mayors Delivery Unit, Freetown	Nandini Sharma Olive Leonard	01/09/21
Martin Travers, Tony Blair Institute Advisor, Mayors Delivery Unit, Freetown	Kato Kimbugwe	17/03/22
Martin Travers, Tony Blair Institute Advisor, Mayors Delivery Unit, Freetown	Anna Bailey- Morley	17/05/22
Martin Travers, Tony Blair Institute Advisor, Mayors Delivery Unit, Freetown	Anna Bailey-Morley	23/05/22
Lamin Sanyang, Director of Services, Kanifing Municipal Council	Claire Kumar Olive Leonard	02/06/21
Lamin Sanyang, Director of Services, Kanifing Municipal Council	Nandini Sharma Claire Kumar	02/09/22
Lamin Sanyang, Director of Services, Kanifing Municipal Council	Claire Kumar	20/01/22
Lamin Sanyang, Director of Services, Kanifing Municipal Council	Claire Kumar	29/04/22
A. Mohammed A. Foboi, Head of International Affairs, Monrovia	Nandini Sharma Olive Leonard	07/12/21
Fredrick Cole, Director of Central Region Solid Waste Department, Monrovia	Nandini Sharma Olive Leonard	07/12/21
Edwin D. Johnson, Project Coordinator of Chessemanburg Landfill and Urban Sanitation Project, Monrovia	Nandini Sharma Olive Leonard	07/12/21
Massa Stubblefield, Director, Solid Waste Management Department, Monrovia	Nandini Sharma Olive Leonard	07/12/21
A. Mohammed A. Foboi, Head of International Affairs, Monrovia	Claire Kumar	29/03/22