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Managing solid waste for a sustainable Accra

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LIST OF ABBREVIATIONS

ACARP	Accra Compost & Recycling Plant
ACC	Accra City Council
CCC	Central Communal Container
EHD	Environmental Health Department
EPA	Environmental Protection Agency
ESP	Ghana's Environmental Sanitation Policy
ESPA	Environmental Services Providers Association
GAMA	Greater Accra Metropolitan Waste
GARID	Greater Accra Resilient And Integrated Development
GDP	Gross Domestic Product
GhG	Greenhouse Gas
GPAP	Global Plastic Action Partnership
IRECOP	Integrated Recycling and Compost Plant Limited
MESTI	Ministry Of Environment, Science, Technology, And Innovation (Mesti
MLGRD	Ministry of Local Government and Rural Development
MMDAs	Metropolitan, Municipal and District Assemblies
MSW	Municipal Solid Waste
MSWM	Municipl Solid Waste Management
MSWR	Ministry of Sanitation and Water Resources
NESSAP	National Environmental Sanitation Strategy And Action Plan
NGOs	Non Government Organization
NPAP	National Plastic Action Partnership (Npap
NPV	Net Present Value
NSD	National Strategic Document
PPP	Public Prvate Partnership
SDGs	Sustainable Development Goals
SWC	Efficient Solid Waste Collection
SWM	Solid Waste Management
TCP	Teshie Compost Plant
UNDP	United Nations Development Programme
WMDs	Waste Management Departments

SECTION 1

BACKGROUND TO THE STUDY

Key Takeaways:

- Like most metropolises worldwide, GAMA is caught in the headlong rush towards unplanned urbanisation. This, coupled with the twin factors of urbanisation and rising GDP, has translated into exponential growth (in volume and context) in solid waste.
- GAMA, like many metropolitan areas, has proven thus far to lack the capacity to manage solid waste, continuing to employ a linear collection and disposal model.
- For effective solid waste management, GAMA needs to formulate a deeper understanding of the solid waste sector through modelling, raise public awareness to improve community buy-in, and explore strategies for creating a financially viable SWM sector.

Managing solid waste sustainably has been a longstanding challenge in Ghana. The genesis of meeting this challenge can be traced to establishing the Accra City Council (ACC) in 1898. The council aimed to maintain cleanliness in Accra (Oteng-Ababio, 2020). However, although the council met this challenge to a reasonable degree in its early years, managing the city's waste became a more pressing concern as the population exploded from 18,574 in 1911 to 337,828 in 1960, and by 2010, had passed the 3 million mark (Owuusu and Oteng-Ababio, 2015). This monumental growth has presented authorities with a two-prong challenge—finding an equilibrium between promoting economic development and meeting the needs of low-income communities. According to UNEP (2018), the growing amount and intricate nature of waste pose a significant threat to the environment and human well-being (Mudu et al., 2020). This threat has become an important challenge for government agencies, pollution control organisations, regulatory bodies, and the general public (Das and Bhattacharyya, 2014). As a result, governments globally have implemented intentional policies and legal structures to tackle the rising accumulation of municipal solid waste (World Bank, 2021).

Over the years, MSWM has become a perplexing policy challenge in the context of developing economies. An often-stated truism is that SWM is the most critical of all the challenges confronting developing economies (Godfrey et al., 2019). It is, therefore, not surprising that most environmental policy decisions are devoted to how technical issues and formal regulations guiding waste disposal can be enhanced (World Bank, 2021). For the past twenty years, many city authorities have suffered a decline in improved solid waste disposal services driven by limited funding sources amid increased population (UNEP, 2018). The SWM sector reflects a situation where urbanisation, lifestyle changes, shifting consumption habits, and accelerated economic growth have led to an overwhelming increase in volume and content waste generation in cities (Owusu-Sekyere, 2020). With urban areas housing about 55 per cent of the world's population, a proportion expected to increase to 68 per cent by 2050, the problem is yet to peak (United Nations, 2017).

Today, about 80 per cent of the global Gross Domestic Product (GDP) and two-thirds of greenhouse gas (GHG) emissions are attributed to urban areas (Dobbs et al., 2011; Frolking et al., 2022). A key characteristic of these centres is that they exhibit profound infrastructure inequalities, with significant variations in availability, provision, and access (Pandey, Bresford, and Seto, 2022). High levels of inequality result in poor waste management practices, correlating with city growth and GDP (Duranton & Puga, 2020; Oteng-Ababio, 2014). This threatens human health and well-being by engendering the increased spread of communicable diseases (Mudu et al., 2021) and undermines efforts to sustain the city's aesthetic appeal (Oteng-Ababio & Van de Velden, 2019).

With cities experiencing population explosion and urbanisation, one inevitable consequence is a concomitant increase in waste generation, which must be managed sustainably (see Box 1.1). Solid waste, a by-product of daily human activities, encompasses a range of disposable products from the many invented and mass-producible complex synthetic materials (principally

plastics) that are discarded as unwanted and useless (Szaky, 2013). Increasing consumption due to economic growth as the national GDP grew typically translates into a corresponding increase in the amount of waste produced per person.

Box 1.1: Defining Municipal Solid Waste

Technically, municipal solid waste (MSW) is from domestic, commercial, industrial, and institutional activities in urban areas. The scraps can be substantial, semi-solid, and liquid and include materials that are neither wastewater discharges nor air emissions. Although waste characteristics vary considerably and geographically, waste in developing economies includes predominantly vegetable and putrescible matter and different amounts of paper, metals, plastics, and inert matter such as coal ash or sand. Characteristically, such waste streams contain significant amounts of human faecal matter and, to various extents, industrial, commercial, and medical wastes, a portion of which may be hazardous.

MSW services include waste storage and collection, street and drain cleaning, waste transfer and transport, disposal, and resource recovery. Other activities include vehicle maintenance and repair, financial management, administrative activities (e.g., routing, scheduling, recordkeeping), staff management and development, and strategic planning. These activities fall within the municipality's jurisdiction, but often, the private sector may be contracted to offer services for and on behalf of the local authority.

Surprisingly, in cities like Accra (Ghana), the responsibilities for refuse collection, disposal, and vehicle maintenance are assigned lower levels of official attention. Moreover, the widespread absence of strategic planning and inappropriate technology creates serious inefficiencies in expenditure and effort. Hence, solid waste services in cities like Accra remain unreliable, lack universal coverage, and fail to provide safe disposal methodologies; thus the abundance of improperly (illegally) disposed waste constrains urban productivity and poses significant threats to public health and the environment.

Thus, the global rate of waste generation surged from about 31 million tons in 1980 to 157 million tons in 2009 and was expected to move from the 2016 figure of around 2 billion tonnes/year to 3.4 billion tonnes by 2050. The 3.4 billion tonnes figure translates to a footprint of 0.74 kilograms per person per day (World Bank, 2018). Since its inception, the SWM trail has been bumpy, exhibiting occasional transformations in tandem with waste and technology's

changing volume and content. While some waste streams are recyclable, most are non-recycled using traditional recycling systems, thus creating pressure for city authorities to develop and manage at a higher cost (Mudu et al., 2021).

Being a social problem, waste menace in cities remains a significant yet often overlooked challenge in planning for sustainable, healthy cities. The accompanying impacts severely challenge the natural environment and fall disproportionally on the most vulnerable in society, who end up losing their lives and homes from landslides of waste dumps. The poor are also those most likely to work in unsafe, waste-picking conditions. This often results in profound health repercussions (Agyei-Mansah & Oteng-Ababio, 2015). Also noteworthy is that a damaged local environment, contaminating water, sinking groundwater levels, unhealthy soils, and polluted air hit society's most vulnerable groups the hardest. This is because the poor and marginalised lack resources and tend to usually be directly dependent on their close natural environment for their daily survival. Entirely too often, the cost transcends the human realm (Mudu et al. 2020). In a business-as-usual scenario, solid waste–related emissions may increase to 2.6 billion tonnes of CO^2 equivalent by 2050 (Kaza et al., 2018).

Meanwhile, previous studies have advanced several reasons to explain Ghana's poor municipal SWM status. A lack of financial and human resources and organisational inefficiency within municipal bodies cause much trouble. Transportation arrangements are generally inadequate due to the unavailability of proper vehicles as well as the low productivity of the personnel. Policy gaps must also be addressed (e.g., to desist people from throwing garbage in public areas). In addition, the assemblies find it hard to raise resources to acquire suitable land and often lack the technical capability to design appropriate landfills. While these flaws have been much studied in recent years, comprehensive analysis of the potentials embedded in the entire waste value chain is only now gaining traction. Although there is consensus among researchers and practitioners that a comprehensive SWM architecture has the potential to contribute to

achieving sustainable development goals, there needs to be more knowledge about whether they in fact, do and how. Recent scholarship points to an increasing research interest in appreciating the entire value chain spectrum. Our study aims to contribute to this emerging body of knowledge.

Our study focuses on understanding the entire value chain of waste generated in GAMA and envisages what is possible. The key to achieving the long-term SWM goal is accurate information regarding solid waste quantity, quality and sources. The paper takes its point of departure in the argument that the linear, non-cyclical way of treating and relating to waste in Ghana, both in policy and in practice, is fundamentally flawed and problematic. Significantly, waste is not seen as a resource that can be refined (e.g., as nutritious compost manure or energy) or recycled (e.g., into new paper and plastic), thereby generating wealth. Instead, it is often treated as the leftover that needs to be eliminated. Indeed, waste is rarely discussed as part of a production, consumption, and recovery cycle, nor is it assessed for environmental sustainability. On the contrary, SWM is seen as a linear collection and disposal process, and the preceding actions of production and consumption are seldom reflected upon.

Additionally, the study critiques how the informal waste system is considered dirty, and those dealing with it are perceived as inferior, second-class citizens. This negative attitude towards the informal waste system runs contrary to the fact established in the literature that though informal waste workers live and work under extensive health risks and suffer severe exploitation and deprivation, they hold the key to sustainable urban environmental futures. Our assessment has both evaluative and, crucially, strategic value. We argue that to assess the promise of MSWM for sustainable development, it should be examined in terms of its impact potential, that is, whether the stakeholders along the value chain are of such nature as to be likely to produce a development impact. Largely overlooked so far are the effects of these

dynamics on the urban fabric and its social structure, especially in questions related to the inequality of service provision and how that can inform future policies.

1.1. The Research Aims and Objectives

Undoubtedly, Ghana has made some improvements and innovations in the quest for sustainable MSWM. Still, the overall ambition of the President of "making Accra the cleanest city in West Africa" remains threateningly daunting, complex, and needs urgent action (World Bank, 2018). We believe that achieving a clear vision requires conscious understanding, appreciation and harnessing of the entire waste industry value chain. Specifically, we aim to:

- provide estimates of the volume and content of waste generated in Metropolitan Accra;
- model the waste flow to facilitate quick estimation of waste generation rate and content, and
- explore sustainable pathways for MSWM and long-term fiscal sustainability in Metropolitan Accra.

Generally, efficient municipal waste collection, transportation, and disposal are among the vital functions of every local authority. Prior studies indicate that city authorities employed many staff to discharge this function. Consequently, the authorities had to use a substantial portion of their annual budget on waste collection, transportation, and disposal. Despite these, the challenges of MSWM remain overwhelming as various neighbourhoods continue to grapple with a lack of basic services due to the unavailability of waste management infrastructure. What is more, the virtually yet-to-be-considered or non-existent implementation plan of source separation and sorting facilities and poor stakeholder cooperation have heightened environmental pollution.

Additionally, solid waste recycling has yet to receive official attention. Although the primary concern for any MSWM is to deliver a well-functioning and sustainable system, recycling,

waste recovery activities, and environmental control still need to be appropriately conceptualised and incorporated into the entire architecture. Earlier literature has revealed that various types of waste in varied volumes are generated due to human activities and should be treated appropriately and safely disposed of. These waste streams should be managed to reduce and minimise their adverse health hazards and environmental impacts, thereby maximising the environmental, social and economic benefits and contributing to sustainable SWM development.

Regarding waste disposal, indiscriminate dumping in open spaces and landfill sites without proper treatment and disposal is a widespread problem in Accra. This raises issues of public attitudes, commitment, and environmental awareness. It suggests a lack of understanding of how SWM contributes to public health and environmental issues. Accra's SWM operations lack an integrated framework; thus, waste is inappropriately disposed of in illegal sites. In most neighbourhoods, especially the peri-urban areas, waste is disposed of in conventional landfills. Nevertheless, the containment of these landfills is inadequate: they are open and unlined, without leachate collection systems in the basements. They also lack pre-treatment facilities. Therefore, these sites have the potential to impact and degrade groundwater quality.

Generally, there is an urgent need to improve the design of landfills towards engineered and sanitary operations, develop pre-treatment facilities, and effectively monitor and manage the disposal sites. Landfills must have waste pre-treatment facilities before disposal. Existing approaches and experiences should be evaluated nationally regarding practices for improving services, especially in peri-urban areas, due to existing infrastructural imbalances. Scavenging activities and the informal sectors should be institutionalised to leverage their potential and minimise negative environmental impacts.

Our study showed that MSWM is a multi-dimensional issue involving diverse stakeholders (interests) and incorporating environmental, political, institutional, social, and economic aspects. Thus, improving SWM practice requires understanding and accepting these realities, raising public awareness, increasing funding, building expertise, and investing in infrastructure. The study further showed that in the case of Metropolitan Accra, making sustainable progress will mean embracing new systems for MSWM that are participatory, contextually integrated, complex, and adaptive. It is also essential to recognise the informal sector's contribution, whose business model has proven environmentally and economically beneficial. Apart from offering critical services at no cost to the city authorities, people pay them to remove their waste. At the same time, the recyclables serve as raw materials for some local companies. Thus, they do make money on both ends. More importantly, their ability to recover the recoverable serves as an exemplar to the local authorities, who have so far over-concentrated on waste disposal, of the many opportunities for real cost savings that are being missed in the waste industry. Their activities help recover waste (reduce the amount to be landfilled) and put it to good use, saving cost and helping the environment simultaneously.

1.2 Structure of the Report

In our study, we explore the concept of SWM, which involves a streamlined process city authorities use to dispose of, reduce, reuse, and prevent waste. This approach involves implementing comprehensive strategies to efficiently manage waste from its origin until final disposal, in contrast to the traditional model where raw materials are collected and transformed into products that are used until discarded to manage wastes from their origin until their final disposal efficiently. We build our conceptual approach by engaging with interrelated bodies of literature, starting with an executive summary followed by a general introduction to the study in section 2. Section 3 briefly outlines the methodology we adopted for the study. As researchers interested in conducting empirical studies on the impact of institutional

arrangements on MSWM architecture, we used qualitative and quantitative techniques, which involved a combination of surveys, participatory observations, interviews, and documentary material. This approach facilitated in-depth elicitation of information and enabled follow-up questions to explore the outcomes of how the waste industry in Metropolitan Accra has operated over the years and continues to work today.

Sections 4 to 7 overview the current waste management practices, which have become obligatory functions of city authorities due to their potential effect on human and environmental health. The sections highlight generation estimates, future rates and composition, and solid waste collection and disposal practices. We maintain that waste management in the sub-region, in general, suffers from limited technological and economic resources and poor funding, which collectively result in the prevalent low standards of waste management. The situation is exacerbated by the public perception of waste disposal as a welfare service issue and their apparent reluctance to pay for waste disposal, especially among the poor. The situation has persisted and been condoned because, across sub-Saharan Africa, the legal and institutional frameworks for engaging in environmentally sound waste management are either lacking or inadequately applied.

Providing good SWM services and ensuring the financial sustainability of the system remains a significant challenge for cities in developing countries. In the metropolitan city of Accra, municipal waste management services have been outsourced to private waste companies since the early 1990s. While this change has brought about a significant improvement in the cleanliness of the city, it is unclear whether it is financially sustainable. Can the private companies generate enough revenue from their activities to cover the costs and make a profit? In Section 8, we present the financial sustainability of the industry by conducting a cost-revenue analysis based on data from July 2018 to June 2020. The section shows that the overall costs of the waste management system in Accra increased significantly, mainly due to rising

costs related to waste transportation. On the other hand, there is only one significant revenue stream: the waste collection fee from households, commercial enterprises, and institutions. As the efficiency of fee collection from households is only about 50 per cent, the amount collected is insufficient to cover the running costs. This results in a substantial yearly deficit.

Section 9 of the study focuses on the waste industry's challenges using Metropolitan Accra as the sub-regional lens. Our study found that instituting a proper waste disposal strategy has been, and continues to be, a challenge for most city authorities due to multiple obstacles. Despite the plurality of challenges, these industrial setbacks relate primarily to its labour-intensive and often ineffective collection and disposal processes, which could also result from poor waste conceptualisation, disparate and conflicting policy initiatives, overlapping regulatory functionality and guidelines, and financial and infrastructural gaps.

The penultimate section provides some recommendations for policy consideration. Our study found that the city authorities in Accra continue to struggle with managing its solid waste effectively. In their quest to save the city's environment from being swallowed by waste, especially plastics, several initiatives have been undertaken with limited success. We identified and discussed some reasons for these failures and proposed some policy recommendations for consideration by the government and city authorities. In our view, the government and the city authorities must preserve a level-playing field that does not disrupt or impede the operationalisation of the tenets of the waste hierarchy in the long run since any functional SWM chain ultimately relies on interdependent linkages. Improper waste disposal in Africa has resulted in poor hygiene lack of access to clean water and sanitation by the urban poor. Consequently, most city authorities may not be able to meet the Sustainable Development Goals (SDGs) target of reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2030.

SECTION 2

SOLID WASTE MANAGEMENT IN ACCRA

The quest for sustainable solid waste management (SWM) has been a long-standing issue in Ghana. The Accra City Council (ACC) was founded in 1898 to keep the city clean (Oteng-Ababio, 2020). However, managing the waste produced by the city's growing population became increasingly challenging, as the population grew from 18,574 in 1911 to 337,828 in 1960, and by 2010, had surpassed three million (Owusu and Oteng-Ababio, 2015). Like many cities worldwide, Accra is undergoing significant transformations driven by institutional efforts to manage urban spaces and populations in response to global environmental change and the neo-liberalisation of governance (Nygren, 2018). The authorities face the challenge of balancing the need to promote economic growth while assisting low-income communities. According to UNEP (2018), the increasing amount and complexity of waste pose a significant threat to the environment and human well-being (Mudu et al., 2020), creating significant challenges for government agencies, pollution control organisations, regulatory bodies, and the public at large (Das and Bhattacharyya, 2014). As a result, governments worldwide have implemented purposeful policies and legal frameworks to address the growing accumulation of municipal solid waste (MSW) (World Bank, 2021).

Over the years, MSWM has become an unwarranted policy challenge, and it is commonly stated that among the many challenges facing developing economies, poor SWM is the most critical (Godfrey et al., 2019). Most environmental and policy decisions are focused on how technical issues and formal regulations guiding waste disposal can be improved (World Bank, 2021). For the past two decades, many city authorities have faced a decline in improved solid waste disposal services due to limited funding sources amid an increasing population (UNEP, 2018). The SWM sector reflects urbanisation, lifestyle changes, shifting consumption habits, and accelerated economic growth, which has substantially increased waste production and

diversity in cities (Owusu-Sekyere, 2020). With urban areas housing about 55% of the world's population, a percentage expected to increase to 68% by 2050, the problem is yet to peak (United Nations, 2017).

Today, approximately 80 per cent of the world's Gross Domestic Product (GDP) and two-thirds of greenhouse gas (GHG) emissions are produced by urban areas (Dobbs et al., 2011; Frolking et al., 2022). However, these urban areas experience significant infrastructure inequalities, resulting in inadequate availability, provision, and accessibility (Pandey, Bresford, and Seto, 2022). Since urban infrastructure is highly correlated with urban growth and city-level GDP (Duraton & Puga, 2020), these inequalities lead to poor solid waste management (SWM) practices. This, in turn, poses a threat to human health and well-being, as it increases the spread of communicable diseases (Mudu et al., 2021) and undermines efforts to maintain a city's aesthetic appeal (Oteng-Ababio & Van de Velden, 2019; Jerie, 2016).

As cities continue to grow and urbanise, the amount of solid waste generated also increases. Solid waste refers to all non-liquid waste produced as a result of daily human activities, including disposable products such as complex synthetic materials (especially plastics) that are discarded as unwanted and useless (Szaky, 2013). Excreta is not typically included in this category, although sometimes nappies and the faeces of young children may be mixed with solid waste. As the national GDP grows, waste production increases with economic growth, producing more waste per person. The global waste rate has thus surged from approximately 31 million tonnes in 1980 to 157 million in 2009. It is expected to increase from around 2 billion tonnes/year in 2016 to 3.4 billion tonnes in 2050, resulting in a footprint of 0.74 kilograms per person per day (World Bank, 2018).

The journey towards effective SWM has been bumpy, with occasional transformations that align with changes in the volume and content of waste and technology. While some waste

streams can be recycled, others require more costly management strategies, putting pressure on city authorities with critical infrastructural needs competing for investment attention (Mudu et al., 2021). By empowering residents to be more conscious of their waste's environmental impact, city authorities can catalyse mass ideological change in society's perception of waste.

A SWM system or waste disposal is a streamlined process that city authorities use to dispose of, reduce, reuse, and prevent waste. It is an approach where city authorities implement comprehensive strategies to efficiently manage wastes from their origin until their final disposal. Possible waste disposal methods include recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimisation. Instead of excessively purchasing new materials and carelessly discarding unused resources, city authorities should encourage residents in its geographical space to reduce waste generation and strengthen their waste reduction efforts. Ultimately, living in an unhygienic and untidy environment can lead to demoralisation and less motivation to improve the conditions around oneself. Waste attracts more waste and leads to less hygienic behaviour in general. Therefore, it is crucial to manage waste effectively to prevent adverse environmental and social impacts.

2.1. Understanding solid waste management and how it works

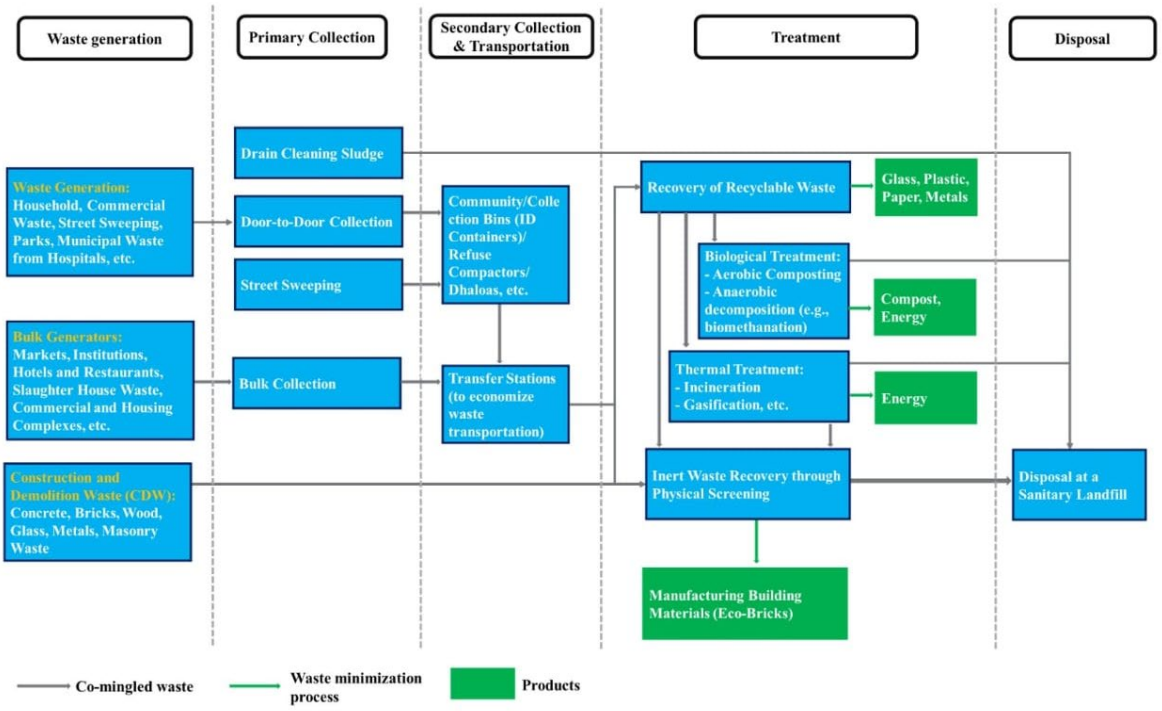
Waste management is a crucial issue in planning sustainable and healthy cities. However, it is often neglected, leading to severe challenges for the natural environment and vulnerable communities. The negative impacts of SWM are often borne by underprivileged communities, who risk their lives and homes due to waste dumps, work in unsafe conditions, and suffer from health issues. Moreover, a damaged local environment, such as contaminated water, sinking groundwater levels, unhealthy soils, and polluted air, affects society's most vulnerable groups. Appendix A presents some of the potential risks associated with improper SWM. The poor lack resources and depend on the natural environment for daily survival, making them more

susceptible to the adverse effects of improper SWM. If left unaddressed, solid waste-related emissions may increase to 2.6 billion tonnes of CO^2 equivalent by 2050.

Ghana's poor SWM status can be attributed to various factors, including a lack of financial and human resources, organisational inefficiencies, and inadequate transportation arrangements. Policy gaps and overlaps must also be addressed, including littering in public areas. Municipalities struggle to acquire suitable land and lack the technical expertise to design efficient SWM systems. While these issues have been studied extensively, there is a growing interest in understanding the entire waste value chain's potential. Thus, a comprehensive understanding of the entire SWM architecture has the potential to contribute to achieving sustainable development goals (SDGs), but it is unclear if and how it does so. Recent research has focused on appreciating the entire value chain spectrum, and our study aims to contribute to this emerging body of knowledge.

Our study focuses on understanding the entire value chain of waste generated within GAMA and envisioning what is possible (see Figure 2.1). The study argues that the linear, non-cyclical way of treating and relating to waste in Ghana, both on paper and in practice, is fundamentally problematic. MSWM is a process (not an action) that involves storing, collecting, transporting, and disposing waste generated in households, commercial premises, and institutions. It comprises a highly complex set of operations on an enormous scale. Indeed, the study sees good SWM as an essential component of a strategy for improving environmental health. The study believes that uncollected solid waste rapidly putrefies in tropical climates, creating noxious smells, giving rise to polluting leachates, and providing breeding areas for countless flies and, in the wet season, mosquitoes. Vermin also abound, and a particularly important indirect effect is the blocking of drains, which causes local flooding with its associated environmental health risks and economic disbenefits.

Figure 2.1: An Overview of the Solid Waste Management Chain



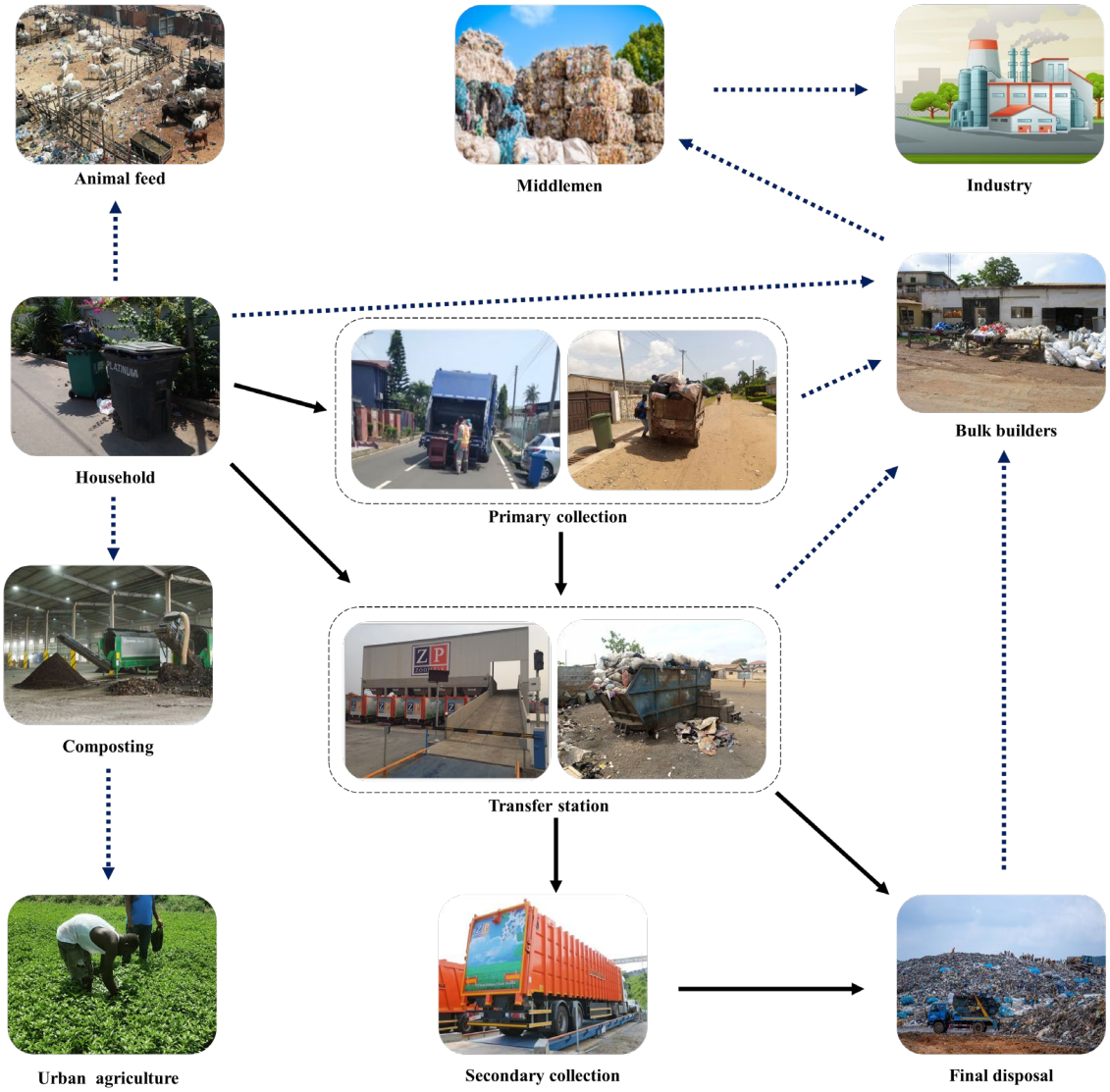
Source: Authors' Construct

Presently, waste is not seen as a resource that can be refined (e.g., as nutritious compost manure or energy) or recycled (e.g., into new paper and plastic), thereby generating wealth. Instead, it is often treated as the evil leftover that needs to be eliminated. Indeed, waste is rarely discussed as part of a production, consumption, and recovery cycle, nor is it assessed for environmental sustainability. On the contrary, SWM is seen as a linear collection and disposal process, and the preceding actions of production and consumption are seldom reflected upon. Additionally, the study bemoans how the informal waste system is considered dirty, and those dealing with it are perceived as inferior, second-class citizens. Our concern stems from prior studies revealing that though informal waste workers live and work under extensive health risks and suffer severe exploitation and deprivation, they hold the key to sustainable urban environmental futures. This is even though they face several possible health hazards, including raised levels of infant mortality, hand and leg injuries, intestinal and respiratory infections, eye infections, lower back pain, malnutrition, skin disorders, and exposure to hazardous waste.

Our study has both evaluative and, crucially, strategic value. In general terms, we explore how urban SWM works; we describe the situation of a typical city in sub-Saharan Africa, although exact details will vary from place to place. Using metropolitan Accra as a lens, we explore whose responsibility is to manage municipal solid waste (MSW). In Accra, it remains surprising that dedicated waste management departments (WMDs) are rare in most municipalities, given the size, complexity and budget share. We look at what happens to MSW regarding the collection system. From our study, the waste collection frequency in Accra varies daily upwards, depending upon the resources available and the locality's perceived importance. Further, those who work in MSW are also considered. For example, although waste pickers are relatively poor in Accra and carry out what is often regarded as demeaning work, they hold prized positions and contribute more than 50 per cent of the total waste collected in the metropolis. Of critical to MSWM is the question, “Is there any waste recycling/reuse?” This is because MSW is a vital resource. As a result, in most developed economies, a highly developed and complex system of waste recovery, reuse and recycling operates commercially.

Managing solid waste is a market-based and market-driven industry, with itinerant waste buyers purchasing recyclable items from householders and selling them to middle dealers specialising in certain types of waste. Waste reprocessors also play a significant role in the industry, employing up to 40,000 people in places like Karachi alone. The industry is complex, involving various activities from the public sector to small-scale private enterprises and service users. Figure 2.2 presents a graphical representation of the various activities involved in the waste industries. It is important to explore the full extent and range of activities within MSWM to understand the operating processes and systems. The involvement of NGOs, CBOs, and municipal organisations in promoting local schemes is also examined. Furthermore, the complex intra-household relationships between women and domestic servants have gender implications in the industry.

Figure 2. 2: Complex formal and informal activities in the waste industry



Source: Authors' Construct

Many waste pickers are not part of the formal system and make their living from picking out material for reuse/recycling from communal bins, transfer points, and waste disposal sites. These individuals may be among the poorest of the poor. Aside from the actors, proper MSWM also explores whether other enterprises are associated with solid waste. In addition to waste reuse/recycling, residents in some areas have taken initiatives to improve primary collections from their neighbourhoods. Rich and poor residents alike in most cities pay for additional waste services. In some jurisdictions, area-based organisations and NGOs have played essential roles in waste management. This may involve waste pickers being paid extra, local activists

facilitating or managing the collection, or a small contractor providing local services. Or study assesses the promise of MSWM for sustainable development, examining its impact potential and whether the stakeholders along the value chain are likely to produce a development impact. We opine that the effects of the dynamics on the urban fabric and its social structure, especially those related to inequality of service provision, should be considered in future policies.

SECTION 3

METHODS AND DATA

Solid waste management is one of Accra's most challenging and contentious issues. In a survey conducted in Accra in 2010, residents viewed MSWM as the third-most crucial urban service, behind sanitation (including toilets) and drainage (World Bank, 2010). While most solid waste articles theoretically cover institutional arrangements and their implications for sustainable environmental management (Mudu et al., 2020), their empirical contributions do not guide how to proceed methodologically (Oteng-Ababio, 2021). Significantly, researchers who conduct empirical studies on the impact of institutional arrangements on MSWM architecture and their prerequisites use qualitative and quantitative techniques and a combination of surveys, participatory observations, interviews, and documentary material (Mmereki, 2018).

Most materials for our study were derived from semi-structured interviews with key decision-makers at institutions, departments, and agencies responsible for planning, implementing, and regulating municipal waste-related policies and issues. The approach facilitated in-depth elicitation of information and enabled follow-up questions to explore the outcomes of how the waste industry in Metropolitan Accra has operated over the years and continues to work today. As interviewees' elaborations on the sustainability of waste management practices were sparse, existing accounts of the subject were also used. An interview guide based on a literature review of and including several selected themes was used as a point of reference to conduct the interviews (mainly in English, except for a few minutes of vernacular in two instances). Each interview took between 48 minutes to 2 hours, depending on the interviewee's availability and position. The emphasis shifted slightly over time as some questions were excluded and replaced with those eliciting richer replies.

The fieldwork was conducted in June and August 2022, with several follow-up interviews in 2023. The city is home to many governmental and non-governmental organisations (NGOs)

working in the waste industry. The magnitude and complexity of the challenge required involvement from both central and local-level actors, and interviewees in the formal and informal sectors provided insightful accounts of how trust, legitimacy, integration, and power imbalances, which are critical ingredients for sustainability - played out during interaction across the central–local actor divide. The informal interviewees gave a local perspective on the practicality and reform implications of the industry. In contrast, the formal sector highlighted how they remain more severely impacted financially by the present arrangements. The primary selection strategy of interviewees, apart from their position in the waste industry, was 'snowball sampling' on-site. The empirical setting presented some difficulties for data collection, especially regarding access to the officials of some of the private service providers and their documentation since professional secrecy (especially among the private service providers) is a strong norm within the Ghanaian administrative setup for various reasons. At times, this was worryingly delimiting, but interviews were eventually established via interlocutors, who metaphorically served as 'door openers' and often proved decisive for data collection and subsequent snowball sampling.

Of the 26 interviewees, six were experts from academia whose research output and interests' border on MSWM, and seven were from government ministries and agencies. The formal sector had seven representatives, three NGO/CBO representatives who advocated for the welfare of the informal operators, while four casual operators were consulted. In total, 10 out of the 26 respondents (about 39%) were women. As some interviewees preferred to remain anonymous, all interviewees were anonymised to minimise the risk of identification. These interviews were recorded in audio, transcribed verbatim, and analysed thematically. As discussions were semi-structured, the analytical themes partly overlapped with interview themes, but new themes also emerged. The interview results were also contrasted and compared

with primary sources (Ghana Statistical Service; local government reports, official websites), secondary sources (news articles, academic articles, and UN reports), and field notes.

The waste generation rates for the city were also forecasted and projected by adopting the methodology described in Kaza et al. (2018). Technically, waste generation rates depend on essential variables, including the level and rate of urbanisation, economic development, and population growth. The methodology adopted uses a regression model to capture the relationship between GDP and waste generation (see Appendix B for the full model description for calculating Ghana's GDP as described by Kaza et al. 2018). The current objective aimed to determine the volume of litter dominating the litter stream in public spaces in GAMA to inform policy decisions and intervention planning for litter management. A list of key informant interviews and the interview date are highlighted in Tables 3.1 – 3.4 below.

Table 3.1: List of Interviewees from Tertiary Institutions

Name and Title	Institution	Date
Dr Paulina Amponsah	Ghana Atomic Energy Commission	
Prof Ebenezer Owusu Sekyere	University of Development Studies	
Prof Kwabena Simon Mariwah	University of Cape Coast	
Dr Kwaku Oduro-Appiah	University of Cape Coast	
Dr Kwadwo Meizah	Kwame Nkrumah University of Science and Technology	
Dr Benedicta Fosu Mensah	University of Ghana	
Prof Gerald Yiran	University of Ghana	

Table 3.2: List of Interviewees from Government Institutions

Name	Institution	Date
Godfred Fiifi Boadi	Ministry of Sanitation & Water Resources	
Josephine Manu	Ministry of Sanitation & Water Resources	
William Kodwiw	Greater Accra Resilient and Integrated Development Project	
Engr. Solomon Noi	Accra Metropolitan Assembly	
Anthony Mensah	Ex-Staff- Ministry of Sanitation & Water Resources	
Prince Gyekye	Council for Industrial and Scientific Institute	
Faustina Essandoh	Department of Community Development	
Bertha Darteh	Private Consultant – Marple Consult	

Table 3.3: List of interviewees with the waste recycling company

Name	Institution	Date
Ama Ofori Antwi	Environmental Service Providers Association	
Vivian Ahiagbor	City Waste & Recycling	
Peter Dagadu	Waste landfill limited	
Matilda Owusu	Accra Compost and Recycling Plant	
Dr Emmanuel Sekyere	Africa Environment Sanitation Consult Ltd	
Farouk Barimah	People's Dialogue	
Cyril Adzornu	Jekora Ventures	

Table 3.4: List of interviewees at informal waste Collection companies

Name	Institution	Date
Lydia Bamfo	Tricycle and Borla Taxi Association	
David Alagadu	Savana Research Consult	
Dr Owusu Boampong	WIEGO	
Tema male waste picker	Informal Operator	
Tema (male waste picker)	Informal Operator	
Ashaiman (female waste picker)	Informal Operator	
Dr Sekyere	Africa Environment Sanitation Consult Ltd	

SECTION 4

SOLID WASTE MANAGEMENT PRACTICES IN ACCRA

Key Takeaways

- Accra, a city of over 2 million inhabitants, generates around 900,000 metric tonnes of solid waste annually. However, over half of the city's residents do not benefit from regular waste collection. This has led to significant issues relating to open dumping, including air pollution and flooding. Despite investing between 20 to 50% of the municipal budget on MSWM, over 90 per cent of municipal waste is often disposed of in unregulated dumpsites or openly burned.
- Accra's SWM service delivery exhibits low user and provider inclusivity in decision-making, financial sustainability, the cohesiveness of institutions managing the system, and the proactiveness of the legislative and regulatory framework. Accra municipality, for example, incurred a debt of US$8,400,000.00 to private solid waste contractors for waste collection and disposal charges between 2000 and 2007.
- Poor MSWM has significant financial, health, and environmental costs in Accra. As of 2012, transport and collection of waste costs about GH₵ 6.7 million (US$ 3.45 million) annually and about GH₵ 550,000.00 (US$ 0.28 million) per month to pay for private service providers and landfill maintenance. Poor sanitation due to indiscriminate waste disposal costs the country about $290 million yearly, equivalent to 1.6 per cent of the country's total GDP.
- The public role has changed from central control of the process resources and power to a present facilitative agenda. In principle, the public sector now acts as the purchaser of services on behalf of citizens. In reality, SWM is delivered by formal sector operators in zoned areas while poor households are served by small-scale service providers.
- Due to weak governance and limited government capacity, the informal sector plays a key role in provisioning recycling and informal collection services, accounting for 51 per cent of the total waste collected in Accra. Further, informal pickers provide most of the city's recycling services, where only 10 per cent of municipal waste is recycled. However, individuals engaging in informal SWM services are still marginalised despite providing a crucial service.
- Interviewees critiqued Accra's poor enforcement of environmental standards, lack of public awareness, and drawbacks from the current policy regimes.

4.1 Overview

Human advancement is directly connected to waste generation due to changes in consumption patterns, lifestyles, affluence, population growth, urbanisation, economic growth, and the increasingly diverse nature of modern products (Dangi et al., 2017). Improper waste management has become a significant concern for city authorities due to its potential impact on human and environmental health. In Accra, where service levels need to improve, developing an effective MSWM system has been a long and complicated process (see Oteng-Ababio, 2020). Even though a significant portion of the municipal budget is allocated to MSWM (Oteng-Ababio, 2014; Meizah et al., 2015; World Bank, 2018; Oduro-Kwateng et al., 2020), poor waste management continues to be a persistent issue in most cities. For example, the Accra Metropolitan Assembly (AMA) spends about 20 –50 per cent of its budget on MSWM. Despite this amount, over 90 per cent of its waste is often disposed of in unregulated dumpsites or openly burned. This practice often results in severe health, safety, and environmental consequences (Agyei-Mensah & Oteng-Ababio, 2013; Mudu et al., 2021).

Most areas, except for a few affluent neighbourhoods, are affected by environmental pollution and health hazards due to a lack of appropriate technical, managerial, administrative, financial, and institutional arrangements (Oduro-Kwateng et al., 2020). This issue has been a growing concern, particularly regarding environmental sustainability. As a result, various strategies have been developed to reduce waste, improve waste recovery, recycle waste (Friedrich & Trois, 2013), and divert waste from landfills (dos Muchangos et al., 2015). It is widely agreed among scholars that improper SWM can harm the environment and public health. Therefore, governments must prioritise resource recycling from waste and control environmental pollution.

Accra's SWM systems date back to the late 1800s when the Accra City Council (ACC) was established and charged with managing waste. Before then, there was no formal policy or harmonised regulatory framework for MSWM. According to Adu-Gyamfi et al. (2017, p. 4), public health maintenance before the colonial era was handled under the traditional authorities' directives. The authorities' primary concern was ensuring their subjects' social, economic, and spiritual well-being. Arhin (1985, p. 35) notes that establishing various traditional rules in taboos, customs, and laws helped significantly in promoting environmental sanitation long before the European presence and colonisation.

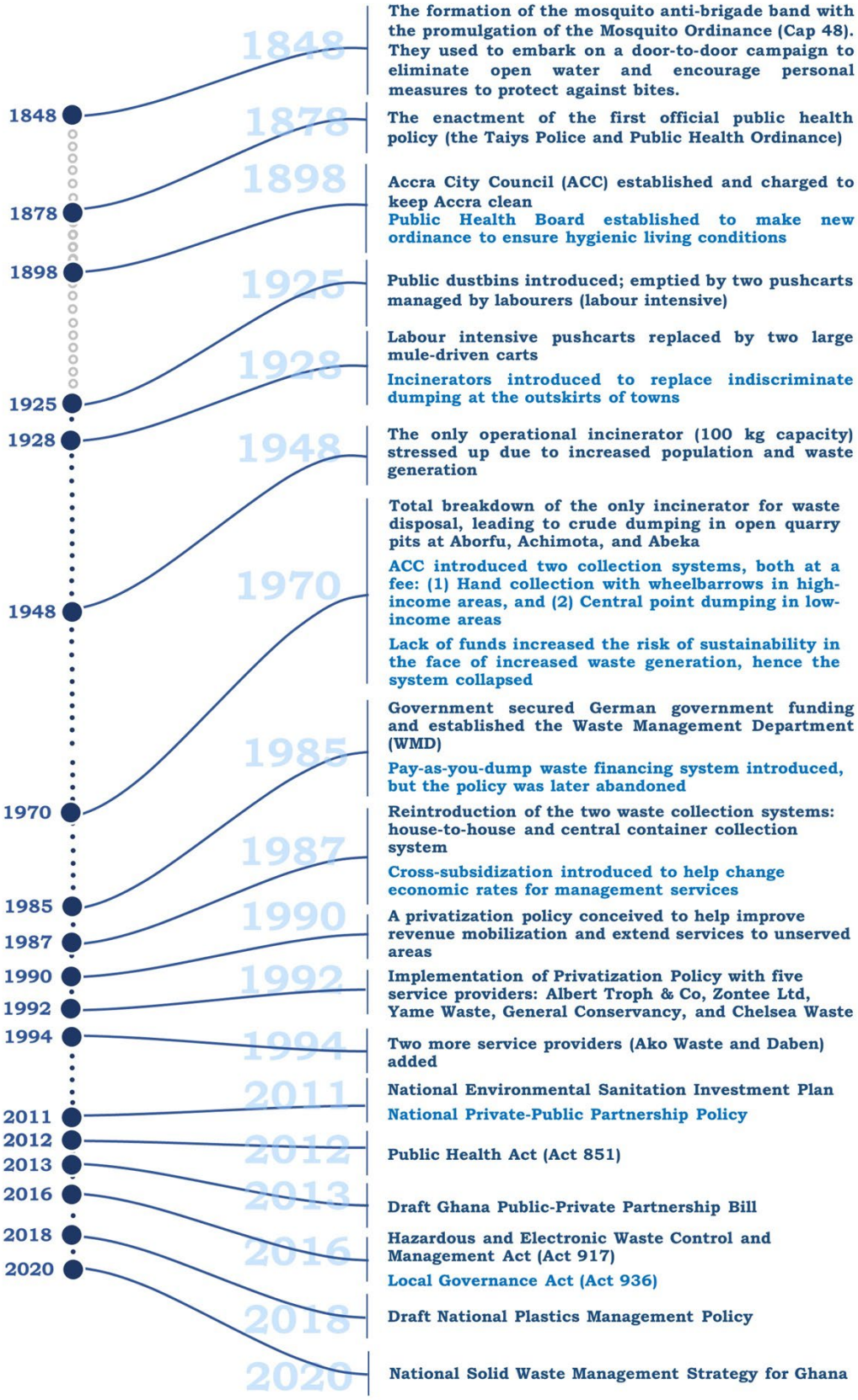
Thus, the establishment of the ACC coincided with the implementation of the first official public health policy—the Towns, Police, and Public Health Ordinance of 1878, in the Gold Coast. This ordinance aimed to promote proper environmental sanitation activities and was used to dispatch inspectors and surveyors to independent neighbourhoods and homes to ensure strict implementation. The Mosquito Ordinance of 1848 cap 48 also required the anti-mosquito-brigade- band to go door-to-door to eliminate open stagnant water sources and encourage the adoption of personal measures to protect against bites (Strother, 2016). Addae (1997) also notes that the ordinance helped guide households, communities, and city authorities in their sanitation efforts:

> "*The gang consisted of sanitary inspectors, labourers, and police (officers) who ensured the people followed the recommended measures. The sanitary inspectors visited each compound once every fourteen days. To ensure the people complied with the ordinance, larvae fine 7/6d was imposed on convicted offenders*".

The SWM system in Accra has undergone numerous transformations over the years, with changes in waste volume, content, and technology. However, historical studies have shown that implementing effective sanitation laws has always been challenging. The colonial administration faced difficulties maintaining public health, including inadequate legal provisions, stiff opposition from local authorities, lack of health workers, and insufficient

political support. These challenges have persisted, with increasing urbanisation of poverty and uncontrolled development significant factors affecting the waste industry. Despite this, new legislation and institutions have been implemented over time, with various actors competing and collaborating to make the system more efficient. Figure 4.1 provides a timeline of the evolution of MSWM in Accra since the 1800s.

Figure 4.1: Historical trajectory of Accra's waste management architecture

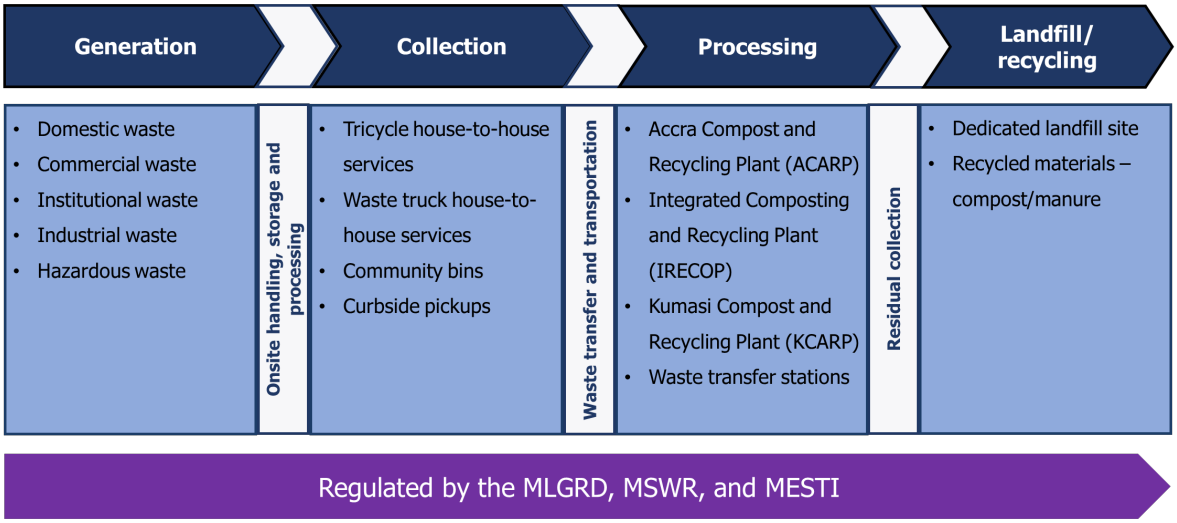


Source: Compiled by the Authors, 2023.

Today, managing waste in Accra has become a contentious issue. The city suffers severe environmental management shortfalls due to inadequate infrastructure and institutional bottlenecks (World Bank, 2010). For instance, IQAir (2020) report described Accra as Africa's 3rd most polluted city. This was after, near the end of 2009, the news that the travel guide *Lonely Planet* had ranked Accra as the second worst city in the world hit many Ghanaians like a slap in the face. In a listing of the "9 least favourite cities," compiled from feedback by the site's members, the nation's capital was described as "ugly, chaotic, sprawling, and completely indifferent to its waterfront location" (Wagle, 2010). These "*enviable achievements*" mask the benefits of a well-functioning system, including guaranteeing the health of all citizens and achieving Sustainable Development Goal #7 (environmental sustainability). Effective MSWM is costly but critical in protecting the environment and improving urban productivity and water resources (Mudu et al., 2020).

As mentioned earlier, the local authorities require more technical, managerial, administrative, financial, and adaptive institutions to provide proper guidance for efficient SWM. The current practice of MSWM in Accra is linear with a take-use-dispose approach (refer to Figure 4.2). It often leads to a system that is inefficient, costly and depletes natural resources. From gold to coal, mining commodities can spoil ecosystems and disrupt nearby communities. Making steel from ore requires a large amount of energy, which produces Earth-warming carbon dioxide. A byproduct of the linear model is material waste, which takes up space and may include contaminants. Trash ends up in undesirable places. The so-called Great Pacific Garbage Patch is only the most well-known example of global-scale plastic pollution. Yet products like steel and plastic can be reused, refurbished and recycled to capture untapped value. A totally circular economy — with no waste and no new materials— is likely impossible to achieve, but squeezing the maximum waste out of the system could curtail the use of new resources.

Figure 4.2: The waste management value chain



Source: Authors' Construct

Unfortunately, more than 90 per cent of waste generated is disposed of exclusively at uncontrolled dumpsites and landfills. It is often associated with open burning to reduce the volume of waste. This "collect and dispose of" approach prioritises waste disposal rather than adopting a more inclusive, sustainable, and minimising approach (Oduro-Kwarteng et al., 2020, pp. 44 - 46). Figure 4.4 presents typical unsanitary scenes and sights at landfill sites in Accra. As earlier indicated, as cities experience rapid economic development and population growth, there is an urgent need to prioritise effective and efficient MSWM due to its critical role in protecting the environment and public health (Oteng-Ababio, 2020). However, local authorities need help to keep up with this, which has led to unsanitary disposal practices and has made SWM one of the neglected areas of urban management in Accra. Despite claims that more than 70 per cent of waste generated in the city is collected, transported, and disposed of, reports from C40 (2019) rightly indicate that the city is having difficulty disposing of over 600 tonnes of waste per day in open dumps, leading to fires, high levels of air pollution, and increased greenhouse gas (GHG) emissions.

Figure 4. 3: Unsightly scenes of scavengers operating selected at landfills in Accra

Source: Authors' Fieldwork

Technically, SWM in Accra depends on local factors, such as income, physical infrastructure, community organisation, local politics and policies. Each locality has its way of managing waste, which is closely related to its socio-economic status. However, the fast population growth has made it difficult for some local authorities to meet the infrastructure demands, affecting service delivery quality. Consequently, in 2011, the "polluter pays principle" was introduced to create a fee- and performance-based waste collection strategy, improve the financing of MSWM, and extend the service coverage. Additionally, formal private operators were to be contracted to collect waste from markets, institutions, and other places through the skip system, with the financial obligation remaining with the city authorities. However, five years after its implementation (i.e., by 2016), coverage under formal service provision chains had dropped from 60 to 55 per cent, and illegal dumping had increased while, during the same period, the informal service providers had increased their client base (C40, 2019).

The current arrangements have led to a mix of weak policies and regulatory frameworks, partial collection coverage, low recovery and recycling rates dependent mostly on informal recycling enterprises, under-regulated private sector participation, and the unavailability of environmentally appropriate disposal facilities. In addition, the "polluter-pays-principle" policy did not improve the problems with revenue collection. As a result, Accra municipality, for example, incurred a debt of US$8,400,000.00 to private solid waste contractors for waste collection and disposal charges between 2000 and 2007. According to one of our stakeholders, the government owes the Jospong Group of Companies about GH₵ 224 billion as of September 2022, despite having paid the company GH₵ 100 million in March 2022 to manage landfills nationwide.

Box 4. 1: Functional Elements of Municipal Solid Waste Management System

There are six (6) functional components of the MSWM system, as outlined below:

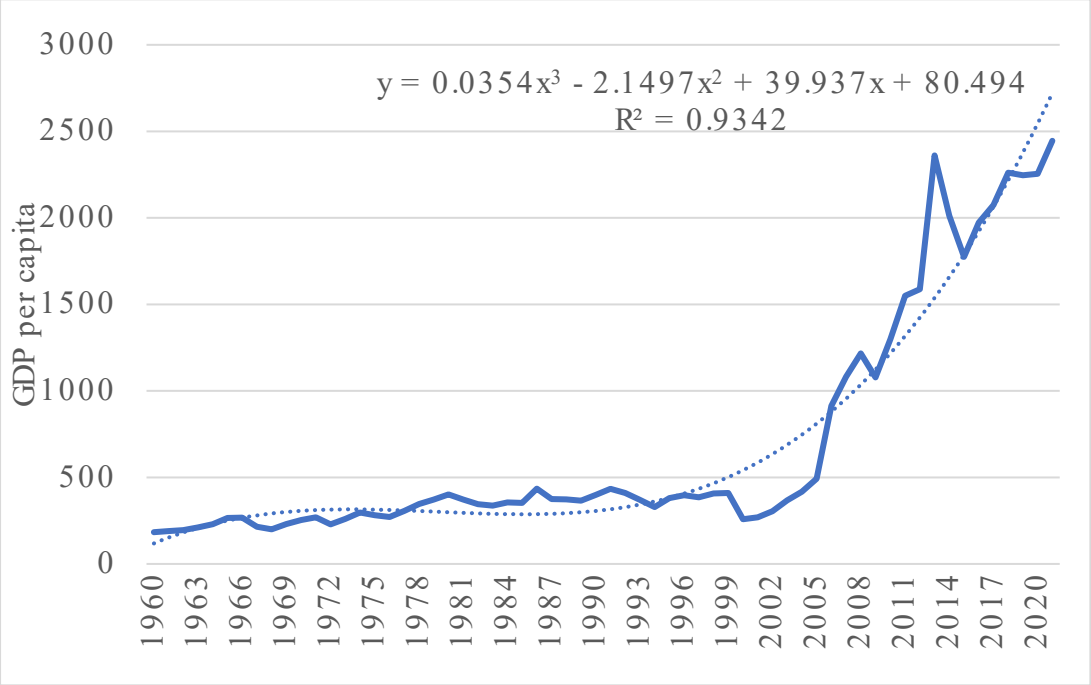
- Waste generation: This encompasses any activities involved in identifying no longer usable materials gathered for systematic disposal or thrown away.
- Onsite handling, storage, and processing: This relates to activities at the point of waste generation, which facilitate more accessible collection (i.e. placing waste bins at sites that generate sufficient waste).
- Waste collection: This includes activities like placing waste collection bins, emptying those bins, and accumulating waste in transfer stations, etc. The collection phase involves some movement, but this is not the main stage of waste transportation.
- Waste transfer and transport: These activities involve moving the waste from the local waste collection locations to the regional waste disposal site in large transport vehicles.
- Waste processing and recovery: This refers to the facilities, equipment, and techniques employed to recover reusable or recyclable materials from the waste stream and to improve the effectiveness of other functional elements of waste management.
- Disposal: The final stage of MSWM. This involves systematically disposing of waste materials in locations such as controlled dumpsites, landfills, or waste-to-energy facilities.

Accra's quality of life is deteriorating due to inefficient labour-intensive waste collection and disposal processes. This has made it necessary to develop a better MSWM architecture and improve environmental conditions. Unfortunately, authorities and service providers often rely on inadequate frameworks to design and plan strategies. The result is ineffective and unaffordable arrangements, making city authorities overwhelmed by the daily waste volumes. Meanwhile, knowledge of the cost and value of unsanitary conditions is critical, especially in poor urban areas. Some prior studies have used the contingent valuation approach, with very few taking on a hedonic approach to estimate the cost of improper environmental sanitation in settlements. In Metropolitan Accra, some budgetary studies show that about 50 to 70 per cent of the city's budget is spent on waste collection and disposal today (Muda et al., 2020). An

earlier report of the Water and Sanitation Programme of 2012 had also revealed that city authorities in Ghana collectively spent about GH¢ 6.7 million (US$ 3.45 million) annually on the collection and transport of waste for disposal and about GH¢ 550,000.00 (US$ 0.28 million) per month to pay private service providers and for landfill maintenance (WASH, 2012).

The report further revealed that poor sanitation due to indiscriminate waste disposal alone costs the country about $290 million yearly, equivalent to 1.6 per cent of the country's total GDP. This study adopted a hedonic approach (based on population growth) to estimate the cost of poor sanitation on the local economy. Even though our model is deficient in a detailed and vigorous analytical framework, the value of R2 (see Figure 4.) was quite significant and indicative of the potential cost of poor environmental management on the economy. Our observation concurs with those of a study by Gulyani et al. (2012), who used a hedonic approach with a log-linear model to assess the determinants of rent prices in the informal settlements of Dakar (Senegal) and Nairobi (Kenya).

Figure 4. 4: Trend of Ghana's GDP per capita from 1960 to 2020



Ghana's GDP per capita from 1960 to 2020. NB: 1960 is the base year ($x = 1$).
Data Source: World Bank.

As mentioned before, MSWM is one of the essential administrative functions all MMDAs must perform. The Local Government Act 624 of 1992, amended by Act 936 of 2016, states that MMDAs are responsible for MSWM. The Constitution recognises SWM as a public health issue, which makes it non-exclusive, non-valued, and essential. Previously, local authorities managed waste using their staff, equipment, and funds. However, the public role has changed from central control of the process, resources, and power to a facilitative agenda amidst different levels of the political and socio-economic environment (Oteng-Ababio, 2010). In principle, the public sector now acts as the purchaser of services on behalf of citizens. In other words, the private sector now provides 100 per cent of the previously public service, which obscures the SWM status as a public good (Oduro-Kwarteng et al., 2020).

Box 4. 2: Consequences of Improper MSWM

Proper MSWM is essential both for the health of residents of Accra and its environmental protection and future. This is critical for the urban poor, who are most vulnerable to the effects of a poorly managed system. Due to the dumping of waste into open drainage and unauthorised areas, drains are clogged with waste material, leading to a proliferation of vermin and disease vectors. Due to drainage clogging, standing pools of water promote breeding conditions for disease-carrying mosquitoes. The spread of malaria, now the most familiar communicable disease in Accra, among other communicable diseases (e.g., dengue and yellow fever), is associated with poor environmental sanitation and conditions associated with extreme poverty. In 2005, about 292,685 cases of malaria were reported in Accra, against the then population of about 1.7 million (AMA 2009)

The current systems for managing waste in Accra have resulted in inadequate coverage and poor service delivery, particularly in low-income and peri-urban areas. This has led to unsanitary conditions in these areas, posing a threat to public health and the environment while creating a business opportunity for informal waste collectors. Most affected areas lack essential infrastructure such as access roads, water, sanitation, and electricity, exacerbating the problem. Due to inadequate service delivery, illegal waste dumping, burning, and burying in open spaces close to human habitats are some pollution-laden practices that have emerged. Recent

developments reveal that two groups are dominating the waste management industry in the city. The first group comprises formal sector operators who get government contracts within the zoned areas in the MMDAs. The second group comprises many small-scale service providers, known as "Kaya bolas," who directly serve the poor and dormitory households.

Despite the government's effort to invest in formal public-private partnerships (PPP), the low rates of revenue collection and the availability of low-cost labour due to a growing population have weakened the autonomy of the public waste system. The shortcomings in the privatisation and public-private participation (PPP) management models in most Ghanaian cities can be attributed to a complex mix of factors such as weak governance, lack of political will, and moderate capacities in both the private and public sectors, exacerbated by rigid financing and budgeting systems. Unfortunately, the current institutional framework fails to capture the operations of the informal sector, which plays a significant role in Accra's solid waste management practices. The informal sector involves recycling enterprises, itinerant waste buyers and dealers, self-employed sweepers, and city sweepers who collect solid waste from households or clients for agreed payment.

4.1.1 Ramifications of the Current SWM Policies and Practices

Our study shows that waste minimisation remains an unfamiliar concept in the current SWM system in Accra, yet that is a strategy crucial for a sustainable MSWM. Shockingly, almost 90 per cent of the waste collected in Accra ends up in landfills. Meanwhile, prior studies (Oduro-Kwarteng et al., 2020) indicate that adopting waste minimisation practices can save city authorities from incurring expenditures for waste handling, recycling, transportation, and disposal. Currently, only 10 per cent of the city's waste is recycled, and this is mainly done by often marginalised and stigmatised informal waste pickers and recyclers, who account for about 84 per cent of waste collection (Oduro-Kwarteng et al., 2020).

Accra's SWM service delivery must be more inclusive for users and providers in decision-making, financial sustainability, cohesive institutional management, and proactive legislative and regulatory frameworks. This results in an ineffective waste collection system that fails to combine segregation and resource recovery. A practical and reliable SWM system demands firm policies, effective planning, and sustainable public-private partnerships that promote behavioural change. The final crucial functional element in MSWM systems is disposal. Unfortunately, all solid waste generated in Accra is disposed of through landfilling or uncontrolled dumping. This includes residential waste, residual materials from material recovery facilities, residue from solid waste combustion, rejects of composting, and other substances from various solid waste-processing facilities. Despite the authorities' knowledge of what an ideal landfill facility should be, such a facility remains non-existent in Accra. A landfill facility should be engineered to ensure the safe disposal of solid waste on land or within the earth's mantle without creating nuisances or hazards to public health or safety, such as breeding rodents and insects and groundwater contamination.

This study is motivated by multiple factors. Its purpose is to enhance current MSWM practices by outlining the current status of management approaches in the city and identifying significant challenges and issues that hinder the implementation of more efficient and sustainable waste management systems. This study aims to assist decision-makers in restructuring the city's current architecture for an effective waste management system. Ultimately, this study provides empirical evidence for developing more efficient and sustainable management systems in urban centres, including secondary cities in the sub-region, and contributes to environmentally sustainable and cost-efficient solutions for the waste problem.

4.2. Governance Structure for Municipal Solid Waste Management

This section will discuss the contextual protocols related to institutional roles, policies, and regulations regarding SWM in Accra. The primary aim of the governance mechanism is to

regulate the waste sector to ensure sustainable environmental management. This process includes the participation of users and service providers to achieve financial sustainability while strengthening institutions to perform their mandated tasks. This approach has become the accepted paradigm. However, it has been observed that proven techniques have failed in the past due to insufficient attention being paid to both the 'hardware' and 'software' of the MSWM processes (Oteng-Ababio, 2020). To ensure socially acceptable, environmentally friendly, economically sustainable, and mutually beneficial long-term MSWM solutions, both 'hardware' and 'software' of MSWM processes should complement each other (see Wilson et al., 2013; Oteng-Ababio, 2020).

According to Lissah (2021), Ghana's waste management system is theoretically sound and up-to-date. Still, it falls short compared to developed economies because of technical, financial, and governance-related obstacles that prevent the provision of the entire value chain service. The developed economies have a well-functioning, integrated sustainable waste management (ISWM) system that enforces solid policies and laws, supported by robust institutions that oversee the entire value chain. Consequently, the relationships between the state and local actors determine the success of partnerships in the industry's service provision, as noted by Oduro-Kwateng (2012).

Accra's MSWM industry has undergone significant changes, transitioning from a public sector-led approach to a collaborative partnership with the private sector. The effectiveness of this partnership and its impact on service coverage and environmental cleanliness relies heavily on how both parties maintain an enabling environment (policies, legal frameworks, and regulations), which provides the necessary incentives for investments, improved service quality, and regular price adjustments (OECD, 2000). Oduro-Kwateng et al. (2020) indicate that every organisation is influenced by its external environment and the activities of auxiliary actors. The households and institutions external to the waste management industry and the

frameworks for service delivery bring to the fore the external environment in which the private sector operates. While the private sector has little control over this environment, it can better adapt and develop appropriate strategies to deal with the issues (Lusthaus et al., 1999).

4.2.1. Policy and Legislative Frameworks

Accra, the capital city of Ghana, has implemented several policies to promote sustainable MSWM. These policies are supported by comprehensive strategies, acts, and regulatory guidelines, as Figure 4.4 indicates. In addition to these local laws, the country has ratified numerous international environmental protection, safety, and public health conventions. These laws and regulations cover various aspects, such as land ownership, standards, accountability, and social benefits. On the international front, Ghana has notably ratified the UN Agenda 2030 and the African Union Agenda 2063 to protect the environment, promote safety, and reduce public health risks. However, despite these efforts, our study revealed that the authorities in Ghana have struggled to enact and enforce an appropriate regulatory regime, which has led to challenges in the waste industry in Accra.

Table 4. 1: Key dates in the reform of the SWM sector

Year	Legislation/policy	Type
2006	Energy Plan	Policies and strategies
2010	National Environmental Sanitation Strategy and Action Plan (2010–2015)	Policies and strategies
2010	Revised Environmental Sanitation Policy (2010)	Policies and strategies
2011	Strategic Environmental Sanitation Investment Plan	Policies and strategies
2011	National PPP Policy	Policies and strategies
2012	Public Health Act (Act 851)	Legislation
2012	National Environmental Policy	Policies and strategies
2013	Draft Ghana Public Private Partnership Bill	Legislation
2014	Ghana Shared Growth and Development Agenda, 2014–2017	Policies and strategies
2016	Hazardous and Electronic Waste Control and Management Act (Act 917)	Legislation
2016	Local Governance Act (Act 936)	Legislation
2017	Coordinated Programme of Economic and Social Development Policies (2017–2024)	Policies and strategies
2018	Draft National Plastics Management Policy	Policies and strategies

From Figure 4.5, Ghana has a long-standing commitment towards protecting its environment. In 1994, the Environmental Protection Agency (EPA) law was passed through an act of Parliament (Act 490) to regulate environmental activities, further strengthening the country's efforts. Before this, the SWM sector relied on borrowed legislation. Besides the policies listed above, several ministries, including the MSWR, MESTI, MLGRD, and the Ministry of Health, also develop guidelines and standards for environmental management. Previous studies have shown that any legislation related to MSWM must exhibit good waste management practices, as listed in Box 4.4. Today, the Ghanaian waste policy environment aligns nicely with modern public health protocols and plastic recovery practices.

Box 4. 3: A good waste management legislation should establish the following:

A good waste management legislation should establish the following:

- Laws that define hazardous wastes and specify their methods of management, including:
    - Local ordinances which stipulate the responsibility of citizens to store, sort, recycle, discharge, and dispose of their solid wastes;
    - local ordinances which prohibit littering and clandestine dumping.
    - Local ordinances outlining the management of hazardous wastes.
    - Local laws, policies, and procedures governing the involvement of the private sector in solid waste services and
    - Local laws or agreements which specify the institutional arrangement for SWM.
- Policies on recycling and resource recovery.
- Tariff structures and procedures

The National Environmental Sanitation Policy (NESP) is Ghana's primary legal framework for managing solid waste. It was established in 2010 after nationwide consultation with stakeholders to improve upon a previous policy from 1999. The policy's main objective is to establish a clear and nationally recognised vision for environmental sanitation as a crucial social service that improves Ghana's health and quality of life. To achieve sustainable MSWM, the policy views environmental sanitation as an economic and public good that the polluter-pays principle should support. This principle aims to generate financing revenue, ensure cost recovery, and promote equity and gender sensitivity. The strategy acknowledges the importance of indigenous knowledge, cultural and religious diversity, community participation, and social intermediation in achieving sustainable MSWM.

Ghana's current waste policy framework aligns with modern protocols and practices for public health and plastic recycling. For instance, the National Plastics Management Policy 2018 proposes an extended producer responsibility scheme for the plastic products and packaging industry. The Strategic National Energy Plan of 2006 also recommends a tariff regime favourable to renewable energy, such as pyrolysis or gasification. The National Environmental

Sanitation Strategy and Action Plan (NeSSAP) advocates for material recovery through materials in transition (MINT), which focuses on the value of waste and considers recovered components as secondary resources.

Despite global efforts to manage municipal solid waste (MSW), there are still some issues with the current MSWM architecture. One of the fundamental principles of MSWM is waste prevention and payment by the polluter-pays-principle. However, there are still inadequacies in this regard. Another issue is the lack of cooperation among the parties involved. Although waste hierarchy is seen as the pathway towards sustainable MSWM, the current system operates inversely. Landfilling is still the most preferred and practised disposal method, while waste materials are often indiscriminately burnt and buried. This goes against the priorities of the waste hierarchy, which sees waste disposal as the least preferred option and reuse and recycling as the highest priorities. (Mmereki et al., 2014)

The development of sustainable MSWM in Accra has faced numerous challenges, as highlighted by various studies (Mieza et al., 2015; Oduro-Kwateng et al., 2010). Our research also identified several interconnected barriers hindering the progress of MSWM in the city. These include insufficient technically skilled human resources to design sustainable management plans, inefficiency in operational matters, inadequate waste reduction and sorting infrastructure, insufficient selective collection, lower financial penalties, inadequate funding, and inadequate knowledge of MSWM technologies. We observed that many MMDA actors and authorities need more knowledge of the changing national policy environment. Local governments tend to focus on the fundamental operational issues of waste collection, transportation, and disposal, with little emphasis on waste recovery or financial mechanisms to support the implementation of progressive policy instruments.

4.2.2 Reflections on our key stakeholders' responses

Based on the responses of our stakeholders, it is evident that the success of MSWM in Accra depends on various factors. These include having a technically skilled workforce, engaging in research and development of appropriate technologies, effective planning, awareness of environmental issues, and proper landfilling techniques. It is also critical to have an engineered and sanitary operational setup with leachate and gas collection systems, as well as the development of innovative technologies. These prerequisites are necessary for the creation of sustainable MSWM systems and the implementation of effective waste policies. Following the 'waste hierarchy' principles and SWM planning is essential to accelerate improvements toward MSW efficiency and sustainability in Accra and the sub-Saharan region.

Accra's "no enforcement and no compliance" attitude towards environmental laws was criticised by our interviewees. They revealed that these laws only seem to work when dealing with informal waste collectors. The waste pickers are often viewed as unwanted individuals, and the city authorities may take back or seize certain areas from them with little regard. During one of the workshops, a high-ranking official from the WMD of the AMA admitted to the leniency and inconsistency in enforcing waste laws as follows:

> *[…] We are running the city in a way that is victimising minority groups like waste pickers and pushing them to the edges. Such an act of cleaning the city* [citification] *impacts mainly the marginalised communities. However, without a doubt, the city is a poorer space without informal operators. […] yet, efforts are being made to erase them and whatever they signify because their activities are seen as a blot on the cityscape.*

Collaborating with the previous remarks, a private waste consultant described Ghana's waste policies as 'overwhelming'. She expressed disappointment at their lack of proper implementation, contributing to system gaps.

> "*So, it is not so much as in the policy but in the implementation because we have enough policies dating from the pre-independence era. […] I think the implementation is often our greatest challenge: translating the otherwise well-crafted policies into actions and getting the kind of results we want*".

A municipal engineer who has worked in the industry for over 30 years shared how, in recent days, legitimate summons to punish those who dispose of waste inappropriately are frequently disregarded due to the intervention of chiefs and politicians. He noticed that this starkly contrasted with the past, where strict compliance with regulations led to cleaner environmental standards. He proudly and energetically recounted his experiences as follows:

> "[…] *in the past, there was virtually no education on good sanitation. However, strict adherence to the law was the order of the day. Potential sanitary offenders knew the consequences of their actions and feared the environmental officers because of their swift actions in court. Indeed, the sight of a Health Inspector sent shivers to everyone, with mothers running helter-skelter to remove all environmentally challenging materials from sight in the house. Today, the situation is not the same*".

An Environmental Officer in the Ablekuma South sub-metropolitan district complained about how the youths in Glefe have turned the two local lagoons into dumpsites with impunity. He recounted:

> *Glefe is located on a two km-long sandbar along the Gulf of Guinea. To the north of the settlement are two lagoons, Gyatakpo and Gbegbu, which act as boundaries to the settlement of Mpoase. In the past, Mpoase used to be very active inland fishing grounds. These ponds are filled with waste today, and the city and traditional authorities seem helpless to address the issue. Despite being located in AMA and within the central business district, Glefe has always been seen as a peripheral community. This is a worrying situation given that the area is flood-prone, has poor housing quality, and lacks sanitation infrastructure. That notwithstanding, the area provides low rental prices and reliable connections to the CBD, making it an attractive option for low-income earners from other areas and in-movers to Accra.*

Figure 4. 5: Stages of one of the community pods in Glefe being filled with rubbish

Source: Authors' Fieldwork, 2022

During our fieldwork, we discovered several inconsistencies and policy conflicts that cannot be overlooked. For instance, the MSWR is responsible for SWM, but none of its six directorates can handle waste-related issues. As a result, the Sustainable Development and Climate Change Unit is tasked with coordinating and providing policy guidance for MMDAs on sanitation. A senior WMD official stated that, technically, the NESP should be reviewed every ten years, but the policy is now two years overdue. Furthermore, Ghana currently has a national SWM strategy, but there needs to be appropriate guidelines for its implementation. As a result, there are no guidelines for the implementation of source separation of household waste and composting, which are necessary for sustainable MSWM. The AMA 5-year Climate Action Plan [2020-2025], developed in 2019, has yet to implement guidelines.

During one of our workshops, an academician shared the results of a study commissioned by the Greater Accra Resilient and Integrated Development (GARID) Project on SWM in low-income areas of Accra. The findings indicated that informal waste pickers now account for 51% of the total waste collected in Accra, adding:

> *[…] GAMa generates about four thousand and fifteen (4,015) tons of solid waste daily. Out of the total amount collected, the formal sector comprising the waste management companies operating in Accra collects thousand five hundred and forty-three (1,543) tons, representing 48%. In contrast, the informal waste collectors, waste pickers, and recyclers collect one thousand five hundred and forty-nine (1,549), representing 51%, with the remaining one per cent collected by some of the municipalities.*

He confidently explained that the findings indicate the significant job opportunities created by the informal waste sector for particular residents within the city.

> *[…] the sachet water plastic industry alone generates over 5000 jobs. An estimated 600 sachet of water plastics (HDPE) buyers purchase and sell an average of 400 kg daily. The activities of these actors are complemented by about 65 enterprises of intermediate buyers, recyclers, and innovators who are turning recyclable materials into new products, creating more than 5,000 livelihoods through employment.*

There seem to be gaps in the regulatory regime, and laws are not enforced, indicating that the waste management sector needs focused attention. Our stakeholders (25 out of 27) believe that the inefficiency in Accra's MSWM practices is partly due to the drawbacks in the policy regimes. These issues have been previously raised by Obiri-Yeboah et al. (2004). They pointed out that the differences between formal rules and actual practices, particularly in private sector involvement, explain the weaknesses inherent in Accra's SWM industry. The authors attributed the MSWM issues to the weak internal revenue mobilisation capacities of local governments, ineffective urban governance, and the general lack of attention to environmental concerns in the development plans and programmes of the city.

Despite the decentralisation policy, our key informants blamed the central government for unnecessarily interfering in district matters, especially in the awarding of contracts. This observation is consistent with earlier studies conducted by Starovoytova (2018), Mudu et al. (2020), and Oteng-Ababio (2020), which link the non-enforcement of the city's by-laws to the development of a "throw-it-where-you-like" attitude. This attitude is the basis of the polluter-pays-principle financing model that the city is currently implementing. This example vividly illustrates how policy gaps can intersect with public behaviour and potentially sow the seeds for future environmental wars. In other words, converging policy crises can force residents to resort to illegal and indiscriminate dumping, which creates unsanitary conditions and ultimately leads to a breakdown in resilience and governance capacity. To avoid losing authority and facing future repercussions, city authorities should share all the facts and evolving knowledge of the environmental situation in the city without reservation.

4.2.3. Institutional Structures for Sustainable MSWM

This section provides the necessary context to understand better the connection between policy and regulatory regimes and the institutional responsibilities that ensure quality-of-service delivery. While the regulatory regime defines the obligations of all institutions and agencies

involved in waste governance, institutional arrangements cover several dimensions, such as service delivery mode, the role of actors, and financial arrangements. These arrangements provide a framework for the public, private, and households to play their expected roles in the various stages of the industry. In Accra, the waste industry is organised collaboratively among multiple stakeholders. However, a shift has shifted from central government control of waste service provision to private sector involvement. Three ministries, the MLGRD, the MESTI, and the MSWR, play critical but seemingly conflicting roles as either implementers or regulators. Table 4.2 summarises some essential institutions responsible for SWM in Accra.

Table 4.2: Some critical institutions associated with and responsible for solid waste management in Accra

s/n	Ministry/Agency	Role	Law/Act
1	Ministry of Sanitation and Water Resources	They contribute to improvement in the living standards of Ghanaians through increased access to and use of safe water, sanitation and hygiene practices and sustainable management of water resources	Civil Service Law, 1993 (PNDCL 327) and the Civil Service (Ministry) Instrument, 2017 (EI 28), National Environmental Sanitation Policy, 1999, National Water Policy, 2007,
2	Ministry of Local Government and Regional Development / Metropolitan, Municipal and District Assemblies (MMDAs)	Responsible for enforcing waste and sanitation policy and programs at the MMDA level	Local Government Act 462, 1993; re-enacted as Act 936 of 2016,
3	Ministry of Science, Environment, Technology, and Innovation	They ensure accelerated socio-economic development of the nation through the formulation of sound policies and a regulatory framework to promote the use of appropriate environmentally friendly, scientific, and technological practices.	Executive Instrument (E.I.) 7 Civil Service (Ministries) Instrument, 2009, Executive Instrument (E.I.) 1 Civil Service (Ministries) Instrument, 2013
4	Ministry of Health and Ghana Health Service	To improve the health status of all people living in Ghana through effective and efficient policy formulation, resource mobilization, monitoring, and regulation of delivery of health care by different health agencies.	Ghana Health Service and Teaching Hospitals Act, GHS ACT 525, HPRBA ACT 857 (2013), Mental Health Act 846 2012, National Health Insurance ACT 2012 (ACT 852), Pharmacy Act – 1994 (Act 489), Public Health Act 851
5	Community Water and Sanitation Agency	Responsible for increasing the effective and sustained use of improved community water and sanitation services in rural communities and small towns.	Community Water and Sanitation Agency Act 564, 1998
6	Ghana Water Company Limited	Responsible for overall planning, managing and implementation of urban water supply.	Ghana Water Company Limited Act 461, 1999
7	Water Resource Commission	Responsible for the regulation and management of water resources and for the coordination of policies in relation water.	Water Resources Commission Act 522, 1996

Based on Table 4.2, it is evident that different institutions have distinct mandates concerning MSWM operations. Before the establishment of MSWR in 2017, the MLGRD and its MMDAs were the primary institutions responsible for the governance of SWM services in the country. According to the Local Government Act 624 of 1992, later repealed and re-enacted as Act 936 of 2016, the Ministry is responsible for formulating solid waste and sanitation service delivery policies for all the local authorities. Therefore, as per the Act, MMDAs are mandated to implement solid waste and sanitation services locally, sometimes through contractual relationships with the private sector (see Box 4.4).

Box 4. 4: The Provision of Waste Management Services

Waste management (covering collection and sanitary disposal of wastes, including solid wastes, liquid wastes, excreta, industrial wastes, health-care and other hazardous wastes; stormwater drainage, cleansing of thoroughfares, markets, and other public spaces) shall be carried out by Waste Management Departments, within Metropolitan and Municipal Assemblies, or by Waste Management Departments of District Works Departments (DWDS) and District Environmental Health and Management Departments of District Assemblies. They may provide services directly or indirectly through private contractors or franchisees. The Assemblies shall, in all cases, maintain an in-house capacity to provide at least twenty (20) per cent of the services directly.

Further, as an effective and efficient relationship is ultimately based on trust, the Act expressly requires MLGRD to supervise the activities of the MMDAs, as stated in its mission.:

> "*…to promote the establishment and development of a vibrant and well-resourced decentralised local government system for the people of Ghana to ensure good governance and balanced rural based development."*

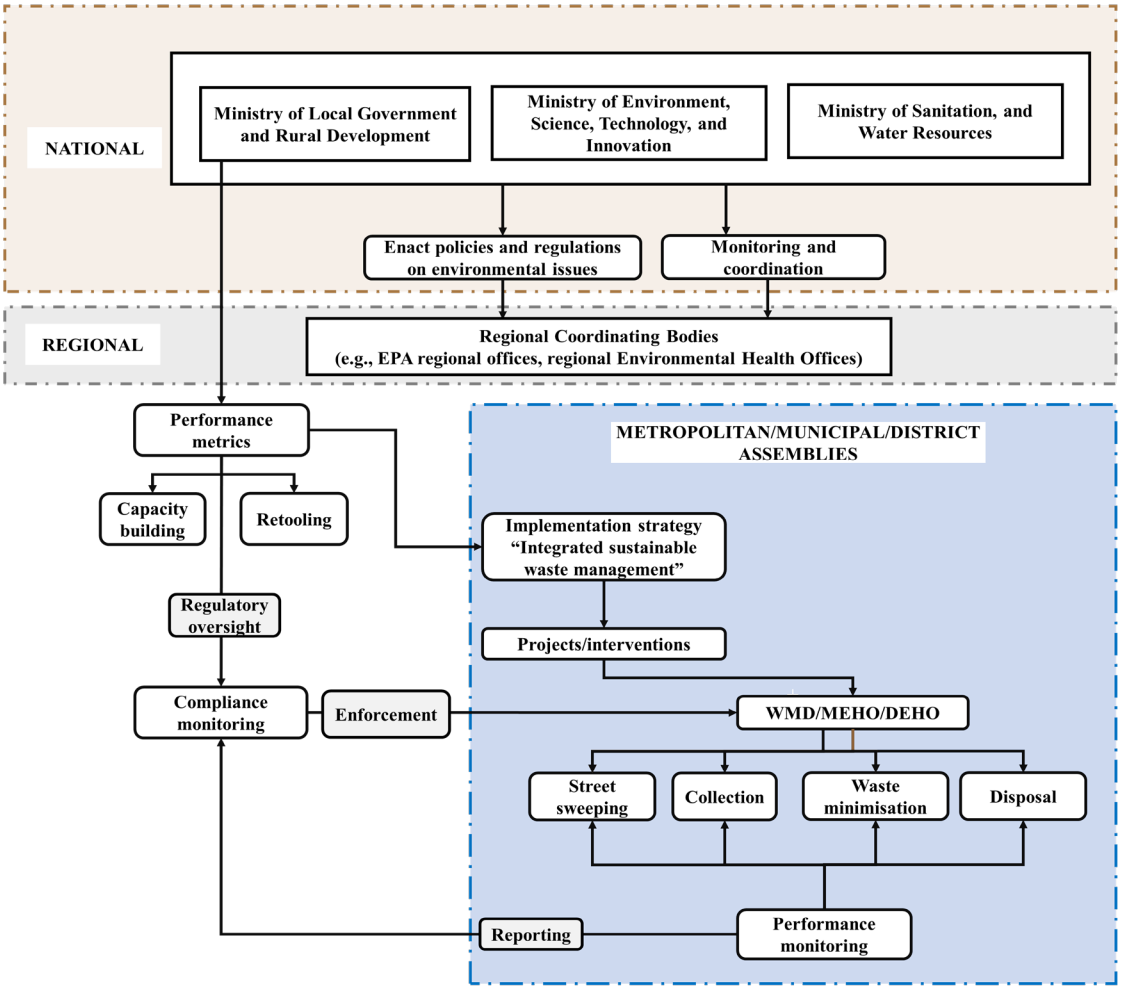
Indeed, all local governments have three primary responsibilities towards the MMDAs concerning MSWM. These are:

- provide policy and planning direction;
- enact the appropriate legislative instruments, and
- ensure strict implementation, monitoring, and enforcement (Kwateng-Oduro, 2011).

The Constitution of Ghana clearly states which ministry is responsible for MSWM operations. The MLGRD is responsible for formulating policies and providing guidance for the MMMDAs. It is also responsible for disbursing common funds to the MMDAs to carry out waste delivery services, staff training, retooling, and providing subsidies for specific services. The MMDAs have several functional departments, including the WMD, responsible for collecting and disposing of liquid and solid waste, public cleansing, educating the public on MSWM, and supervising activities of private contractors engaged by the assemblies. Additionally, the MMDAs have sub-metro cleansing or sanitation officers who monitor solid waste collection.

Each assembly has an Environmental Health Department (EHD) responsible for regulating and monitoring the quality of service delivery and overall sanitary conditions. The inspectors of EHD are expected to prosecute potential offenders. Meanwhile, the MESTI is mandated by the Parliament of Ghana to protect the environment. The EPA, an agency under the ministry, monitors the activities of the various MMDAs to ensure proper waste collection and handling and educate the public on sanitation issues. Since its establishment in January 2017, the MSWR has provided strategic direction and policy development for the waste industry. The creation of this ministry is said to demonstrate the government's commitment to addressing the challenges that have plagued the industry for decades. The new ministry is supposed to work through the MMDAs under MLGRD to achieve its goals.

Figure 4. 6: MSW Governance structure



The figure above highlights overlapping responsibilities among the ministries and departments, which leads to a lack of clear assignment of tasks relating to MSWM. This, in turn, hinders effective planning and monitoring, as well as cooperation and synergy between different levels of government. The MLGRD has regional and district linkages and structures and discharges its responsibility through the MMDAs. The MMDAs work with other public, private, and civil society entities to implement the Ministry's technical guideline— The Expanded Sanitary Inspection and Compliance Enforcement, in four areas:

- adequate environmental health inspections;
- dissemination of sanitary information;
- pest/vector control; and
- law enforcement (MLGRD, 2010).

The amended Local Government Act 936 (2016) expects the Ministry to preserve and maintain district regulations related to waste disposal on land and effluent discharge into still or running water bodies. The Ministry is also expected to centralise the WMD at the metropolitan level and remove counterparts at municipal and district assembly levels. However, per the current arrangements, this policy may fall under the remit of another ministry. A key informant commented on this matter as follows:

> *[…] The Ministry of Sanitation and Water Resources has a sanitation directorate, now in charge of SWM policymaking. […] However, how these policies trickle down for implementation at the MMDAs, which work directly under MLGRD [i.e., the Coordinating Director's department], remains unresolved. […]. Currently, all municipal assemblies do not have WMDs. They rely on Environmental Health Officers to execute solid waste issues, an arrangement that may not be technically prudent.*

Limited information is available on using an integrated approach for SWM in Accra. The waste industry involves the general public, private operators, and waste policymakers responsible for managing MSW. However, there is no coordination among departments and ministries. This lack of coordination leads to the implementing of ad-hoc strategies for MSWM operations. There are at least three ministries involved in waste governance, but there are no corresponding structures for policy implementation at the local level. For instance, the Sanitation Ministry is responsible for handling solid and liquid (sewage) waste, except for plastics and e-waste streams, which fall under the purview of MESTI. This situation creates problems in dealing with MSW management issues uniformly.

As per the literature, public involvement is crucial in any integrated SWM system. However, in Accra, this has not been put into practice yet. While the MSWR aims to use local government structures to execute its policies, the MESTI operates with a different level of decentralised units to achieve its objectives. This fragmented structure poses a challenge in allocating a dedicated national budget for waste service delivery. As per Oteng-Ababio (2022), this has

rendered the WMD units “orphans” without proper support. A respondent described the governance structure as fragmented and conflicting, which is a worrisome development.

> *“[…] [It is] a source of worry and situation that has brought us this far. [...] Today, the city waste policy is under the MSWR. Health waste is under the Ministry of Health. When it comes to separating and managing plastic, it falls under MESTI. […] The structures are incoherent and poorly defined […]. They do not come together as one piece. The sanitation situation will only get worse if we continue like this. Nobody is responsible for anything “.*

The current system for waste service delivery is fragmented, leading to incoherence in achieving policy goals, regulatory oversight, and implementation. This, in turn, perpetuates complex and conflicting policies that need to be addressed. The lack of a "responsible agency" to coordinate waste programmes and set clear roles and responsibilities for waste generators and public sector actors is another hindrance to coordinated MSWM operations. Moreover, the waste industry's institutional setup is characterised by low levels of cooperation among stakeholders and inadequate staff training to enhance and improve implementation initiatives and the development of MSWM plans. Additionally, there is a lack of an integrated framework and guidelines for monitoring the processes to reduce the amount of waste being taken to landfills or indiscriminately disposed of, which can have negative environmental and health impacts. Furthermore, there is a lack of procedures and institutional mechanisms for monitoring and enforcing the regulations. The industry also faces challenges in terms of financial and human capacity and technical expertise to develop and improve initiatives for SWM operations, as noted by the World Bank (2018) and Oteng-Ababio (2022).

Box 4. 5: Aligning Sector Responsibilities – MSWR, MLGRD, and MESTI

Before the establishment of MSWR in 2017, the management of sanitation and solid waste was under the purview of MLGRD. The current framework reflects some legacy challenges associated with this change. According to the Local Government Act, the MMDAs are responsible for providing waste management services, which means funds are allocated for SWM from the District Assembly Common Fund (DACF). As a result, significant contracts, such as the SIP, rest with MLGRD, whereas sectoral responsibility lies with MWSR. A second example is that MLGRD, working with the Ministry of Finance, is mandated by Act 512,1996 to specify the use and modalities of the plastic waste recycling fund. The Act is yet to be modified to reflect the changes in SWM's ministerial responsibility and that MESTI is in charge of the plastic waste policy. The result is that financial-level autonomy and duties need to be coherently aligned with service-level responsibilities. The sector's governance will be undermined if these inter-ministerial accountabilities, functions, and technical expertise are not sufficiently aligned.

One of the main obstacles to approving and implementing the NESP of 2010 within Accra's waste industry is the lack of political will and leadership in addressing SWM issues and operations. As various scholars have noted (Meizah et al., 2015; World Bank, 2018), the enforcement of waste policy is heavily influenced by political will and leaders' interests. Therefore, political leaders must demonstrate interest in SWM operations to protect the environment and public health. For instance, in Glefe, a community pond is filled with garbage, putting many residents in unsanitary conditions. However, despite the challenges, there is little public outcry about the hazard, its root causes, and potential future effects. Perpetrators, therefore, get away with their illegal activity.

To achieve sustainable MSWM, cooperation among different levels of governance (including departments, ministries, municipalities, citizenry, and the private sector) is critical. Effective planning and development of a designated agency to improve efficiency in operations, prioritising ISWM practices, and environmentally sustainable strategies to reduce environmental and health risks are also important. Furthermore, in-depth research is needed to guide and shape Accra's MSWM planning, practices, and issues such as societal characteristics, government administration, and economic status. Instituting an environmentally sound waste

delivery system touches on many critical aspects of the city's development in Accra. Suppose the city authorities want to achieve the global SDG agenda of not leaving anybody behind. In that case, they must take urgent action to address the multi-ministerial conflicting roles plaguing the industry. Moving toward sustainable service delivery requires clearly delineating and strictly enforcing the roles and responsibilities of all stakeholders. In summary, confronting the complex realities embedded in MSWM policies and institutional regimes is more urgent than ever. Cooperation, effective planning, and prioritising sustainable strategies are critical to achieving sustainable MSWM.

In this section, we examined the institutional, policy, and regulatory frameworks surrounding SWM services in Accra. The assemblies have the legal mandate and accountability for SWM, and they are responsible for implementing policies that ensure socially acceptable, environmentally friendly, economically sustainable, and mutually beneficial long-term MSWM solutions at the local level. The local government ministry is expected to regulate, monitor, and enforce appropriate laws on MSWM services as part of its oversight responsibility. Our findings align with the work of Charles Weiss in his book, "The Survival Nexus," which emphasises the need for science and technology to address the dangers we face. He warns that time is running out, and nature does not wait for slower social learning and political change processes. Measures that could have been smoothly and affordably phased in two or three decades ago are now drastic, painful, expensive, and hampered in many countries by populist tendencies. (Weiss, 2022, p. xx).

The lack of effective governance mechanisms prevents sustainable solid waste management (SWM) service delivery in Accra. In other words, sustainable management of solid waste can only be achieved if the existing governance mechanism is made more enforceable and transparent to waste operators, and institutions and agencies involved must have clearly defined roles and responsibilities. Our study has revealed that Accra's waste sustainability policies and

institutional frameworks overlook the importance of science and technology. Therefore, a comprehensive review of how we tackle the MSWM challenge is required. In subsequent sections, we will explore how the formal rules (external factors) are actually used and how they affect service performance. Finally, the geography of waste generation in Metropolitan Accra will be discussed in the next section.

SECTION 5

WASTE GENERATION IN METROPOLITAN ACCRA

Key Takeaways

- Each person in Metropolitan Accra generates an average of 0.40 kg of waste, with more than half (54%) being organic, while plastics constitute close to one-fifth (16%). The high organic content of Accra's waste suggests potential higher Greenhouse Gas (GHG) emissions, which can pose environmental and public health effects.
- As a country's income level and urbanisation rate increase, so does the solid waste it produces. For instance, Asase (2011) indicates that in Kumasi, waste generation rates are 0.63 kg per capita in Asokwa, a high-class area; 0.52 kg per capita in Atonsu, a middle-class area, and 0.27 kg per capita in Ahinsan, a low-class area. While low-income communities generate the least waste per person, they cumulatively produce about 80 per cent of Accra's total waste.
- Lower-income countries' waste generation rates will double over the next 20 years. This will result in at least a four-fold increase in the cost of managing solid waste.
- Some private entities and informal pickers are contributing to better waste practices by reusing or remanufacturing waste into new items and products. Improved waste segregation would help facilitate these initiatives and reduce the volume of waste disposed of in the city.

Reliable data is crucial for developing effective MSWM plans, practices, and strategies. Our study shows that solid waste processing and disposal are significant problems in most cities, and there is an ongoing debate on the best solutions. Often, the discussion assumes that MSW production will continue to increase. For example, the World Bank predicted in a 2013 report that global MSW generation levels will double by 2025. This assumption drives the choice of incineration over landfilling to reduce urban waste. In this context, essentialism provides a practical model for analysing Accra's waste stream and composition.

5.1. Waste Generation Rates

Broadly, solid waste generation involves identifying no longer usable materials gathered for systematic disposal or thrown away. Studies by Miezah et al. (2015) and Oduro-Kwarteng et al. (2021) acknowledge that unpacking the rate of waste generation and its volume and content is challenging. However, the exercise is necessary to select appropriate MSWM policies, plans, and operating systems (Oteng-Ababio, 2020). Lisa et al. 2021 rightly submit that increasingly ineffective policy regimes, glaring changing societal socio-economic conditions (lifestyles), and increasing production processes coupled with rapid population growth have made such granular waste data imperative. Though quite complicated, herculean, and often non-existent, getting reliable waste audit data for informed waste policy success is non-negotiable.

Metropolitan Accra has been facing significant challenges in acquiring accurate data on MSWM. Despite the government of Ghana conducting a comprehensive waste audit in 1994, no updated or reliable data has been available. This information gap can lead to policy failure, especially when the city is experiencing rapid economic development, urbanisation, industrialisation, and increasing waste generation. To ensure that waste policy and technology choices are functional and sustainable, it is crucial to have access to reliable statistics on waste streams, including particle sizes, calorific values, moisture levels, and heating values. Therefore, conducting regular waste audits is imperative to obtain accurate data for policy planning and discussions.

Several studies have been conducted in Accra to produce critical benchmark waste statistics, which are commendable (see Miezah et al., 2015; Oduro-Kwarteng et al., 2020). Unfortunately, however, these studies were conducted using varied methodologies. They were also conducted at different times and in different geographical locations or settlements. As a result, the waste generation rates also varied, ranging between 0.70kg/cap/day and 0.72kg/cap/day, much higher than the waste generation rates in other regional capitals in the country. The average waste

generation rate in these capitals was 0.51 kg/person/day, while outside of the regional capitals, it was 0.47 kg/person/day (Miezah et al., 2015). Waste generation rates obtained from recent siloed waste audits conducted in Accra are presented in Table 5.1.

Table 5.1: Siloed waste audits conducted in Accra

Author	Waste Generating Rate (kg per capita)
Fobil et al., (2008)	0.40
Kramer et al., (1994)	0.68
Boadi et al., (2003)	0.43
MLGRD (2010)	0.75
MWD/AMA (2010)	0.60
Asase et al., (2011)	0.73
UNESCAP (2012)	0.52 to 1.0
Oduro-Kwarteng et al, (2013)	0.35 to 0.75
Meizal et al., (2015)	0.74
Deku, (2017)	0.97
Oduro-Appiah et al., (2017)	0.60
Badolo et al., (2020)	0.49 to 0.89
Goddard, (2020)	0.57
Oduro-Kwateng et al., (2020)	0.70
Kuranchie et al., (2020)	0.50
Ghana Statistical Service (2021)	0.45
Adedara et al., (2023)	0.51

Source: Compiled by the Authors'

According to a recent waste audit conducted by Oduro-Appiah et al. in 2020, Metropolitan Accra generates an average of 0.70kg per capita, regardless of socioeconomic status. This figure is similar to the averages of 0.71kg and 0.72kg recorded by Oduro-Appiah et al. (2017) and Meizah et al. (2015), respectively. However, it is higher than the estimated average of 0.54 kg for developing countries, as reported by Kaza et al. (2018). Accra is a significant waste generator in Ghana, with a national waste generation rate of 0.47/person/day, which equates to about 12,710 tons of waste per day. Accra's unique situation can be attributed to the city's rapid

population growth, increasing urbanisation, and changing social lifestyle (World Bank, 2018; Oteng-Ababio, 2020).

Studies have shown that an area's socioeconomic status in Accra influences the amount of waste produced (Oteng-Ababio, 2020; Lisa et al., 2021). Table 5.2 shows waste generation rates at different times for different socioeconomic zones. The studies indicate that waste generation in peri-urban and low-income settlements has increased from 0.40 kg per capita in 1990 to 0.51 per capita in 2020. Waste generation in middle-income residential areas saw a marginal increase from 0.68 kilograms per capita in 1990 to 0.69 per capita in 2020. However, affluent neighbourhoods experienced a significant increase in waste generation, from 0.62 kg per capita in 1990 to 0.91 per capita in 2020. This trend is consistent with previous findings that suggest higher socioeconomic classes consume more and generate more waste. For instance, Asase (2011) reported waste generation rates of 0.63 kg/person/day for Asokwa (a high-class area), 0.52 kg/person/day for Atonsu (a middle-class area), and 0.27 kg/person/day for Ahinsan (a low-class area), all in Kumasi. Similarly, Fobil et al. (2005) and Owusu-Ansah (2008) obtained similar data on waste generation rates in different socioeconomic areas in Accra.

Table 5.2: Waste Generation for Distinct Economic Conditions

Description	1990	2010	2015	2020
Low-class areas*	0.40	0.49	0.62	0.51
Middle-class**	0.68	0.62	0.73	0.69
High-class area***	0.62	0.67	0.86	0.91

Source: Compiled by the Author

NB: *These are residential areas with relatively good roads and reliable social amenities and services.

**Flats or bungalows characterise these residential areas. The buildings are often occupied by more than one household.

***These are areas with poor social services and amenities. They are primarily located in the slum areas of the cities.

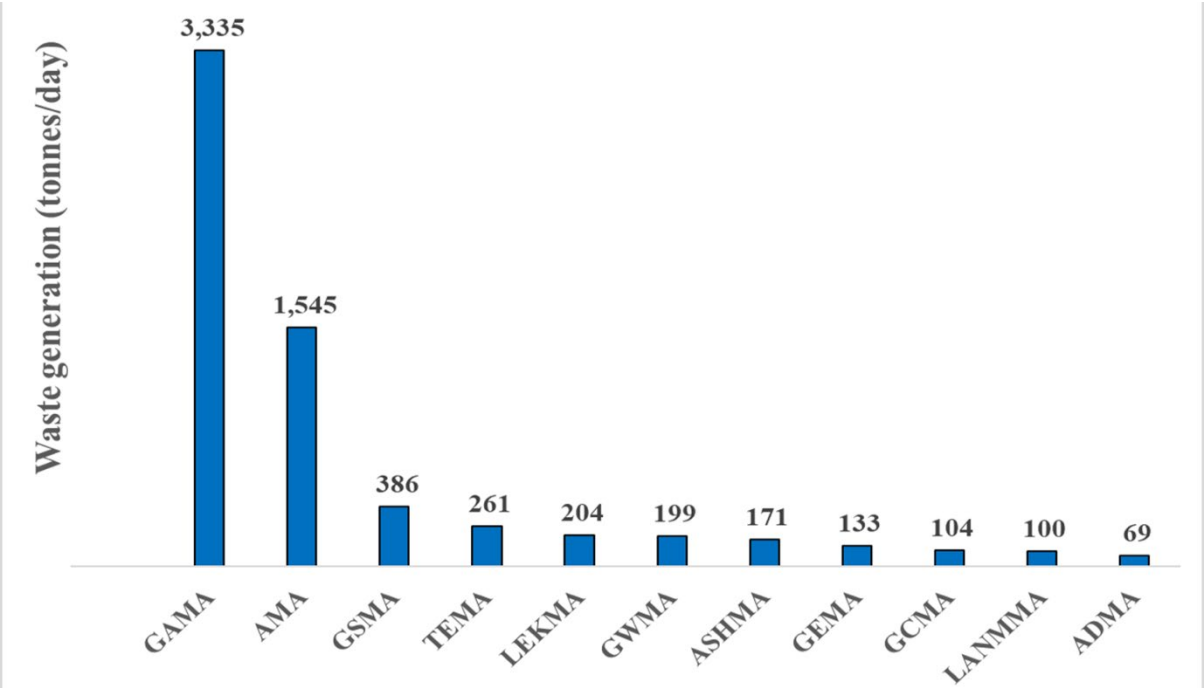
Waste generation varies geographically within the city. Less waste is produced in low-income communities and peri-urban zones, while waste generation per capita increases steadily in the

more affluent communities. This trend is expected to continue due to the increasing urbanisation and uncontrolled peri-urban development. Therefore, developing efficient and effective inclusive MSWM designs, strategies, and technology is essential to manage the consequent increase in total waste generated. It is worth noting that even though low-income communities generate the least waste per person, they cumulatively produce about 80 per cent of Accra's total waste generated (Oduro-Kwateng et al., 2020; Oteng-Ababio, 2020).

5.2. Trends in waste generation

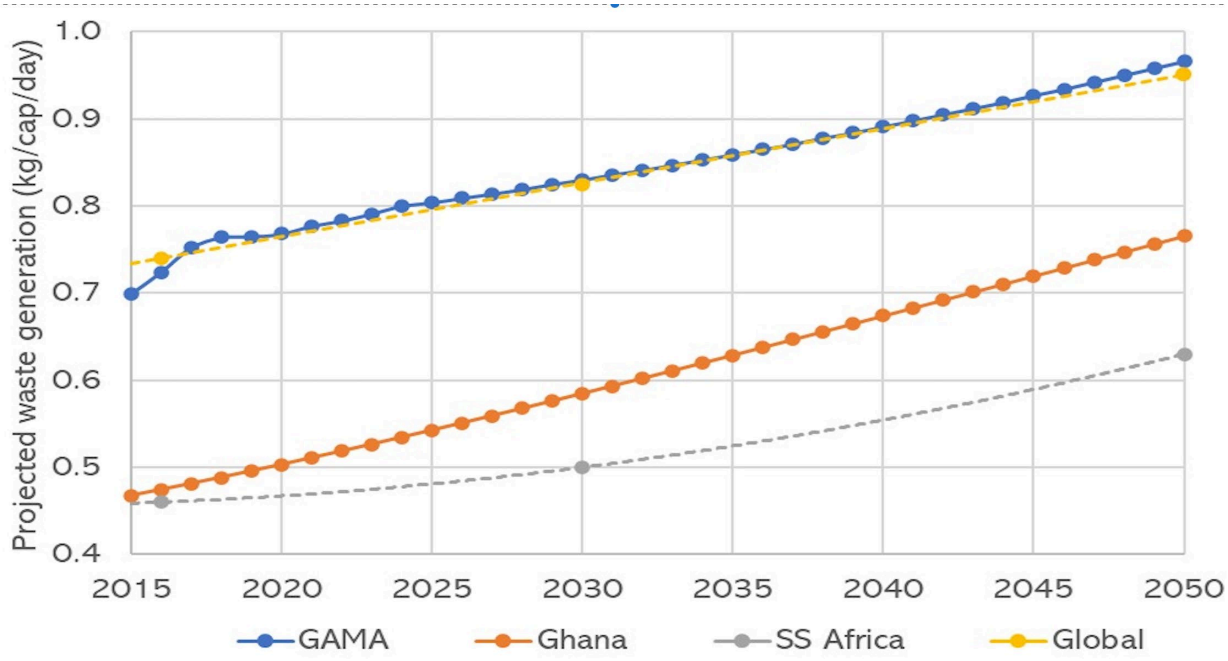
Studies have shown that waste characterisation and projections can be challenging, but they are necessary to understand future waste content and volume changes (Lisa et al. 2021). Scholars in Accra have made significant efforts in this direction, and their work has produced results consistent with global estimates. These results provide hope for the future. In our study, we estimated the waste trend for Accra using the methodology employed by the UNEP to produce the Global Waste Management Outlook. This methodology used regression analysis and GDP per capita to estimate the per capita waste generation rates. The principle behind this methodology is that as the economy improves, people's purchasing power and product demand increase, increasing the amount of waste generated per capita (see Appendices C; D; E; and F for projected tonnage and proportion of waste fractions; projected waste generation and waste generation rates and projected waste fractions).

Figure 5.1: Daily waste generation for MMA in GAMA



Accra's population has grown rapidly, from less than 1,197,000 in 1990 to 2,060,000 in 2010. It is projected to reach 3,311,531 by 2030 and 3,687,346 by 2050. The study estimates that the city's waste generation rate is 0.783 kg/capita/day, based on the metropolitan GDP of about USD 2.473 per capita in 2022. Therefore, Accra is expected to generate approximately 2,153.00 tons/day of waste in 2022. By 2050, waste production is expected to increase to 3,562 tonnes, more than double the population growth. The data shows that waste generation in Accra initially increased and then stabilised or continued to rise. Although Accra's population is projected to peak around 2050, sub-Saharan Africa's population is expected to grow until 2100. The data also indicates a positive correlation between waste generation and income level. As a result, the daily per capita waste generation in Accra, the most affluent settlement in GAMA, is anticipated to rise by 84.95 per cent by 2050.

Figure 5.2: Authors' Construct

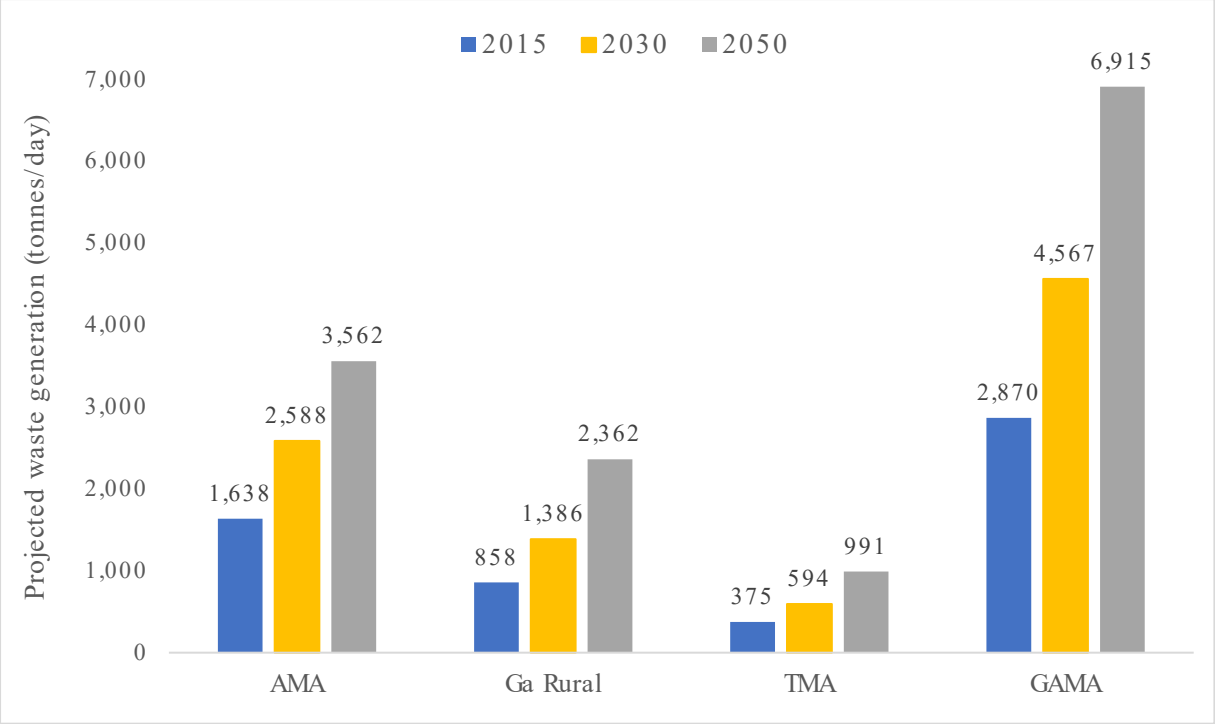


The population growth of Accra is increasing, putting more pressure on the scarce resources and infrastructure. The amount of waste generated has increased due to a shift towards more plastic and paper packaging (Oduro-Appiah et al., 2020). Providing essential SWM services to a rapidly growing city with inadequate road infrastructure is an enormous challenge. Previous studies (Meisah et al., 2015; UNDP, 2015) have shown that waste generation tends to decrease at low-income levels but increases faster with incremental income changes.

Based on previous studies in GAMA, the areas with the highest waste generation are the economically prosperous regions around AMA, where the daily waste generation reaches 1,638 tonnes. These areas also have better infrastructure (e.g., roads) and waste collection operations. On the other hand, TMA and Ga Rural generate the least waste, with daily rates ranging from 375 to 858 tonnes, respectively. However, the waste generation in these dormitory settlements, home to the fastest-growing residential communities, is expected to increase significantly, surpassing that of AMA in the future. Our projections indicate that waste generation rates in high-income communities of Accra may be peaking (3,562 tonnes) in 2050. At the same time, those in low-income settlements are expected to increase more than three times (2,362 tonnes)

by 2050. Figure 5.3 illustrates the daily projected waste generation for AMA, TMA, and Ga Rural from 2015 to 2050.

Figure 5.3: Projected waste generation for AMA, TMA, and Ga Rural (2015, 2030 & 2050)



Source: Computed by the Authors

It has been found in previous studies (Owusu and Oteng-Ababio, 2015) that the population growth in Accra, particularly in peri-urban areas with poor infrastructure services (such as unpaved roads, and water supply), will increase waste production. Currently, SWM in these areas is poor, and most waste is openly dumped and buried, as seen in Glefe, where community lagoons are used as landfills. Therefore, it is crucial to restructure the current MSWM system to cater for the waste management needs of these emerging peri-urban areas. The study's findings provide a spatial overview of waste generation across Accra. It is also important to note that waste collection does not equal waste generation, and only a fraction of the waste produced is collected. This has significant implications for the sustainability of environmental health and prosperity in the future. Therefore, planning futuristically to address SWM issues in peri-urban areas is technically and strategically wise to ensure the sustainability of MSWM in Accra.

5.3. Municipal Waste Composition

Managing MSW in a way that is both affordable and environmentally sustainable is crucial. This applies regardless of the waste's origin, volume, and content. Ideally, a city's spatial planning and development framework should account for its SWM architecture, taking into consideration its population growth dynamics and lifestyle changes that come with economic development as shown in Table 5.5. To achieve this, it is essential to periodically update data on its waste composition. Failure to do so can lead to waste facilities incorrectly gauging the waste content, affecting operational and technical capacity and reducing satisfaction levels among beneficiaries. Based on individual waste audits in Accra (see Table 5.5), three household waste components - organics, plastics, and inorganics - dominate the waste stream. Our findings align with these waste audits conducted in different locations and times in Accra.

Table 5.3: Selected Waste fractions in GAMA

Year	1993 WMD	2003 WMD	2010 MCI	2015 Miezah et al.	2020 Oduro-Appiah et al.
Organic material	72.6	65.0	67.0	65.8	53.9
Inert material	8.9	17.1		5.2	12.9
Plastics	4.0	3.7	20.0	10.4	16.2
Glass	2.0	3.0	2.0	2.8	2.1
Paper and cardboard	7.2	6.0	4.0	5.3	3.7
Metals and cans	2.8	2.5	2.0	3.1	1.9
Textiles	1.5	1.7	5.0	2.0	3.2
Leather and rubber				2.1	1.3
Miscellaneous or other waste	0.9	1.2		4.1	4.9

Source: Compiled by the Authors

Previous waste audits have been inconsistent and used inappropriate methodologies to classify waste sources. For instance, Meizah (2015) used an income-based classification method that does not align with international best practices. A typical waste source classification includes residential, commercial, industrial, construction, and demolition categories. Therefore, the "aggregated" or "lumped" unit generation rate used in Meizah (2015) failed to accurately quantify the contribution of non-residential waste sources, such as commercial, institutional, industrial, or construction and demolition activities in any of the MMAs. It is important to note that Accra lacks reliable and continuous empirical data on waste generation and composition trends. The only nationwide comprehensive waste audit was conducted in 1993. Since then, it has not been possible to study waste generation and composition trends studies similar to the characterisation done by Meizah (2015). As a result, predicting the increase or decrease in the proportion of specific material fraction components and per capita generation rates in the medium to long term is challenging.

This study did not consider the impact of seasonal variation on household waste generation and composition, as previous surveys have shown that it does not affect the change in waste composition and generation in Ghana. For example, various studies carried out in Kumasi

during the wet and dry seasons by Adjei (2013), Asase (2011), Ketibuah et al. (2004), Kotoka (2001), and Opoku (1999) did not reveal any trend in waste composition and generation variation. Similarly, studies conducted by Anomanyo (2004), Dagadu (2005), and Fobil et al. (2005) on the quantity and composition of household waste could not establish any seasonal trend. Typically, seasonal variation affects the generation of outdoor waste, including yard waste, and the quantity depends on the trimming rate (Hancs et al., 2011). The results from these studies show higher levels of organic waste generated in Accra than the UNEP's prediction of about 53 per cent, though the figures are consistent with other empirical studies (see UNEP, 2018; Wilson et al., 2015), which also predicted similar high organic content (i.e., 66-70%), making the need for beneficiation strategies to create valuable by-products, imperative.

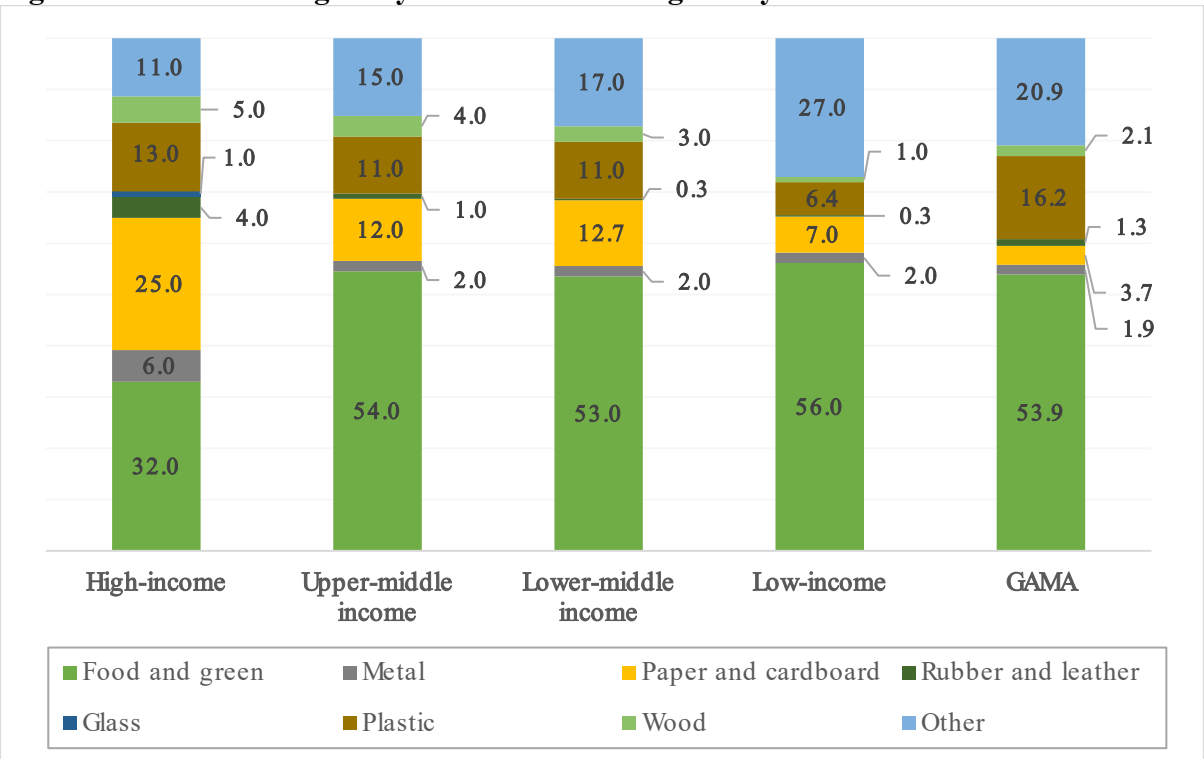
The composition of solid waste in Accra varies depending on income levels, sociocultural practices, and consumption patterns, as previously mentioned. A study by Miezah et al. (2015) confirmed that waste generation varied geographically, with metropolises generating the highest amount of waste in each category, followed by municipalities and districts generating the least (except for plastics). Previous studies have identified organic, paper, and plastic waste as significant categories, but inert materials and miscellaneous items contribute significantly. According to Miezah et al. (2015), organic waste remains the most significant fraction of waste generated by the MMDAs, with a per capita per day generation rate of 0.38 kg for metropolitan areas (above the national average), followed by 0.25 kg for municipals and 0.17 kg for districts (all close to the national average of 0.29 kg).

Table 5.4: Some beneficiation strategies

Company History	Activities	Remarks
West African Feeds, established in 2018 and located at Madina, Accra	• The company produces high-protein feed from insects, which serves as equally nutritious alternative to fish-meal • Converts food waste from restaurants, breweries, etc., into insect-based animal feed and high-quality compost.	The sector provides employment opportunities for a significant portion of the population. This includes activities such as animal husbandry, veterinary services, feed production, transportation, and marketing.
Safisana, established in 2010, located in Ashaiman	• The Company collects organic waste and faeces and converts them into biogas.	As of 2017, Safisana had employed 80 workers. 40 males and 40 females.
Loo Works, established in 2014 amd located at Katamanso in Greater Accra, Ghana.	• The company transforms plastic waste and sawdust to sturdy construction materials such as bio-digesters.	
Alchemy Alternate Energy, established in 2014, and located at Osu, Accra.	• Converts waste from plastics and tyres into hydrocarbon products.	10 Employees, and an annual revenue of US$1 Million. Tax: US$1 250,000 annually
Coliba Ghana Ltd., established in 2016 and located at Dome, Accra	• The company recovers, collects and recycles plastic waste, paper and beverage cans into **planterette**. • Coliba sorts and processes recovered plastic waste into flakes and pellets	Contribute to reducing plastic pollution in Ghana and promote sustainable waste management practices.
Nelplast Eco Ghana Ltd., established in 2018, and located at Katamanso nearTema	• Recycles plastic wastes into Lego bricks and tiles. • Recycles more than 570 tonnes of plastic into 104,000 pavement slabs and 40,000 paving tiles per annum	The company employs 79 workers; Recycles 2 to 4 tonnes of plastics a day. informal waste collectors of at least GHS 330,000 per annum
Neat Eco Feeds Ltd., e**stablished in 2017 and located at Zebilla,Upper East Region.**	• Uses waste from livestock and crops as food for black soldier fly larvae to feed chicken. • Recycles waste to substrates to produce maggots	
Plastic Punch, e**stablished in 2018 and located at Kotobabi, Accra**	• Recycle plastics into tables, chairs, plastic basins, bowls.	10 Employees
Environment 360, established in 2014. And located at Adenta, Accra	• Supports local waste pickers and aggregators to collect plastic bottles, bottle lids and other plastics	Supports the livelihoods of waste pickers

The data from Accra also reveal the exciting heterogeneity in waste globally (see Figure 5.4). From the results, it is appropriate to submit that unlike the case in developed economies, which generate less food and green waste (about 32% of total waste) and more dry waste (about 51%) that could be recycled, including plastic, paper, cardboard, metal, and glass, the situation in Accra as in many low-income countries has an average of 53 and 57 per cent of food and green waste, respectively, with the fraction of organic waste increasing as economic development levels decrease.

Figure 5. 4: The heterogeneity of waste fractions globally

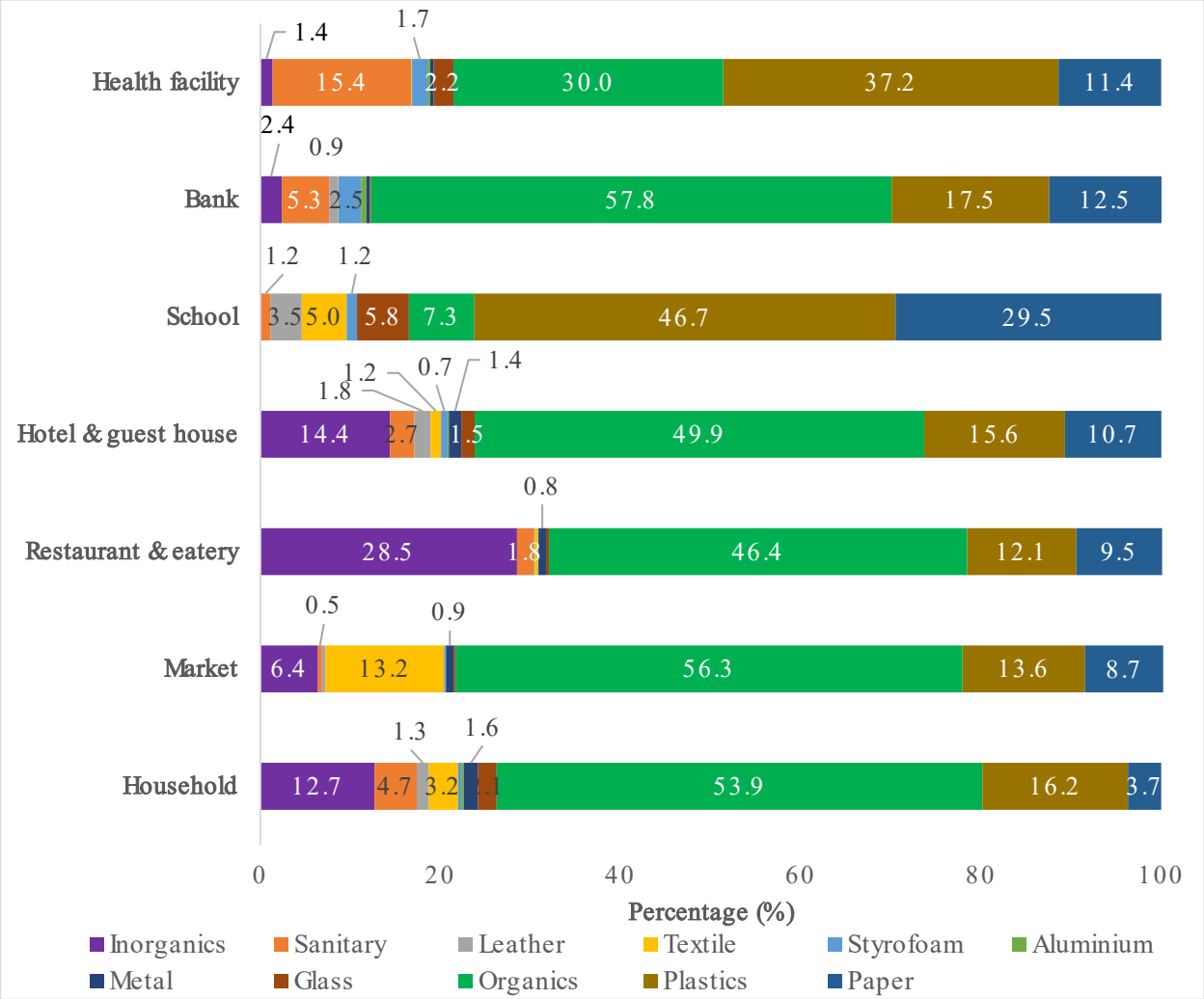


Source: Authors' Construct

Our study has found a significant variation in waste content generated by different institutions. Schools were found to generate the highest amount of paper waste, followed by government institutions and banks (see Figure 5.5). Socio-economic differences also play a role in waste composition. However, determining the amount of waste generated at the institutional level and how much can be recycled is challenging. To address this issue, we conducted a comprehensive school waste sort and composition study, the details of which are presented as part of this study.

By understanding school waste's total generation and composition, we can identify opportunities to reduce waste and design effective recycling and organics programs. This study's findings can benefit municipal solid waste professionals, school operations and facilities managers, and anyone working with schools to improve their waste-management practices. In contrast, market waste is highly composed of organics (56.27%), followed by plastics (13.59%), textiles (13.17%), and paper (8.75%) (see Oduro – Appiah et al., 2021).

Figure 5. 5: Waste composition generated by different institutions – (banks)



Source: Compiled by the Author

Our study further revealed that waste audits in public spaces, including lorry parks and transport terminals in Accra, have received limited academic attention or have been subjected to less exploration. Our study considered this deficiency a significant void and a barrier to our quest for

sustainable MSWM for Accra, mainly when public spaces generate substantial environmentally threatening waste such as plastics. To fill this empirical vacuum, our study supported an exploratory waste audit in four public spaces in Accra, including the Kaneshie market, Odawna lorry station, the University of Ghana Campus, and Maamobi General Hospital. These spaces were randomly selected, motivated by their land use characteristics and socio-economic activities. Table 5.4 presents a summarised result of the exploratory study.

Table 5.5: Summarised results of litter composition studies at four public spaces

Material	Quantity	Percent
Plastic	29,145	79.3
Paper	5250	14.28
Organic	910	2.48
Textile	660	1.8
Metal	190	0.5
Others	915	1.06
E-waste	125	0.34
Glass	Litt35	0.1
Cotton	25	0.07
foam	25	0.07
Total	**37,280**	**100**

Source:

As already noted, any place where people live, work or congregate, including schools, lorry parks, and churches, produces waste. Table 5.4 shows the waste collected in selected open or public spaces in Accra, which mainly contrasts household waste types. The survey counted a total of 37,280 pieces of items from the four study sites. These items were dominated disproportionately by plastics (79%) and paper (14%). Besides the two, the remaining 7 per cent was shared among organic, textile, metal, e-waste, glass, foam, and others, including COVID-19-related litter. This observation is quite critical for public policy response. From the data, waste from open spaces consists mainly of plastics, food, paper and packaging, most of which can be

easily recycled (Kodua & Anaman, 2020) as against regular household waste, which is mainly organic (Keizah et al., 2015). The predominance of plastics in the public spaces surveyed, except the health facility, was instructive for sustainable MSWM strategy. Of the 37,280 litter items, 11,910 were branded waste from 147 companies.

Significantly, 97 per cent of the identified brands were of local origin, with beverage-related litter, general packaging, and food-related litter accounting for about 37, 31, and 16 per cent, respectively. Equally significant is the revelation that products of three local companies, Special Ice Company Limited, Baron Water House, and Brooks Water Limited, accounted for 52 per cent of the identified branded litter. For sustainability's sake, the vast amount of waste paper and cardboard in schools, for example, can be collected, recycled and remanufactured to become cardboard packaging and newsprint. Similarly, the estimated 30 per cent of food waste from schools can efficiently be dealt with by composting to provide a valuable resource like fertiliser for the school grounds (Singh, et al., 2011). From our findings, the best way to approach waste and litter education and action within open spaces is to integrate curriculum and waste-conscious operations. An example would be setting up a recycling system with the students as they learn about the importance of recycling to conserve resources.

Another relevant aspect for local policy consideration is separating household recyclable materials and collecting and handling these separated streams. Neighbourhoods vary in recycling collection regimes: some systems are easier to use than others, and the difference between settlements can sometimes be confusing. Separation also has implications further down the waste stream, particularly regarding the quality of the waste stream reaching recycling facilities and how much further sorting it may require before that stage. As with many sub-Saharan cities, Accra faces significant inequalities. In addition to a governance crisis, the lack of up-to-date data makes policymaking narrow-minded, leading city authorities to enact policies that only worsen

existing inequities. This shortsighted approach to planning can create new risks and result in maladaptation, as exemplified in Glefe, a suburb of Accra (see Møller-Jensen et al., 2022). A radical scale-up in adaptation measures and a comprehensive approach to waste risk analysis and management that covers a full range of hazards is necessary. The current risk analytics are insufficient to enable effective preventive and anticipatory action to reduce climate-related disasters' environmental and human-risk impacts because it is based on an empirical vacuum,

Some difficulties are inherent in even the current attempts at waste categorisation, which is based on the waste material content, hazard potentials, or origin. Such varied categorisation parallels the problems inherent in MSWM process. Technically, using inappropriate waste source classification, exemplified in the case of Meizah (2015), which adopted income zonation, i.e., high-class, middle-class, and low-class, does not conform with international best practices, which typically include residential, commercial, industrial, construction, demolition, etc. Such an approach that uses an "aggregated" or 'lumped" unit generation rate does not make it possible to quantify the specific contribution of non-residential waste sources including commercial, institutional, industrial, or construction and demolition activities.

The lack of reliable data on waste generation and composition trends has also been a nagging concern. So far, it has not been possible to conduct longitudinal studies of waste generation and composition trends due to a lack of similar nationwide studies as the one conducted by Meizah et al. (2015). This makes it difficult to speculate on the increase or decrease in the proportion of specific material fraction components and per capita generation rates in the medium to long term. Indeed, without methodically consistent, disaggregated, updated data, city authorities can neither establish the requisite baseline data nor routinely update and produce evidence-based environmental policy decisions.

5.4. Source separation and waste valorisation

Managing solid waste in Accra is difficult, as per capita waste generation is expected to increase with population and economic growth. To manage future waste, reducing waste generation is crucial. City authorities prioritise source separation of waste into biodegradable and nonbiodegradable components. However, this lengthy process requires a change in attitude and careful execution. The public must be educated about the need for and advantages of separating waste. Ultimately, reducing household waste through separation and source reduction are the two main methods for reducing landfilled waste.

Our research has shown that the key to effective and efficient SWM in Accra is to increase the rate of waste valorisation, which includes reusing, recycling, composting, and converting waste to energy. This is crucial because compostable waste materials account for approximately 53 per cent of the total waste in Accra. Still, recycling and composting efforts are minimal, accounting for only about 10 per cent of current practices. Composting is not a financially viable intervention due to its high costs and limited market opportunities. Additionally, Carboo and Fobil (2005) have long argued that Accra's high moisture content and silt components make converting waste to energy an unviable solution. They instead saw composting as a more suitable method for managing Accra's solid waste.

On a somewhat positive note, some large shops have begun packing items in reusable or biodegradable bags. If continued and scaled up, this initiative can contribute immensely to the reduction of plastic waste in particular. Our study revealed that handling biodegradable waste properly can considerably lessen the burden of solid waste that city authorities in Accra must tackle. These observations are relevant because studies indicate that different categories of waste generated in the city take their time to degenerate (as illustrated in the table below, which was adapted from the works of Oduro-Kwateng, 2017).

Table 5.6: Type of solid waste and approximate time it takes to degenerate

Type of litter	Time to degenerate
Organic waste	a week or two.
Paper	10–30 days
Cotton cloth	2–5 months
Wood	10–15 years
Woolen items	1 year
Tin, aluminium, and other metals	100–500 years
Plastic bags	one million years?
Glass bottles	undetermined

Source: Oduro-Kwateng (2017)

In principle, effective waste valorisation is a public good. It creates many environmental benefits, including reducing greenhouse gas emissions, preventing leachate from decomposing waste and reducing landfill space needs (Mudu et al., 2020). Our interviewees maintained that source separation is a prerequisite for effective waste valorisation. They explained that mixed waste often makes biodegradables adhere to the inorganics, thus making them unsuitable for recycling or, at best, costly to clean. A remark by a researcher sums up the sentiments of most participants in the study:

> *The mixing of plastics and inorganic reduces the quality of waste and its usability for compost; […] If you generate plastics, you should have a container for them, food leftovers, and biodegradable peels; these must be collected separately. So, we do not need to mix everything as they become dirty to work with […] Source separation is the way to go.*

The study revealed a limited source separation initiated by a private service provider operating in 'an elite community.' The initiative nevertheless provides an opportunity and benchmark information as it signals the possibility of including source separation in MSW contracts and crafting targeted education for residents on waste separation. This is consistent with earlier studies stating that most residents are willing to source-separate if given the right incentives and

support (Oteng-Ababio, 2013). Hence, if local authorities provide separate bins and collection days, most residents will find the initiative very accommodating. A female consultant explained:

> […] *currently, no law exists on source separation, albeit Accra's climate action plan initiated in 2020 promised to institute one. Such a legal gap makes an effort at source separation unhelpful. Why are there no legal guidelines or an Act of Parliament that compel residents to separate waste? I just do not get it.*"

In our interactions with some informal waste collectors, they revealed that effective source separation would save them the time of sorting out marketable waste and could also be a mode of financing waste collection at the household level. One waste picker explained the 'waste financing model' thus:

> "*If I go to a place and the plastics have been separated, I do not charge the person for the rest of the waste […] the plastics, papers, books, or boxes are recyclables. Many companies buy them [...] so the rest is sent to landfill.*"

Aside from the limited official and unofficial value-addition initiatives, our interviewees alluded to the existing positive culture of reuse in the metropolis. They, for example, referred to situations where some religious bodies and charities often appeal for used clothing and other household materials for donations to the less privileged. Thus, they see source separation as nothing new; some households sell particular marketable wastes while others give used clothes and other materials to churches and needy homes. Nonetheless, our stakeholders saw the lack of a legal regime on source separation as a significant setback and an indication of the government's commitment to sustainable MSWM [see Appendix G on how the government of Ghana is handling the plastic industry so far). A female study participant commented on the government's commitment to MSWM thus:

> *[…] the National Medium-Term Development Plan does not mention source separation or waste diversion. Instead, it focuses on increasing waste collection from 85% in 2020 to 95% in 2025 and landfilling it. In truth, the document only focuses on recycling e-waste, industrial waste, and wastewater but does not mention the recycling of MSW, which pollutes the environment. What a commitment*!

Continuing, the researcher supported her comments thus:

> *[…] multiple ministries today handle waste issues in Accra. This makes it challenging to implement any policy effectively. Studies elsewhere indicate that cities do better when policies are consistent and operated by a responsible body. Today, the waste sector has no dedicated budget; its decentralised units need to be equipped to supervise or monitor anything. Its human resource capacity leaves much to be desired. It is right: the sector is an orphan*!"

Our respondents highlighted some challenges regarding waste separation, including infrastructure to handle the separated waste and a reliable transport network. These may increase the cost of implementing source separation, which could be a disincentive or lead to public rejection. Nevertheless, our study affirmed a high amount of organic waste generated (about 60% per capita). Therefore, efforts to reduce or recycle organic waste by instituting and financing source separation can significantly reduce the quantity of waste discarded from individual households.

SECTION 6

SOLID WASTE COLLECTION PRACTICES IN ACCRA

Key Takeaways

- Like many other cities in the region, Accra lacks municipal solid waste separation despite high household willingness to engage in source separation.
- Municipal solid waste collection and transfer in Accra are inadequate and inefficient due to lack of coverage, inconsistent schedules, and insufficient collection trucks. Formal waste collection in affluent communities is nearly 100 per cent, while lower-income areas have around 40 per cent coverage.
- The private formal service providers are most useful in dense, higher income neighbourhoods where the per capita waste generation if high, but perhaps less viable outside these zones
- Waste collection services are particularly lacking in emerging dormitory communities, low-income neighbourhoods, and slums. This means that 60 per cent of the city's population do not receive adequate SWM services.
- Despite the existence of 174 sanitary sites, waste is often dumped in gutters, drains and streams due to communal disposal containers not being emptied for weeks at a time by unpaid private sector providers. With container sites often located 450 to 500 metres farther than the recommended 150 metre distance from households, dumping and fly tipping can be easier and quicker than established SWM systems.
- While informal pickers play a complementary role to the limited formal provision of SWM in Accra, they are marginalised both by public perception and by the restrictions set by municipal officials. The failure to integrate informal pickers into the SWM system leads to more fly tipping and poor disposal practices.

Efficient solid waste collection (SWC) is crucial for a sustainable MSWM system. According to the Local Government Act, the responsibility of MSWM lies with the MMDAs. This includes the collection and disposal of waste. The waste collection rate varies depending on income, with affluent communities having a nearly 100 per cent collection rate, while low-income areas have only about 40 per cent coverage (Oduro-Kwarteng et al., 2020). Income is a significant factor in determining the collection rate, and the characteristics and limitations of the city space shape the

institutional arrangements for SWC. According to Andreasen et al. (2022), the lack of dedicated waste collection vehicles, routes and passable networks lead to mobility constraints, particularly in low-income and slum areas. This creates difficulties in already haphazardly developed and unplanned settlements with inadequate infrastructure. Oteng-Ababio (2021) identified three main factors influencing SWM in Accra: culture, knowledge, and microeconomics; infrastructure, social provisions, and technology; and policy, institutions, and macroeconomics.

Our study has identified two primary institutional arrangements for SWC in Accra – the Central Communal Container (CCC) and House-to-House (HH) systems. The CCC system is more prevalent in middle- and low-income communities. Under this system, residents are responsible for transporting their waste from their homes to a public refuse container (skip) site provided by the city authorities and managed by formal collection companies. This system operates mainly in areas where poor planning and haphazard development have rendered the area's inner core virtually inaccessible to vehicular traffic. These areas have high population densities ranging from 100-270 persons per hectare and are estimated to be home to 60-70 per cent of the city's population. The residents have lower education and income levels and are primarily unskilled labour in both the formal and informal economy. The CCC system accounts for approximately 80 per cent of the total waste collection in the metropolis.

Table 6.1: Major characteristics and institutional arrangement for MSWM

Mode and source	**Modes of solid waste collection sources**		
Variables	Communal Collection Container	House-to-House	Kerbside
Frequency	Daily	At least once a week	At least 2 separate days in a week
Dominant waste storage facility	Old buckets	Standard plastic container	Standard container
Mode of transport	Skip loader	Multi-lift trucks Three wheeled tractor Push cart	Multi-lift truck
Mode of lifter	Skip loader	Multi-lift trucks	Multi-lift trucks
Main areas of practice	Lower middle-income areas	High and middle-income areas	Middle and high and high-income areas

Characteristics of operational areas	Poor road networks (unpaved, small roads), poor accessibility to houses	Good road networks (tared roads) access to household	Good road networks
Payment user fee	No (but Pay-As-You-Dump in some places)	Yes	Yes
Type of service provider	- Local authority through formal service providers - Waste (informal) Pickers	Local authority through formal service providers	-Local authority through formal service providers -Private (informal) sector

The study revealed that areas serviced by the CCC system mostly lack proper drainage systems except those on major roads. The limited drainage system sometimes appears permanently choked with waste (Figure 6.1). Additionally, the findings show that most of the few roads in these areas are often not paved, which impedes the smooth operation of the waste trucks, ultimately negatively impacting proper and sustainable environmental management. The resulting poor MSWM practices have made indiscriminate dumping, particularly unto vacant lands, into river channels, drains, etc., a common practice in these neighbourhoods to the detriment of the environment in general, as depicted in the Figure below.

Figure 6.1: A Bird-Eye View of Glefe Showing the Local Lagoon being filled with Waste

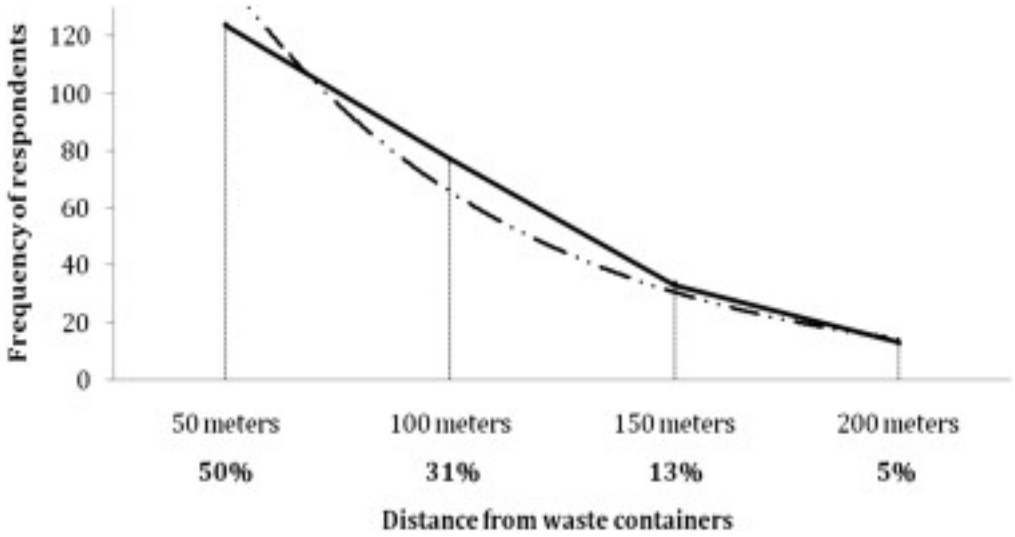
In affluent areas (some medium and high-class areas), mostly planned with population densities ranging between 20-35 persons per hectare. Further, residents' socio-cultural and economic characteristics show marked differences from the low-class residential areas. However, this type of classification has, over the years, been blurred based on recent developments. The analysis shows that some middle-income area residents are serviced by the CCC and house-to-house (HH) systems. Infrastructure-wise, these areas have better access roads than low-class areas. The high-class areas can be characterised as well-developed and maintained residential areas with mainly one household per building and direct access by cars. Collections in both localities account for about 20 per cent of the total SWC.

According to our analysis, the performance of SWC services in Accra improved under the public-private partnership regime. The efficiency increased significantly with increased private-sector control and involvement. Data available at the WMD and the MLGRD revealed that the

collection rate and disposal improved from 51 per cent in 1998 to about 91 per cent in 2000 (Fobil et al., 2008). However, this increase in performance was not sustained beyond ten years of public-private partnerships, and the system can no longer provide efficient solutions today (Oduro-Kwarteng and van Dijk, 2013). Studies by Oteng-Ababio et al. (2013), Miezah et al. (2015), and Oduro-Kwarteng et al. (2020) have all independently revealed that the skips are usually insufficient to handle the amount of waste generated within their catchment areas, thereby encouraging alternate disposal methods such as illegal dumping and littering.

Our findings also confirm that in the low-income, high-density (LIHD) areas, large storage receptacles or communal containers have been provided at locations referred to as sanitary sites. Our study counted 174 sanitary sites in GAMA. Table 6.2 presents an inventory of sanitary sites in the respective MMAs, including a list of suburbs that either have or do not. Nonetheless, waste is often dumped in gutters, drains and streams as a result of CCCs being left unattended to for as long as 2–3 weeks at a time – itself a result in part of companies not getting paid regularly by the local government for pick-up services (Earth Institute, 2012, p. 81). This condition is also related to the distances residents travel to access the communal container sites. Technically, the skips must be sited 150 metres between residences to ensure efficient collection. Individuals are expected to bring their waste directly to the collection point (or a skip) that can be accessed on foot. Nonetheless, these containers are commonly located at distances up to 450 to 500 metres than the recommended threshold. An earlier study (Oteng-Ababio, 2010b) established maximum travel thresholds for residents to voluntarily access the CCC (see Figure 6.2). Once this is exceeded, utilisation tends to fall off considerably. Indeed, the studies have established that the long distances residents have to travel to access a container (in some cases over 200 m), only to find it overflowing in most cases, serves as enough deterrent for them to look for alternative dumping sites, which invariably are very close to their living places.

Figure 6.2. Distance-decay in solid waste disposal in AMA



Source: Oteng-Ababio, 2010b.

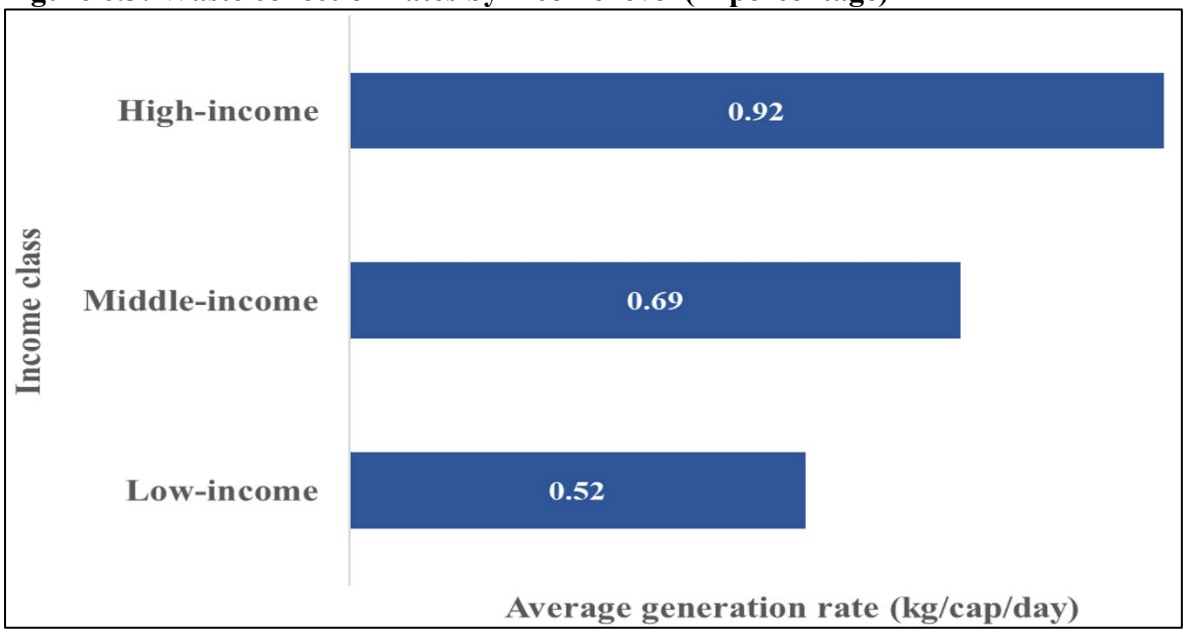
This creates a distant-decay tendency that complements the indiscriminate littering in open spaces, drains, rivers, and uncompleted structures. Ensuring sound practice also presupposes the availability of an adequate number of easy-to-use containers that all residents, including children, can easily access since, in Accra, waste disposal is predominantly by the youth, especially female children. This partly explains ugly dumpsite scenes with their accompanying negative human and environmental costs.

Conversely, the HH system is operated by service providers with formal concessions (contracts) with the city authorities to collect waste at the doorsteps of households and in the markets and other public institutions for disposal at agreed fees. Under this arrangement, residential beneficiaries must wheel their waste containers to a specific location on the collection day and retrieve the containers when empty. Though relatively efficient and reasonably widespread, the operators are characteristically selective regarding whom they would want to serve due to the HH system's embedded principle of the ability to pay and the poorly defined or unenforced zoning.

As previously noted, waste generation in Accra is closely linked to income levels, resulting in spatial variations. Similarly, waste collection in the city follows a distant-decay pattern where

services decline as one moves away from the Central Business District (CBD). According to the study, the city authorities collect only 40 per cent of the waste generated in low-income areas. In comparison, almost 100 per cent is collected in high-income areas (refer to figure 6.2). This indicates that underserved areas include uncontrolled and peri-urban areas where the city's future growth is expected. This observation carries significant policy implications for a sustainable MSWM strategy. It necessitates that city authorities strategically reconsider and redesign the city's entire SWM architecture to plan for and include emerging peri-urban (dormitory) areas, which are experiencing increasing population growth but currently lack services or where waste generated remains inefficiently collected.

Figure 6.3: Waste collection rates by income level (in percentage)



Source: Oteng-Ababio, 2010; Oduro Kwateng et al., 2020

6.1. Partnerships in SWC

According to our findings, regular waste collection is taken for granted in the wealthier parts of Accra. However, around 60 per cent of the city's population in low-income, slums, and emerging 'dormitory' communities cannot access this basic formal waste collection service. As a result, these communities often resort to indiscriminate dumping or burning of their waste, usually near their homes and close to waterways, which becomes a convenient dumping ground for urban waste. Such practices harm public health, local economies, and the environment (Agyei Mensah

and Oteng-Ababio, 2015). Plastic packaging waste not only clogs drains and pollutes the ocean but also poses a severe health risk to humans when burned, as it emits harmful fumes that can cause lung, eye, and skin problems, contributing significantly to urban air pollution (Muga et al., 2020).

There has been a recent debate among scholars regarding the relationship between public and private sectors in MSWM. Some scholars believe involving the private sector is the only way to provide sustainable services. However, others argue that corruption becomes inevitable if the private sector provides public services. They also believe that essential public services should not be a source of financial gain for individuals, especially those not from the area being served. Our study confirms this debate and finds that city authorities in developed economies are generally satisfied with private-sector waste management services. However, the situation differs in developing countries, where outcomes are more diverse. We did not examine how Accra's experiences with private sector service providers compared to the traditional reliance on local government.

Several studies have identified deficiencies and bottlenecks in providing efficient SWM in Accra. These studies have identified inadequate financial resources and a lack of authorities' expertise, competencies, and technical skills to deal with the growing demand for MSWM services (Oteng-Ababio, 2022). This observation corroborates previous findings, which suggest that, despite the authorities' limited budgets, the residents of Accra are willing to pay for improved and well-rendered services, thus giving hope for city authorities to engage in appropriate partnerships (Miezah et al., 2015; Oduro-Kwateng et al., 2020). This explains why private service providers exclusively collect and transport solid waste in Accra today, and several studies have examined the successes of this partnership.

The city's privatisation policy is outlined in the NESP of 1996, which was amended in 2010. It requires all MMDAs to outsource 80 per cent of their solid waste collection services to the private sector and keep at least 20 per cent of capacity in-house. To implement this policy, the WMD of AMA has zoned the city into operational units and offered them as contracts to private service providers. These providers vary in size, complexity, and modus operandi. The service providers are required to bid for the local contracts within their designated zones. However, the competitive bidding process is not transparent, which could negatively impact efficient service delivery. It is worth considering whether private contracts are better suited to higher-income areas, where they can generate profit from waste streams through recycling, leaving the public sector to serve lower-income areas or areas with poorer waste segregation. Box 6.3 outlines the necessary conditions for ensuring efficient PPP in MSWM delivery.

Box 6.1: Takeaways Conditions necessary to ensure efficient PPP

- Public-private partnerships allow large-scale government projects, such as roads, bridges, or hospitals, to be completed with private funding.
- These partnerships work well when private-sector technology and innovation combine with public-sector incentives to complete work on time and within budget.
- Risks for private enterprise include cost overruns, technical defects, and an inability to meet quality standards, while for public partners, agreed-upon usage fees may not be supported by demand—for example, for a toll road or a bridge.
- Despite their advantages, public-private partnerships are often criticised for blurring the lines between legitimate public purposes and private for-profit activity and for perceived exploitation of the public due to self-dealing and rent-seeking that may occur.

It is difficult to accurately estimate the proportion of waste collected in Accra due to infrastructural challenges in low-income and informal communities. Conventional waste collection vehicles cannot access these areas because of impassable lanes, causing residents to resort to illegal dumping. Additionally, the data on the amount of waste disposed of at dumpsites must be interpreted carefully. According to Oteng-Ababio (2022), the government's failure to pay

service providers on time could lead to them exaggerating their claims. Despite these challenges, some studies (Miezah et al., 2015; Oduro-Kwateng et al., 2017; 2020) have estimated that, with the inclusion of the private sector, waste collection has increased from 91 per cent in 2000 (Fobil, 2010) to almost 99 per cent (Oduro-Kwateng et al., 2020) of total waste.

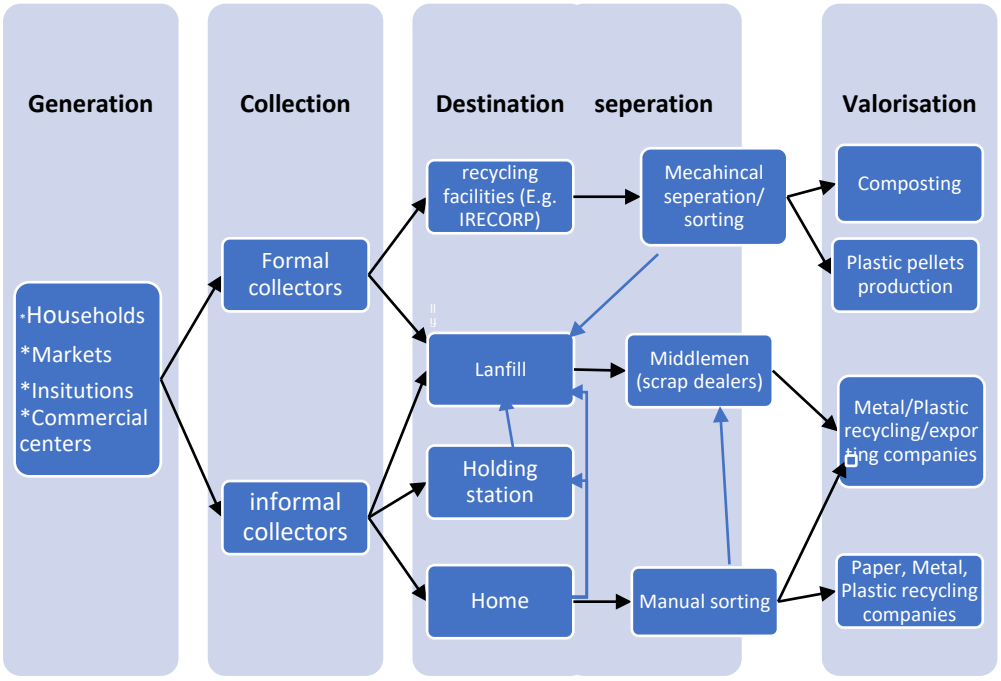
Table 6. 2: Different estimated total waste collected from Metropolitan Accra.

Author(s)	Total amount of waste collected Accra (tonnes per day)	Remarks
AMA/WMD (2003)	1,300 - 1500	Estimated from 1993 waste audit
Anomanyo (2004)	1200	Results from a limited survey
AMA/WMD (2005)	1,220	Estimated from1993 waste audit
Oteng-Ababio (2010)	1500-1800	Projected from exiting studies
Osei et al., (2011)	1250	Results from limited studies
Environmental protection Agency (2014)	2800	Estimated from exiting from existing studies
Sarfo-Mensah et al., (2014)	2200	Results from limited studies
Oduro-Kwarteng et al., (2015)	1552	Results from limited studies
Meizah (2015)	2200	Results from national survey
Appiah (2021)	3092	Results from limited studies
UNDP (2022)	1271	Results from limited studies
Amankwaa et al., (2021)	2500	Estimated from exiting from existing studies
Mensah et al., (2023)	1,200-1,300	Results from limited studies
Mensah (2020)	2100	Estimated from exiting from existing studies
Asamoah et al., (2020)	2200	Results from limited studies

Our study has identified various actors and activities in the SWM industry. We also examined practical information that can be applied to foster future partnerships free of political, institutional, financial, social, or technical problems. The experience in Accra highlights the importance of garnering public support and cooperation to ensure the success of any private sector participation programme, which is often downplayed currently. Based on our analysis, we are convinced that public involvement should be central to any strategy for introducing a private-sector participation programme. Our findings also provide insights into the role of the informal

sector in the waste industry, which is often stigmatised. It is a marginalised group, a majority of which is in the lowest income bracket, that provides a significant service to urban centres across the metropolis. Additionally, they perform a large chunk of a key municipal responsibility at no cost to the city.

Figure 6.4: GAMA MSW Generation chain



Source: Authors' Construct

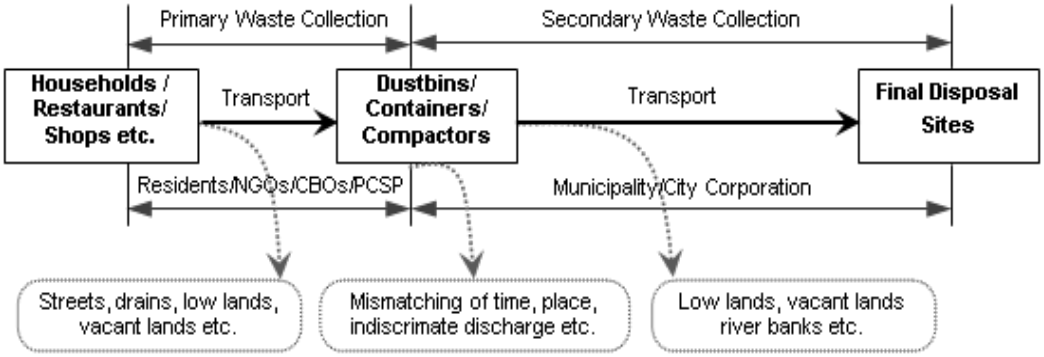
Our research indicates that the absence of an efficient public relations policy and the disregard, non-appreciation, and marginalisation of informal service providers have negatively affected the waste management industry. This is despite the vast amount of data showing the significant contributions made by these providers. More details on this topic can be found in the following sub-section.

6.2 The Pseudo invisible Partners

Our study has identified a group of waste collectors who have found a way to make a living by picking up waste in areas of the city that are often ignored or unassigned, such as slums, informal settlements, low-income neighbourhoods, and peri-urban communities. These informal waste pickers play a significant role in promoting sustainable SWM. However, they remain

unrecognised, marginalised, and stigmatised. Our analysis reveals that these "pseudo-invisible" waste pickers can be grouped into service-chain and value-chain operators. The former group collects waste from underserved communities, small businesses, and economic establishments using tricycles for a fee. On the other hand, the latter group is mostly itinerant waste pickers who collect and sell valuable waste materials like metal, plastic, and paper to recycling companies through primary intermediaries. In most cases, these primary intermediaries sell the collected waste materials to tertiary recycling companies that use them as inputs to manufacture new products brought back to the market.

Figure 6.5:



Source:

The current study could not independently confirm the sector's financial contribution to the Ghanaian economy. However, prior studies revealed that recycling activities, in particular, typically provide a vertical progression, with some participants moving up the ladder from scavenging to retailing refurbished products (Oteng-Ababio, 2018). Economically, the e-waste sector, for example, is said to be contributing between US$105 and $268 million annually to the Ghanaian economy and sustains the livelihoods of at least 200,000 people nationwide (Grant and Oteng-Ababio, 2016). Like others (Oduro-Kwateng et al., 2020), the findings needed to establish a comprehensive database on the number of informal waste workers operating downstream of the waste industry in Accra. Nevertheless, our respondents optimistically believed these operators must be ‘in their 1000s’. They acknowledged their significant contributions to the city’s environmental sanitation architecture and economy. They believe the city will be a poorer place

to live without the informal waste community, which they see as one of the many layers in the urban space.

Our study participants vehemently and unequivocally despised situations where waste pickers are often discriminated against and their perceived association with dirt. Though some city authorities follow a policy of neglect, neither supporting nor discriminating against shadow waste economies, the overall municipal trends veer towards modernised, privatised models that indirectly cripple the informal sector. In that case, the city and other public officials perceive and mistreat these informal actors – collectors, itinerant waste pickers, recyclers, etc. Some study participants recounted how these casual workers were wrongly seen as dirty, thieves, ignorant, etc., and, perhaps, a blot on the city's aesthetic and moral landscape and, therefore, must be expelled or be made invisible. An academic participant described his encounter with these waste pickers (who are being exorcised from the city) as captivating, inspirational and added passionately:

> *[…] it is an irony […] a city is made up of and built by the informal sector - domestic workers, house helps, waste workers, etc. These people are the heart of a city. However, the authorities want to push them to the edges […] the town may be a poorer space without these operators […] they will not only be erasing just the waste collectors but whatever they signify.*"

Corroborating the above concerns, an independent researcher who has been with the informal workers for years (and can be an absolute participant in the industry) described the authorities' actions against the waste pickers as '*revanchist behaviour*', which he explains as:

> *[…]a vengeful reclamation of city spaces from specific groups like waste workers - collectors, itinerant buyers, recyclers, etc., who ironically must be saved by a 'moralistic brigade 'working under the guise of neoliberalism.'[…] envisioning a city this way signifies an attempt to reclaim a sense of purity and aesthetics, which is too exclusive.*

At the policy level, most study participants see the neglected informal sector as a critical stakeholder in Accra's SWM architecture. They noted that the current architecture is selective

and gender-blind, both for men truck pushers and women waste pickers whose contribution is completely zero-rated due to the societal traditional beliefs and stereotypes. The comments by a consultant comprehensively captured this concern:

> *[…] traditionally, women manage household waste, including water, sanitation, etc. Women have performed this task for years and have accumulated considerable knowledge and experience. However, to date, efforts to improve waste services or extend access and coverage to hitherto unserved areas for a fee often overlook the central role of women. Women only come when officials engage in communal labour when free work is needed!*

Our respondents described the above official position as hypocritical, even as they consistently fail to honour their legal responsibility of providing sanitation services to residents. In their opinion, instead of mistreating and maligning waste pickers, city officials must have a moral responsibility to compensate them for expertly stepping in where they [city officials] have failed woefully. To them, the authorities' avowed decision to 'exorcise' the waste pickers from Accra is misplaced and ill-informed. A participant remarked:

> *"[…] it is surprising to hear a minister say he will not allow tricycles on the major roads […]. The officials are utterly ignorant that now, residents are getting quick-value-for-money service; that is why the industry is growing astronomically. Ideally, these waste pickers must be given formal franchises in, at least, areas where others have refused to work…including peri-urban areas. Today, waste pickers do these jobs at no cost.*

In his contribution, a representative of the waste pickers explained how the 'big men' disregard them as essential stakeholders in the waste industry. To them, that explains why the authorities make important policy decisions without seeking their input. He remarked:

> *[…] Officials do not respect Borla [waste] people. Their laws are very selective and do not cover everybody. Right now, the landfill [Kpone] will be closed soon. The new site will be at Agormanya. […]. They say Motor Kings should not travel on major roads; how will we get there to dispose of my waste?"*

Another colleague [waste picker] added in solidarity, thus:

> *No, respect! They do not give you the same care as those working in offices […] perhaps, they see you as a waste. They do not voice it out, but their expression tells it all. However, we love what we do and will keep doing it*".

The comments from the waste pickers show their discontentment with the city authorities. We observed some strategies these operators have adopted to navigate the hurdles artificially imposed by the (in)actions of city officials. These include varying working hours, changing operational turf and payment systems, and sometimes using illegal dumping sites. We observed that some operators had resorted to servicing their clients at dawn to meet their occupational needs (see Figure 6.5). The operators were emphatic that they now compete favourably with the formal sector.

An informal service provider explained:

> […] It is *like Zoomlion is enjoying a monopoly from the authorities. They think we [the informal sector] do not pay taxes, so why bother? […] the landfill used to work 24 hours daily, but they no longer do that. They will wait till daybreak before admitting anybody. You can queue for hours, but we work with time […] most women sweep at dawn and leave for work. You can meet such clients only when you visit them early. […]. Now, most KFCs [restaurants] and fuel stations are working with us because we can work within their preferred times and rate of pick-ups, meet their budgets, and the times of the day that [at dawn] they require services. This explains why we are at war with Mr. Monopoly - Zoomlion…*.".

Figure 6.6: An Informal Waste Worker Servicing a Client at Dawn

Source: Captured by the Author near Ashongman in Accra.

We observed that a subtle impasse between the formal and informal operators over access to landfills could partly be responsible for the increasing fly-tipping along major roads and river bodies in Accra (see Figure 6.6: Sample of fly-tipping). We observed that in most cases, those informal operators hurrying to service their clients tend to find 'somewhere' to empty their waste than the approved disposal sites. This is a price the city stands to pay if the sector can operate independently without any form of control, supervision, and demand for accountability.

Figure 6.7: Sample of fly-tipping of waste near an Informal Settlement (Old Fadama).

Source: Author 2022

From the preceding, we believe the road to a sustainable MSWM destination and enjoying the benefits of the industry will be an exercise in futility if we fail to include all the stakeholders. The private sector (visible [formal)]and invisible [informal]), as well as our development partners, have significant roles to play. The United Nations Development Programme (UNDP)

has demonstrated this through its 'Waste' Recovery Platform initiative. That initiative emphasises and deploys partnerships as an excellent tool for promoting best SWM practices. It allows private sector businesses in the waste value chain to collectively explore ways of turning waste into a resource. The UNDP project is already supporting innovative private businesses that are turning waste into wealth through its 'Waste' Recovery Innovation Challenge. These include Coliba, Nelplast ECO Ghana Limited, Loo Works, Neat ECO Feeds, and West African Feeds utilising various types of waste for pavement blocks, fuel, poultry feed, and other valuable products.

The citizenry has a role to play if the partnership is to be successful. For example, effective MSWM demands citizens to play their unique role of separating waste at source and disposing of it appropriately. Ultimately, the government and the private sector's vision of exploring the economic benefits of waste through recycling can only be realised if citizens succeed in their role. Behavioural change toward MSWM is indispensable and requires actions from all citizens. Put differently, the journey towards sustainable SWM in Accra is not the sole responsibility of an individual or institution. Each stakeholder along the value chain must play their role in making the quest for sustainable MSWM a reality.

SECTION 7

WASTE DISPOSAL PRACTICES IN ACCRA

Key Takeaways

- Accra relies on conventional waste disposal methods such as open burning, dumping, and landfilling. Despite having access to more advanced techniques like incineration, cement kiln co-processing, pyrolysis, gasification, composting, anaerobic digestion, and mechanical-biological treatment, they are not widely used.
- Accra's SWM policy prioritises disposal at dumpsites over waste valorisation. Since 1991, the city has operated 15 landfills with flat fees for disposal and no containment systems to prevent groundwater contamination.
- The city has few official initiatives for waste reduction, reuse, and recycling. In Ghana, 86 per cent of waste generated countrywide is recoverable, with an estimated potential value of Gh 83 billion per annum. This represents a large potential opportunity for value recovery and environmental protection.
- In Accra, about 2.58 million metric tonnes of raw plastics are imported annually, of which 73 per cent ends up as waste. Only about 10 per cent is re-used, while most plastic waste is either incinerated (24 per cent) or disposed of in a landfill or the natural environment (58–62 per cent).
- Two previous composting plants have proved unsuccessful due to a lack of source-separated feedstock; current public and private sector projects continue to face this challenge, which forces some projects to stop collecting from low-income areas.

Improper storage, collection, and disposal of waste pose threats to public and environmental health, and/or can lead to several risks (see Box 7:1). Unfortunately, in Accra, policymakers' minds are dominated by an erroneous perception of waste as an unwanted material with no intrinsic value. This perception has led to the city's exclusive acceptance, approval and reliance

on landfills as the primary waste disposal strategy. There have been little or no attempts to ensure sustainability or explore and quantify the cost therein. Consequently, open dumping and waste burning are prevalent practices in the city, which prior researchers (Agyei Mensah & Oteng-Ababio, 2015; Muga et al., 2010) indicate can potentiate severe human and environmental health problems. Despite these alarming developments, the city authorities seem unable to enact appropriate policies to curtail or mitigate their over-prioritization of waste disposal against minimization.

Disappointingly, Accra's ineffective waste disposal practices are long well-documented (see Post, Broekema, and Obiri-Opareh, 2003; Owusu., Oteng-Ababio, and Afutu-Kotey. 2011; Oteng-Ababio, 2011; 2014). Our analysis affirmed the earlier assertion that waste policies do not succeed or fail on their merits; rather their progress depends on a strict implementation process (Oteng-Ababio, 2010; Oduro-Kwateng et al., 2020). We concur with the assertion by Hill and Hupe (2015) that the normatively attractive top–down view of policy and its implementation, which is the bane of waste disposal policies in Accra, is predicated on three questionable assumptions: a chronological order in which expressed intentions precede action; a linear causal logic whereby goals determine instruments and instruments determine results; and a hierarchy within which policy formation is more important than policy implementation. From our analysis, Accra's waste disposal policy environment is not different, as even though the current model has long been seen as unsuitable, it still retains some popularity with the policymaking authorities.

This development has led to a situation where the city has been practising landfilling, primarily in open dumps or abandoned quarry pits, for years, without proper leachate or gas recovery systems (Ali et al., 2005). This has been attributed to a need for more financial resources to invest in modern treatment systems (Post et al., 2003). The same financial challenge has been cited for the limited budgetary allocations for operating and maintaining the existing dumping sites. This has created a situation where the public has questioned whether landfilling practices constitute

"a blessing or a curse" to the people they serve (Oteng-Ababio, 2012). The problem is aggravated by the rate at which the dumpsites are commissioned and decommissioned without regard to public and environmental health. Since 1990, the city has operated not less than 15 dumping sites. Though it must be exhaustive, Table 7. I. presents the list of dumpsites operating in Accra since 1991 and their status.

Dumpsite	Date commissioned	Date decommissioned	Lifespan
Mallam	1991	2001	10
Djaman	September 2001	December 2002	1.25
Oblojo No. 1	1 January 2002	July 2007	5.5
Oblojo No. 2	August 2008	September 2008	1.1
Kwashibu	September 2008	July 2009	0.33
Kokroko Mallam	January 2009	February 2009	< 1
Mallam SCC	February 2009	September 2009	0.75
Anyaa	2009	July 2011	< 2
Ablekumah	2009	November 2011	About 2
Sarbah	2009	Expected January 2012	> 2
Abokobi	2008	December 2011	3

Table 7.1: The lifecycle of the various dumpsites in Metropolitan Accra

Source: Fieldwork 2012

Several reasons could explain this development, including policymakers' failure to correctly anticipate the delivery challenges; insufficient objective, inaccurate and timely information on costs, timescales, benefits, and risks; optimism about the ability to align different views; interested parties boosting their prospects; and decision-makers desire to seek short-term recognition. Our observation is consistent with comments by Hudson, Hunter, and Peckham (2018: 2) that most policy failures have "three common features that complicate delivery: costs and benefits are distributed unevenly over time – there is a long-time lag between implementation and positive outcomes; they tend to be intellectually contested, politically contentious and hard

to deliver; and the causes and effects span government siloes. In short, inadequate policy design is still far too prevalent".

In Accra, an apparent policy misalignment manifests when one examines official over-optimism to increase waste collection efficiency instead of adopting other appropriate disposal methodologies (Appendix J presents the proposed dumpsites and landfills in Ghana as whole). The latter contrasts the notions of unpredictability, nonlinearity, and adaptability of public policies and only worsens waste disposal and its ensuing challenges. Today in Accra, any significant investment in the waste industry is focused on improving waste disposal facilities and is spearheaded by our development partners and private companies, reinforcing, perhaps, the perceived officials' low priority for waste variolisation. The need to seek more sustainable waste disposal methodologies and encourage less waste to landfill sites was highlighted when a Senior Officer at EPA responsible for landfill constructions and operations in a policy dialogue remarked:

> *The waste problems in Accra include a need for more capacity to identify acceptable sites, strong resistance from nearby towns, and delays in obtaining legal land rights [..]; the difficulty in acquiring land for even a transfer depot seriously impedes companies' turn-around times. In peri-urban areas, the complexities of identifying, conducting the needed assessment, surveying, and obtaining the certificate of occupancy require longer delays in the implementation process.*

Looking into the future, we opine that investments in expanding waste collection capacity must be accompanied by corresponding investments in environmentally safe and sustainable disposal facilities. These must include opportunities for resource recovery and recycling to reduce the volume of waste billed for landfilling and place emphasis on recovering value from discarded materials. In an earlier policy dialogue, a participant from the MSWR noted as follows:

> *[…] the selection of a solid waste disposal system should also factor in issues around environmental impact, costs of resource recovery, operation maintenance costs, and availability of land.* […] *the preferable disposal facilities will remain sanitary landfills, but compost plants become imperative when a market for compost is economically viable.*

Contributing, a land-use and spatial planning representative justifiably criticised the over-concentration of 'managed' dumpsites as primary channels for waste disposal in Accra. He noted, disappointingly, the slight emphasis on material recovery facilities and urged the authorities to strive for small material recovery facilities, thus:

> *Waste management practices in most cities in Ghana are concerning. Household and commercial garbage is often mixed with hazardous waste during storage and handling. Storage facilities are usually old or poorly managed, such as storage containers, while the transportation system is often informal and deficient. Disposal methods include uncontrolled dumping, open-air incinerators, and landfills. Unfortunately, these practices have negative impacts on the environment and public health. They cause air and water pollution, land degradation, emissions of methane and hazardous leachate, and contribute to climate change. These impacts impose significant costs on marginalised social groups and residents.*

Moreover, even when the construction of a landfill site becomes inevitable, he cautioned thus:

> *[…] even when resource recovery or incineration is employed, a sanitary landfill will still be needed to accept rejects and ash. […] whatever method is used; the project designers should explore regionalising the disposal or resource recovery facility to maximise cost efficiency and environmental protection.*

This section has reaffirmed that throwing municipal waste in landfills remains a popular disposal method in Accra. The method also includes 'waste burying,' but beyond this study is whether the authorities follow the processes that help eliminate odours and toxicities before placing waste into the ground. This is important because studies (Oteng-Ababio, 2012; Mudu et al., 2020; Korla and Mitra, 2020) revealed a strong presence of methane and other landfill gases during waste decomposition, which, if not correctly managed, could affect the environment and human and animal life. Further, open burning of MSW is the leading cause of smog and respiratory diseases, including nose, throat, chest infections and inflammation, breathing difficulty, anaemia, low immunity, allergies, and asthma (Mudu et al., 2020).

Equally worth mentioning is that plastic waste incineration produces hydrochloric acid and dioxins in quantities that are detrimental to human health and may cause allergies, haemoglobin deficiency, and cancer (Hong et al., 2006; Brahimi et al., 2019). In addition, smoke from open incineration and dumpsites is a significant contributor to air pollution, even for persons staying far from dumpsites. From this perspective, though landfilling is very popular, it is undoubtedly far from Accra's only plausible waste disposal method. Per our findings, the approach is now seriously challenged due to land availability, compelling city authorities to seek possible "waste accommodation" in adjoining regions – a case of just being synonymous with 'robbing Peter to pay Paul'. This has also resurrected the issue of 'Nimbyism', and several court summons were witnessed in certain metropolises in Accra.

Figure 7.1: Burning of illegally dumped waste within the community to reduce volume C

The Dump Site has no containment system to protect against groundwater contamination, and the leachate is soaking into the soil. The amount of waste transported to the dump site is not the basis for the payment of the private waste hauliers. They are paid a flat fee as there is no weighbridge; the official staff counts the waste transported and manually registers the waste delivery. There is no

opportunity to monitor closely the performance of the waste collection company. Therefore, the waste stream and the collectors' performance have had to be estimated based on our observations.

7.1. Waste minimisation and recovery processes

The environmental challenges to human society have become more concentrated due to the rise in living standards and rapid population growth, especially in regions with high population density. This has led to a significant increase in solid waste generation. In this context, city authorities must implement various SWM practices. However, waste treatment infrastructure is continuously strained despite efficient waste minimisation and resource recovery programmes in emerging economies. Changes influence SWM execution in the community's behaviour, economic system, and solid waste disposal routines. These changes can significantly impact economic growth, environmental pressures, and societal sustainability, which can impede SWM technology, pushing it to its limits and placing unexpected burdens on society.

The MSWM has become a critical challenge in recent times. Ghana generates about 30,000 tonnes of solid waste every day, but only less than 2 per cent is recycled. This necessitates an urgent need to find sustainable ways of managing municipal waste. Sustainable MSWM is crucial not only because of its negative impact on environmental aesthetics and health attributes but also because of its positive potential to unlock and accelerate economic benefits, including job creation. Statistics show that about 86 per cent of waste generated countrywide is recoverable, with an estimated potential value of Gh 83 billion per annum (UNDP, 2019).

The full benefits of waste management can only be realised through a strategic partnership with all stakeholders in the value chain. This includes the government, private sector actors, civil society organisations, development partners, and citizens. All parties must actively participate in waste minimisation, resource recovery, and final disposal. Failure to adopt waste minimisation and resource recovery before final disposal can result in monumental setbacks, as the ills bedevilling landfilling systems demonstrate. Given the finite world resources and growing public awareness of the harmful effects of our 'throwaway culture,' we must move towards a circular economy. This means ensuring

products last longer and recovering materials or other benefits when they become unusable. Recycling can prevent energy usage and the consumption of virgin raw materials. It is the third component of the waste hierarchy.

Waste recycling reduces energy usage, the volume of waste disposed of in landfills, air and water pollution, and greenhouse gas emissions, and preserves natural resources for future use. However, a policy gap is vividly observed. Our study shows that very few officially induced waste reduction, reuse, and recycling initiatives operate at any appreciable scale in Accra. What has even made the situation a bit disappointing is the fact, perhaps with the exception of plastics, these limited initiatives from government operate without any clear-cut framework or guidelines. Aside these government discouraging efforts, the remaining recovery and recycling facilities operating in the country are privately owned, mainly by the informal sector (over 80%), and are overly concentrated in Accra. Therefore, even when individuals voluntarily recover recyclables, they must painfully transport them to market-oriented cities where capacity exists for processing or recyclables can be processed to export standards. Our findings question policymakers' commitment, political will, and dedication to waste recovery. An official from the AMA/WMD narrated as follows:

> *[…] the everyday recycling activity in Accra is the collection and trading of plastic sub-typologies (PET, HDPE, PP, etc.), cardboard, glass, and metals. So far, these activities range from highly advanced recycling and material recovery facilities managed under private arrangements to informal outdoor aggregation points near waste skips and on dumpsites, overseen by informal waste-pickers.* [also] *several small-scale recycling centres within the city, managed by small and medium-sized enterprises (SMEs).*

Summing up in support of the above comments, an ESPA official noted inter-alia thus:

> […] *what is notable about the recycling sector in Accra is the absence of many sustainable businesses valorising recyclables to export-grade quality. Such entities can compete effectively in international markets and drive improved collection practices locally. The lack of such export-driven companies negatively impacts the local recycling industry* […], *and the government must create the enabling environment for such companies to thrive. Perhaps the political will needs to be rekindled.*

7.1.1. Plastic recycling for improved environmental outcomes.

Plastics are a remarkable family of materials that have gathered attention recently due to their ubiquity in the global economy, the low material recovery rates that they currently achieve, and the environmental impacts associated with current disposal methods (see Appendix H for the global overview of the plastic industry). Over the years, governments worldwide have shown their commitment to tackling the problem of plastic waste. They have done so by enacting policies, programmes, and laws that address issues within the waste management sector. Ghana has taken significant steps in this regard. It became the first African country and the second in the world to sign onto the Global Plastic Action Partnership (GPAP). The government launched its National Plastic Action Partnership (NPAP) in 2019 to combat plastic waste pollution in Ghana. Since its inauguration, the 120-member group has brought stakeholders from multiple sectors, including public, private, informal, development partners, civil society, and academia. They meet to drive collective action towards fostering a circular economy for plastics.

The partnership is an initiative of the World Economic Forum with the Ministry of Environment, Science, Technology, and Innovation (MESTI). It focuses on six impact areas: boosting innovation, promoting inclusivity, informing policy, unlocking financing, transforming behaviour, and harmonising metrics. These impact areas are connected components that cut the plastic value chain throughout the NPAP setup and delivery process. The birth of NPAP was part of the strategies for achieving the president’s plea in 2017 to make Accra one of Africa's cleanest cities. However, despite these political promises and commitments, plastic recycling remains an economically marginal activity.

The NPAP is responsible for implementing national strategies to combat plastic pollution, which has been on the increase in recent times. Although early forms of plastics were already in existence during the mid-19th century, plastics other than Bakelite were largely unknown before 1950. Since then, plastics have rapidly become one of the most commonplace materials on the planet. In 2015, global plastics production reached 407 million tonnes per annum (Mtpa), making it more than the production

of paper (400 Mtpa), fish (200 Mtpa), and aluminium (57 Mtpa) (WWF, 2018; World Bank, 2018; USGS, 2016). If production continues to grow at similar rates, plastics production will reach 1 600 Mtpa in 2050 (EMF, 2017). The rapid growth of plastics production and use is largely due to the material's unique properties. Plastics have a high strength-to-weight ratio, can be easily shaped into various forms, are impervious to liquids, and are highly resistant to physical and chemical degradation. Plastics can also be produced at a relatively low cost. These properties have led to the substitution of traditional materials (e.g., concrete, glass, metals, and paper) for plastics in many applications.

To achieve this, NPAP has set priorities that include incentivising changes in material use, building capacity in waste management and recycling, promoting innovation and technology transfer, raising awareness and changing behaviours to reduce the consumption of single-use plastics, promoting gender equality and meaningful work, and ensuring transparent governance and accountability in the transition to a circular plastics economy. According to Oduro-Appiah & Afful (2021), the reasons for the NPAP's development are varied and include the dysfunctional character of plastic markets. This is evident in various ways, such as limited market volumes and liquidity, small trade flows as a proportion of total plastic waste generation, and highly volatile market prices. These findings are not surprising since global plastic recycling rates are low (pegged between 14 and 18%), and the market share of recycled plastics is less than 10 per cent.

In the case of Accra, Ghana, about 2.58 million metric tonnes of raw plastics are imported annually, and 73 per cent of that ends up as waste. At the same time, only 19 % is re-used, according to the Environmental Protection Agency (EPA). Geyer et al. (2017) found that plastic waste generated is either incinerated (24%) or disposed of in a landfill or the natural environment (58–62%). These results are consistent with other studies (see van Ewijk, 2017), which noted that plastic recycling rates are lower than those for industrial metals such as steel, aluminium, copper, etc., and paper, which exceeds 50 per cent. Our analysis concurs that the environmental impact of plastics could be reduced by promoting better collection and treatment practices, introducing reusable plastic products,

substituting alternative, less environmentally harmful materials, developing biodegradable plastics, or designing more easily recyclable plastics and recovering them at end-of-life (Muda et al., 2020).

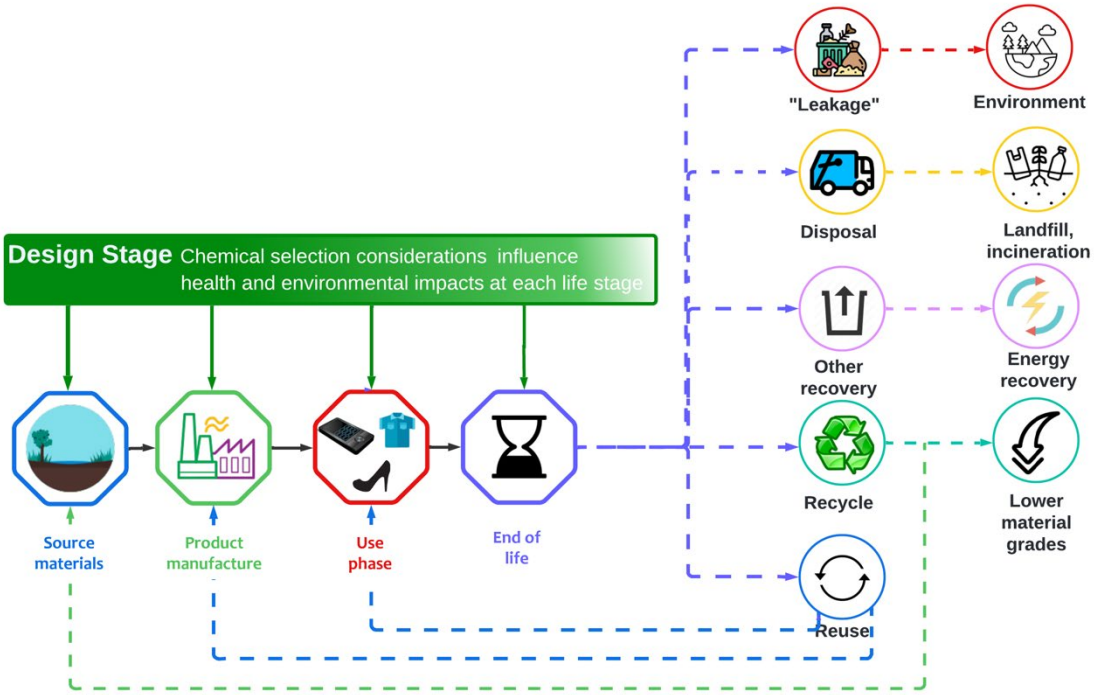
During our analysis, we discovered that efficient markets could play a crucial role in increasing plastic collection and recycling rates. This would help achieve two objectives: reducing plastic pollution and maximising the benefits of plastic use. Diverting plastic waste towards recycling facilities and producing recycled plastics would decrease the demand for plastic incineration and virgin plastics production, both of which are highly carbon-intensive processes. A life-cycle assessment of various options for end-of-life plastics management by Bernardo et al. (2016) showed that plastics recycling has a far smaller greenhouse gas footprint than incineration or landfilling. The study also found that the global warming potential associated with plastics recycling was only half that of incineration or landfilling.

Figure 7. 2: Typical plastic recycling facility with drying benches for cleaned plastic recyclables. Grinder unit and regrind

Source: Oteng-Ababio, (2007)

Without a doubt, the displacement of virgin plastics by their recycled equivalents is a critical reason for the relative desirability of plastics recycling. Thus, recycling may be the most effective alternative to landfilling or incineration in reducing the flow of plastic waste into the environment. In each case, initial efficient waste collection is a prerequisite to guarantee further effective treatment. To achieve this objective and to seize economic opportunities linked to investment in higher-quality waste plastic processing calls for a more robust domestic policy framework. Put differently, a practical policy framework would address challenges across the entire plastics life cycle, from plastics and product design to end-of-life management and recycled plastic production. Figure 7.2. is the general plastic product design and life cycle stages captured in Accra as it persists in most global economic environments.

Figure 7.3: Plastic product design and life cycle stage



Source: Adopted from OECD Report, 2022.

Our study unpacks the rationale for policy action. Policy interventions must address the demand and supply bottlenecks in recycled plastics markets. On the demand side, measures should focus on helping establish a separate demand for recycled plastics and levelling the playing field between virgin and recycled plastics. On the supply side, measures are needed to help increase the supply of recovered plastics and the quality of the resulting feedstock. This should include efforts to improve the sustainability of plastic materials and products at the design stage. Significantly, a coordination failure is at the heart of poorly functioning markets for recycled plastics. Potential suppliers of recycled plastics need to invest sufficiently in sorting and recycling capacity because the profitability of these operations is limited. The potential buyers (i.e., manufacturing firms) have little incentive to use recycled plastics as inputs because they need more certainty about their availability and quality.

It makes economic sense to address these challenges holistically because of improved market outcomes, scale efficiencies, and consumer acceptance. This will help suppliers and buyers of recycled plastics benefit from larger, more liquid markets. The preceding provides a clear rationale for policy re-alignment and a catalyst to handle the plastic recycling industry effectively and

efficiently. The policies will be more effective if they holistically address the industry's supply and demand challenges, including market failures, policy misalignments, and status quo biases. The policies must strive to address the challenges across the entire plastics life cycle spectrum, from product design to end-of-life management and recycled. Ultimately, we need to support the design, development and delivery of policies to make plastics more sustainable, enabling our societies and economies to reap the benefits of plastics while avoiding associated impacts on the environment, health and the economy.

From the foregoing, it can be deduced that addressing uncertainty about the availability and quality of recycled plastics is critical for a thriving recycling industry. Manufacturing firms have incentives to use recycled plastics in their production processes. Doing so can create reputational benefits and may also charge a small price premium if the final product can be marketed as “green”. That said, many manufacturers continue to rely solely on virgin plastic inputs, both because of their lower cost, but also due to inertia and uncertainty about the properties of recycled plastics. While the quality, performance characteristics, and near-term availability of virgin plastics are assured mainly, there may be uncertainty about the same characteristics of recycled plastics. Status quo biases also hinder switching, even when recycled plastics are cost-competitively quality to their virgin equivalents.

There are also increasing concerns over additives (e.g. colours, plasticisers, flame retardants) used in manufacturing some virgin plastics that complicate recycling or pose risks to human or ecological health (Mugu et al, 2020). For manufacturers of recycled plastics, uncertainty about the presence of these additives in plastic waste can hinder recycling altogether (because the resulting output may be of low quality or pose significant health risks in certain food-related applications such as food packaging and children’s toys). The lack of information and transparency regarding the use of additives in some plastic waste streams (e.g. electronics and other durables) is thus a significant barrier to increased recycling of those products.

From our studies, it can be deduced that Ghana has made significant strides in sustainable development in recent years, but much work still needs to be done. From managing plastic waste to

renewable energy, the authorities have numerous opportunities to revolutionise sustainability and become a model for other countries in the region. Our study explored innovative solutions already being implemented by the government and discussed the potential for further progress in this critical area. In today's economic environment, the Environmental Protection Agency (EPA) estimates that about 2.58 million metric tonnes of raw plastics are imported into the country annually, and 73 per cent of that ends up as waste. In contrast, only 19 per cent is re-used. The cost structure of recycled plastics production is different from that of virgin production and is often higher at current oil prices. There are several reasons for this.

Plastic waste generation is geographically dispersed, and aggregating waste materials into economically viable quantities incurs considerable collection and transport costs. This waste is often coming with food residues, paper, and other materials. The separation of the plastics fraction (and the individual polymers of plastic) into clean feedstock for reprocessing can be technically challenging and involves considerable capital or labour costs. In addition, a significant proportion of the plastics in the waste stream are built into more complex end-of-life products that, in many cases, are difficult and costly to disassemble.

7.2. Composting Opportunities and Practices in Accra

Technically, composting is one of the most preferred outlets for municipal waste disposal wherever economic opportunity exists. From our empirical observation and analysis, composting is an easy and natural bio-degradation process that takes organic wastes (i.e., plants, gardens, and kitchen remains). It turns them into nutrient-rich food for plants. Being an alternative waste management option to recycling – landfill or incineration – is relatively cheap in many countries. In almost all developing economies, the per-tonne charge levied for waste disposal may not necessarily reflect the total social cost of these alternatives.

The external (environmental and social) costs of landfilling (e.g. emissions to air, soil and water; and ‘disamenities’ such as odours and pests) are challenging to quantify in monetary terms and are therefore not generally reflected in waste disposal charges or taken into account in decision making

regarding waste management options. This results in a bias against alternatives such as recycling, which may be more expensive than landfilling from a purely financial perspective but preferable from an environmental and social perspective. In Accra, the city authorities have historically engaged with compost projects to introduce advances in waste management technology. One such attempt was the Teshie Compost Plant (TCP), constructed in Teshie, a suburb of Accra, in the late 1970s (see Oteng-Ababio, Arguello, & Gabbay, 2013; Oteng-Ababio, 2020). Conceived around the late 1950s and enduring 'years of stressful ectopic', Our studies revealed that the plant was delivered in the late 1970s. Available records indicate that the plant has never operated at total capacity since its inception, with production capacity falling from about 92 per cent capacity in 1995 to only 11 per cent in 2004 (see Figure 7.3).

Figure 7.4: Annual production levels of the Teshie compost plant from 1994 to 2004.

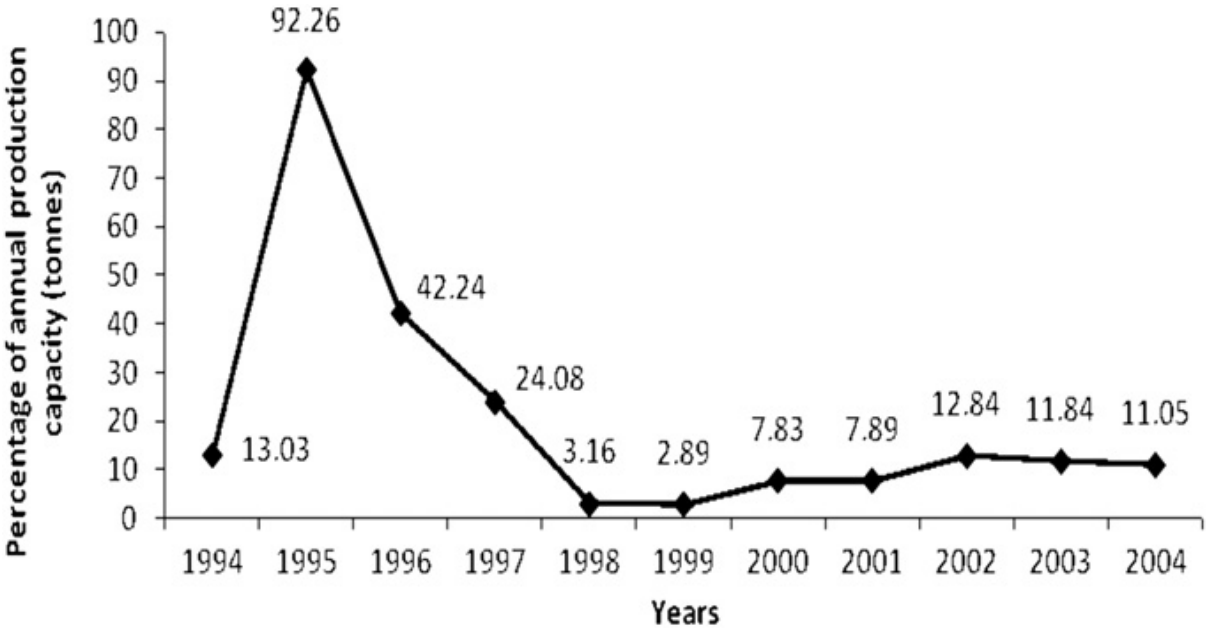


Figure 7.3 presents the annual production levels of the plant between 1994 and 2004. As of 2002, the plant was operating far under its envisaged capacity, composting an estimated 200 tons of organic waste daily out of the projected 1500 tons of waste generated daily at the time, of which at least 60 per cent, or roughly 900 tons, consisted of organic waste (Asomani-Boateng, 2007). The plant's operational failure resulted from constant mechanical failure, the use of technology that had long exceeded its useful life, and the lack of proper active maintenance. Although the TCP failed, it offers

useful lessons for future policy development. The plant, for example, failed primarily owing to a lack of source-separated feedstock, which resulted in the production of insufficient quality compost. This led to continual mechanical failure, exacerbated by the conditions of a technology that had long exceeded its useful life. Thus, 'if the reasons for the Teshie plant's demise had been well digested, it could have held the key to the success of any future compost plant like the Accra Compost Plant.

The Accra Compost & Recycling Plant (ACARP), established in 2012 through a public-private partnership programme, is an integrated waste processing and recycling company (see Figure 7.1). The company receives, sorts, processes and recycles solid and liquid waste to produce organic compost for agronomic purposes in Ghana and the sub-region. They also produce high-quality pelleted plastics as raw materials for local industries to produce various plastic items. The company can process nearly 600 tonnes of municipal waste daily but operates less than 60 per cent due mainly to inappropriate feedstock. The company's challenges are technically no different from those faced by the Teshie plant. For example, today, due to a lack of source-separated feedstock, ACP encounters about 30 per cent faecal matter in its feedstock, which has compelled the company to stop accepting waste collected from low-income and market areas.

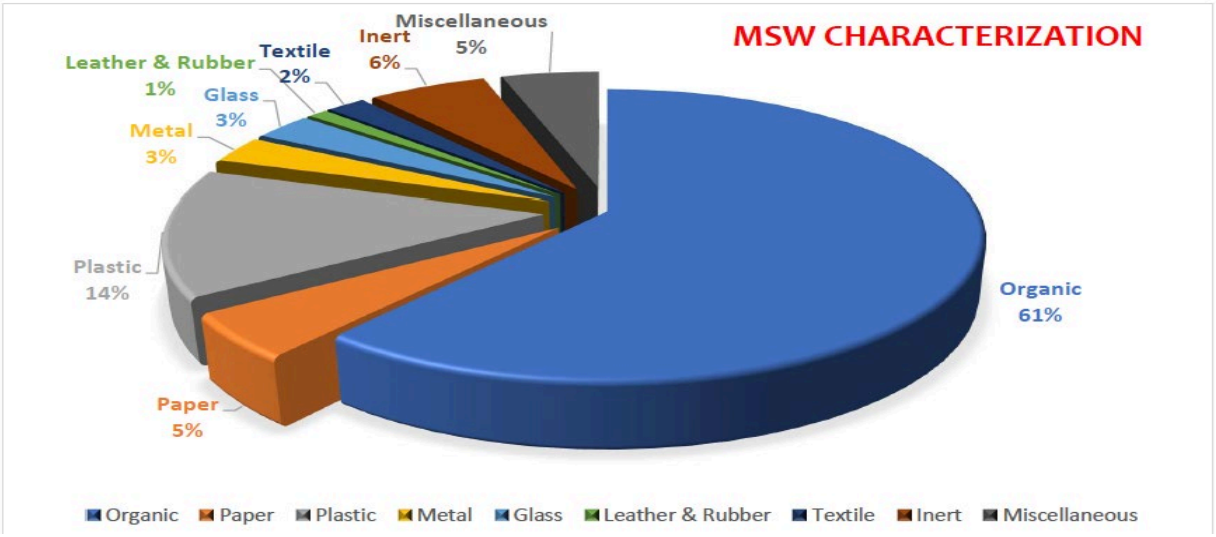
Figure 7. 5: Section of the recycling plant at Accra Compot Plant (ACCARP)

In 2012, the President of Ghana commissioned the second phase of the Accra Compost and Recycling Plant (ACARP) at Adjen Kotoku. This plant was built to receive and process excess municipal waste into reusable products. The second phase added a 1400-tonne line to the existing 600-ton facility, increasing the plant's capacity to bridge the existing gap of untreated solid waste within the Greater

Accra Metropolitan Area (GAMA). The main goal of the second phase was to expand the compost and recycling facility's capacity from 600 to 2,000 tonnes per day. Currently, the plant processes 40 tonnes of waste per hour, while compost production is about 1,000 tonnes per month. The recovered material is mostly PP, which amounts to 1,000 tonnes per month, while HM and HD plastics amount to 2,500 tonnes per month. The recovery efficiency is about 80 per cent. MO195962

Another such company in Accra today is Integrated Recycling and Compost Plant Limited (IRECOP). The company seeks to contribute to the country's environmental sustainability through innovative solutions to waste disposal. With sustainability underpinning its core operations, the company uses organic fractions of MSW in a sustainable path to create compost and recover other recyclables, including plastics, paper, metal, glass, etc., for reuse. Figure 7.5 presents a summary of waste characterisation conducted by the company based on household waste sent to the company from its catchment area.

Figure 7.6: Summary of waste characterisation conducted by IRECOP



Besides the ACARP and IRECOP, other smaller projects exist, and they usually include provisions for resource recovery in their operations. Concerning the implementation of composting facilities, past experiences indicate that low institutional and technical capacities posed significant constraints to effective facility management and operations. A remark by one of our key informants expertly captures these concerns, thus:

> *Most compost industries lack reliable local markets and quality control [..] the plants are producing compost of regular consistency, with high organic content, suitable for soil conditioning. They also recover substantial quantities of recycled metals, plastics, paper, and textiles (see Figure 7.5). However, composting remains the preserve of the private sector without government support and, therefore, is unsuccessful.*

During the policy dialogue, an official of the ESPA re-echoed the participants' concerns, adding that rapid urbanisation and population growth require efficient MSWM systems for sustainable, healthy, and inclusive cities. According to her, waste-related emissions will increase without critical improvements. Improving waste management will help cities become more resilient to extreme climate occurrences that cause flooding, damage infrastructure, displace communities and threaten livelihoods.

7.3. Incineration/Combustion

Incineration or combustion is a disposal method in which municipal solid wastes are burned at high temperatures. The process eventually converts them into residues and gaseous products. The most significant advantage of this type of method is that it can reduce the volume of solid waste to 20 to 30 per cent of the original volume. It also decreases the space waste takes up while reducing the stress on landfills. Incinerators are primarily used in thermal treatment, where solid waste materials are converted to heat, gas, steam, and ash. Incineration is also widely popular where landfill space is no longer available.

The study shows that more advanced methods like incineration, cement kiln co-processing, pyrolysis, gasification, composting, anaerobic digestion, and mechanical-biological treatment are technically unavailable and not widely utilised within metropolitan areas. Instead, the study revealed that most waste disposal sites are not engineered, leading to solid waste littering in open spaces due to using “archaic” practices in waste management. Additionally, recommended methods within the waste hierarchy, such as recycling and engineered landfills, are either absent or rarely used. Instead, archaic practices such as open burning, landfilling, and waste dumping are increasingly used in the Municipality. These archaic practices release toxic organic pollutants such as polycyclic aromatic

hydrocarbons, dioxins, and furans into the air, negatively affecting ecosystems (Oduro-Kwarteng, van Dijk & Ocloo, 2017). Our findings suggest poor adherence to Ghana's Environmental Sanitation Policy (ESP) on final disposal methods. Ghana's ESP specifically recommends technologies for solid disposal, such as sanitary landfills, controlled dumping with cover, incineration, composting, and recycling, as standards for the final disposal of urban and large industrial waste (Grant & Oteng-Ababio, 2016).

Ghana's economy has improved significantly, with an annual gross domestic product growth of 5.7 per cent per capita. There has also been a significant technological transition in the country. However, most citizens are still despondent due to past experiences regarding solid waste management. The government's market-oriented approach has left poor residents to deal with filth and unsanitary conditions, perpetuating the problem. The current waste disposal strategy, which involves dumping waste on neglected, non-systematic disposal sites without pre-treatment, is unacceptable. This method causes significant pollution in the immediate environment and needs to be addressed.

Over the past twenty years, Accra has seen the establishment and closure of many dumping sites. Unfortunately, most of these landfills do not meet the basic sanitary and technical standards, making them unsanitary and posing a risk to human health and the environment. This has caused the public to question whether landfills are a "blessing or a curse" to the people they are meant to serve. The situation has worsened due to the city administrators' disregard for public health when commissioning and decommissioning landfills. According to Mieza et al. (2015), recent SWM approaches, which often rely on foreign aid, have had little success as they are incompatible with local socio-economic realities. This issue will likely persist and worsen until the authorities integrate foreign solutions with all-inclusive It is, therefore, imperative that city authorities, indigenous strategies, which they have failed to do so far. work directly with these communities and their inhabitants to create innovative plans.

There are several policy issues that require attention, especially in light of the ongoing "waste war". Networked modes of governance, where authorities and service beneficiaries cooperate, are

necessary. Policymakers must recognise the limitations of relying too heavily on foreign SWM models, which are not suitable for waste management in Accra. Instead, they should consider local solutions based on local conditions, knowledge, and traditions. Policymakers must also understand that foreign solutions can only provide guidelines and ideas and cannot be implemented as is. Residents must feel like they are part of the solution, have input into crafting the solution, and that it originates from their best understanding and wishes for their future for the solution to be effective.

Solving waste disposal problems is a complex and diverse, and there is no instant cure or one-size-fits-all solution. Public and private practitioners, formal and informal, must design policies that avoid repeating past mistakes and set new benchmarks for effective all-inclusive strategies. Ideally, the future of MSWM must be shaped by the experiences of all households and firms, aiming to achieve a healthy and livable city for everyone. Some low-income communities have already demonstrated their inherent abilities and skills in the war against waste, primarily through the activities of informal waste service providers. Therefore, it is necessary to appreciate that less orthodox approaches may be viable routes to creating an efficient SWM architecture to help build one of Africa's cleanest cities.

SECTION 8

WASTE SYSTEM FINANCES SUSTAINABILITY

Key Takeaways

- Accra has a critical financing gap. Transportation costs between $20 to $50 per tonne, and user fees range from an average of $35 per year in low-income communities to $170 per year in affluent neighbourhoods. This means that the sector remains labour-intensive and is currently funded through a combination of user fees, municipal funding, and national financing.
- A practical method for managing solid waste is to implement a user-pays system. This approach is less dependent on taxes and can substantially decrease the expenses associated with roadside collection and landfill operations. By implementing this system, we can reduce littering and illegal dumping, which can significantly enhance the appearance of public places.
- The informal sector also presents some financing options for SWM. Because informal pickers are more likely to accept flexible pricing and provide consistent services, they can provide affordable support to existing, formal SWM systems.
- The absence of solid MSWM data collection and financial monitoring is a hurdle in finding more sustainable financial approaches in Accra. Precise business plans and additional evidence are necessary to determine whether financing systems are sustainable for SWM in the municipality.

The management of waste in Accra is legally the responsibility of the local authorities as per Act 624 of 1996, revised in 2016 to Act 923. Our analysis revealed that although the private sector handles waste services, from collection to treatment and disposal, the government is still involved in various ways, including regulatory oversight and fiscal transfers. However, we did not evaluate the financial sustainability of the government's arrangement with the private sector. Previous research suggests that the success of such partnerships depends on the implementation of appropriate incentive structures and enforcement mechanisms.

In Accra, several regulatory frameworks exist for MSWM. However, our analysis noted that their implementation, universal application, and enforcement must improve (Oteng-Ababio, 2020). During

earlier consultations, we received critical concerns and comments regarding the fiscal sustainability of Accra's MSWM system. Our participants agreed that the city's rapid population growth and urbanisation have increased waste generation. They also acknowledged that if no action is taken, society could be on a dangerous path to more waste and overwhelming pollution. To ensure healthy and inclusive communities, it will be critical to secure the necessary finances. Our participants cautioned that the environment will pay an even higher price if no action is taken. They further added that solutions already exist, and what is needed now is urgent action at all levels of society.

Our research confirms what other studies have found - financing SWM infrastructure and systems in urban areas is a significant challenge (see Act 624 of 1996, revised in 2016 to Act 923). This is primarily due to the high operational costs involved, which must be considered upfront. According to a report by the World Bank, the operational costs for waste collection, transport, treatment, and disposal in developed economies are typically around $100 per tonne (World Bank, 2018, p.44). Meanwhile, the estimated cost for cities in developing economies is about $35 per tonne, which some authorities still need help to recover. To illustrate, Table 8.1 presents the estimated transportation cost of waste disposal in Accra, as reported by a service provider – Jekora Ventures, for and on behalf of ESPA – Environmental Services Providers Association. (For full cost accounting, see Appendix I)

Table 8. 1: Estimated cost of waste Transport

Elements of cost build-up	Multi-lift (Double Axle) (441HP/324Kw)	Roll-on-off (Double Axle) (340hp/250Kw)	Compaction (Double Axle) (320HP/235kW)	Mini Dump Truck (Borla Taxi) (40HP/41Kw)
Fuel & Lubricants	25,841.55	39,231.71	30,511.91	2,195,96
Personnel (Direct Labour)	5,434.72	4,351.39	10,833.33	4,658.33
O & M (Operations & Maintenance)	13,804.08	16,845.92	14,686.76	2,674.99
Overheads	4,506.04	6,042.90	11,206.40	1,905.86
Working Capital Cost	14,876.52	19,941.57	20,171.52	3,430.54
Truck & Equipment Investment Cost	16,666.67	18,000.00	22,000.00	1,278.54
Pre-Tax Profit Margin including CSR	20,282.89	26,103.37	27,352.48	4,036.05
Totals/Average	**101,414.47**	**130,516.86**	**136,762.40**	**20,180.26**
Average Cost per Lifting (240 Ltr)	31.24	24.59	37.25	Highest due to added on
Average Monthly Service Charge (240 Ltr)	135.82	106.92	161.98	Cost from double handling

Source: Jekora ventures, 2022

Elements of cost build-up

- Fuel & Lubricants: Diesel, Petrol, Engine Oil, Hydraulic Oil, Gear Oil, Grease, ATF, Brake Fluid, etc.
- Personnel: Emoluments for Driver, Sanitary Labourer, Container, Labourer, Revenue Collectors, etc.
- Operation and Maintenance: Tyres, Batteries, Preventive Maintenance, Repairs, Truck and Equipment Hire, Refuse Container Maintenance, Provision of Wooden Steps, Hand Tools, Protective Clothing, Tapauline, Insurance, Permits, etc.
- Overheads: Administration, Management, Training, Public Sensitization, Public Relations and education, Local Travel, Utilities, Legal and audit Fees, Property Rates, Workmen's Compensation, Rent for Office Space and yard for Parking Equipment, Revenue Collection and cost of Enforcement of Compliance etc.
- Working Capital: Bank Loans, Overdrafts, Credit Facilities etc.
- Truck and Equipment Replacement: Investment- Trucks, Solid Waste Containers etc.
- Pre-Tax Profit Margin: Including corporate Tax and Social Responsibility provision, etc.

Independent prices & rates

- Fuel Prices
- Minimum Wage
- Cedi – Dollar/Euro Rate
- Utility Rates
- Insurance Rates
- Lending Rates

Effects of changes in independent prices & rates on elements of cost build-up

- Fuel Price Change — Fuel and Lubricants Cost Adjustment
- Minimum Wage Change — Personnel (Direct Labour) Cost Adjustment
- Dollar Rate to Cedi Change — Operations and Maintenance, Truck and Equipment Replacement Cost Adjustment
- Utilities Rates Change — Overheads Cost Adjustment
- Insurance Rates Change — Overheads Cost Adjustment
- Lending Rates Change — Working Capital and Amortisation Cost Adjustment

Our analysis has confirmed that due to a critical financing gap, a significant portion of the waste industry in Accra remains labour-intensive. Transportation alone ranges from $20 to $50 per tonne. We have also found that the cost recovery rate for waste services in Accra varies drastically across income levels. According to our interviews, user fees range from an average of $35 per year in low-income communities to $170 per year in affluent neighbourhoods. Full or nearly complete cost recovery is limited mainly to high-income areas. User fee models may be fixed or variable, depending on the type of user being billed. Typically, the local government covers part of the investment costs for waste systems, while the remainder comes mainly from national government subsidies and the private sector.

Given the overwhelming cost, financing the MSWM system is a significant challenge. The World Bank's investments in the city have been a primary source of relief in meeting the infrastructural needs of SWM. In 2020, the Bank supported decommissioning the old Kpone landfill site and rehabilitating an adjacent landfill site for $200 million. The Bank had in 2000 endorsed the construction of four landfill sites in Accra, Kumasi, Tamale, and Selkondi-Takoradi that collectively

serve the needs of over two million residents. The structure of these landfill sites also enabled illegal dump closure, developed sustainable livelihood programmes for waste pickers, and linked payments to better service delivery through results-based financing. Box 8.1 describes the creation of the EWROTA organisation and the process by which the EPA collects an Eco levy in Ghana.

Box 8.1. The formation of EWROTA and the collection of Eco levy by EPA

The Environmental Protection Agency (EPA) has begun collecting the 'Advanced Eco Levy' from importers of industrial tires used by large trucks, air conditioners, and other imported electric and electronic products. The initiative was supposed to begin on November 1, 2018, and required that all electrical and electronic equipment, as well as tires exported to Ghana, be registered on the e-environmental platform deployed by Societe Generale de Surveillance SA (SGS). However, the project was stalled because importers and the Ghana Union of Traders Associations (GUTA) resisted it due to a lack of proper consultation.

The new initiative coincided with the inauguration of Electronic Waste Round Table Association (EWROTA), a group of formal sector e-waste management companies. The 10 companies making up EWROTA are City Waste, Presank Limited, Marshal and Co., Jekorah Ventures, JSO, Zeal Environment, Integrated Recycling and Compost Plant, Atlantic Phones, Vermark, and M. Lawson and Co.

The aim of the Eco-levy is to raise funds to support the collection and disposal of those items in an environmentally friendly manner as they wear out. It was also intended to provide sustainable funds for waste management and move away from relying on donors for money to manage waste in accordance with Section 21 of the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917).

An official from EPA said the introduction of the Eco-levy was a significant boost to the agency's goal of ensuring effective management of e-waste. Part of the funds raised would be used to build the capacity of stakeholders in the waste management value chain, particularly those in the informal sector. The Chief Director of the Ministry of Environment, Science, Technology and Innovation (MESTI) said the implementation of the Eco-levy was a big boost to the government's efforts to manage e-waste effectively. The Eco-fund would help build the capacity of informal sector players in the waste management value chain and put an end to the open burning of electronic waste, according to the director.

Despite these interventions, our participants saw Accra's SWM architecture as unsustainable. They believe the formal and informal players were in a dire financial crisis and needed support. One respondent who has been in the industry for over three decades noted:

> *"Our system is not sustainable; […] composting and recycling can recover some cost, but … we mix waste. We do not manage the disposal sites well because of [lack of] finances. It takes finances to set up treatment plants, So, due to our little budgets, we turn blind eyes when our waste is polluting our water bodies."*

During a discussion on SWM, some participants highlighted their concerns about the city officials' lack of commitment towards an integrated system. They believe that the city has competing critical demands and, therefore, needs more financial resources, often leading to diverting funds meant for SWM to other priorities. A specific example is the plastic waste and eco-levies meant for plastic and e-waste management, which are currently in limbo. An official from the Africa Environmental Sanitation Consult, a research unit under the Jospong Group of Companies, made the following comment:

> *[…] With MSWM, the only levy is the EPR. Yet, when the money comes to government coffers, it is not used for the intended purpose. Instead, it is used for other prioritised activities*.

According to our participants, the key to alleviating the crisis faced by city officials in SWM is to shift the financing focus towards data gathering and integrated planning. In their opinion, it is essential to understand the amount and types of waste generated to realistically allocate the limited budget, evaluate relevant technologies, and identify potential strategic partners. They emphasised the importance of waste data and provided some critical financing policy options and planning decisions that include:

- Identify and selectively provide financial support to distressed MMDAs, especially the fastest-growing districts, to develop state-of-the-art MSWM disposal systems;
- Support major waste-producing districts to reduce the consumption of plastics and marine litter through comprehensive waste reduction and recycling programmes and
- Reduce food waste through consumer education, organic waste management, and coordinated food waste management programmes.

8.1. The quest for financial sustainability and the informal sector

The fiscal sustainability of the SWM industry in Accra is linked with the government's infrastructure and human resources investments. The fiscal matter of Accra's SWM industry is closely tied to the government's infrastructure and human resources investments. The revenue from waste collection tariffs, paid by households, commercial enterprises, and institutions, broadly finances the industry.

The industry needs to consider different strategies and options to improve the cost recovery of the waste collection and transport system. For instance, it can design and adopt various financial cost recovery mechanisms instead of relying solely on fixed tariffs. This approach would consider the urban poor, who cannot afford the tariff but still require waste collection services, and reflect a social equity objective. Plans for an adapted revenue collection system and variable tariffs are also possible. This polluter-pays-principle model would couple, for example, the tariff to the water consumption bill rather than directly measuring waste generation. However, all available options to increase revenue streams through tariffs or taxes require strong political will and acceptance of the political constituency, as they are highly political. Besides increasing the revenue base, the industry can also explore various options to reduce current running costs by increasing cost efficiency. Since transportation represents the largest annual cost share, the industry can consider solutions to improve transport efficiency and reduce maintenance costs. Several solutions are proposed, but they need a more detailed analysis with better estimates of cost reduction levels and a detailed Net Present Value (NPV) calculation to assess whether further investments are justified.

Aside from the government's efforts and policy initiatives, the private sector is equally encouraged, empowered and assisted to explore other options to increase revenue, including selling waste-derived recycling products. Meanwhile, our analysis of the situation in Accra pointed to vibrant informal sector operatives, which must be appreciated and factored into the overall framework. The findings show that the informal operator's survival depends mainly on easy accessibility to landfill sites. Failure to do this will result in fly-tipping, creating environmental costs and an unsustainable environment. We observed that these informal operators are business-minded, just like their counterparts in the formal sector. These operators would not survive if the transportation cost outstripped their earnings. To be sustainable within the industry, participants within the informal sector adopt an exceptionally interesting modus Operandi, particularly the flexibility and price differences between service levels.

The MSWM fiscal sustainability can also be enhanced by adopting some of the innovative modus operandi of the informal sector. Unlike the formal sector, which requires payment at regular intervals, the informal sector is flexible in its payment terms. For example, some participants in the informal sector willingly accept lower fees depending on the prospective client's financial capacity and the value of recyclables embedded in the waste generated. They have payment options for a monthly subscription and the pay-as-you-generate model. One of the informal operators elaborated on their modus operandi:

> *[…] to pay and collect is entirely up to you [the client]. Some people like it monthly [...] if you agree that the collection should be done twice a week, you must honour your promise, which is eight times a month before you go for your money*.

Another operator also added:

> *[…] no fixed price. With my customers, if I go and they do not have money, I will still take their waste and for them to pay later. After you charge a fee, the client can negotiate a discount. That is the difference between the other companies and us.*

Another strategy that can facilitate MSWM fiscal sustainability is improving the services rendered to beneficiaries. Residents are willing to pay for quality service (Oteng-Ababio, 2013). An informal operator explained:

> *[…] some institutions and individuals have unsubscribed from formal service providers and run to us [informal providers] even at a higher fee because of our reliability. A filling station was paying a legal company GHS1,000.00 a month but is now paying me GHS1,500 a month, as I can operate when they need services – at dawn before a day's work starts."*

Ultimately, our study edges city officials to support the informal sector and take advantage of its more comprehensive coverage of otherwise underserved areas and the opportunity it presents for instituting source separation officially. Before heralding source separation, a waste picker is called first to create a structural framework to handle the sorted waste streams. Secondly, tactically, compliance needs to be incentivised. He remarked:

> *[…] we [Ghanaians] do not know the use of waste. Governments should have bought waste from us [informal operators]. Fine! If they do not even believe, they should have had some percentage [i.e., MSWM budget] for us. Most residents in the slums and peri-urban areas, where they* [formal operators] *do not want to work, use our services. Their communities* [slums] *also generate sanitation challenges. So, if we were giving such support, we at least, too [the informal], must benefit from the sanitation budget. Today, we roam the city for waste at our own expense but are charged before we dump our waste. There is no compensation or recognition; the authorities are driving us away. The regional minister has threatened to ban us from using the major roads, and society is calling us names. This is highly unfair to us… in some places, they buy waste.*

To ensure SWM's financial sustainability in Accra, our survey participants suggested that waste valorisation (such as value to waste) should be included in the waste disposal strategy. Our study revealed that waste valorisation will create job opportunities, generate revenue and reduce the amount of waste sent to landfills. It can also help attract skilled workers and establish an efficient management system. We showed that a sustainable MSWM system and maximising waste benefits could only be achieved through strategic partnerships with key stakeholders, including informal service providers. The government, private sector actors (visible and invisible), civil society, development partners and the public all have a critical and indispensable role in any sustainable MSWM system.

It is crucial to improve integration and coordination among the various concerned parties. Each agency's responsibilities should be clearly defined to avoid confusion and duplication of effort. Partnerships should be formed among the Central Government, local authorities, NGOs, the community and industry. The current waste management experience has shown that formal organisations alone cannot cope with urban waste's increasing volumes, complexity and diversity. To address these challenges, a partnership approach is necessary, supported by an appropriate framework that assigns responsibilities for effective waste management. An Integrated MSWM System is needed in urban centres, with private-public partnerships encouraged so that the private sector can establish recycling centres, landfills and incinerators designed to engage women and young people.

Continuous monitoring of finances and analysis of financial data is crucial in keeping track of financial flows and responding promptly to any threats to financial sustainability. However, a literature analysis reveals that the issue of financial sustainability is seldom raised in waste management sustainability discussions. Our study offers valuable insights to local authorities seeking to evaluate the effectiveness of their SWM systems. Whether services are public or private, conducting regular cost-revenue analysis is fundamental to avoid the sudden surprises of a PPP failing due to financial deficits. In the case of insufficient revenues to cover costs, there are two fundamental options: to reduce the cost or increase the revenues. When calculating future revenue streams, it is essential to elaborate a precise business plan based on reliable data and realistic assumptions. Often, measures such as tariff changes or road infrastructure improvements to reduce vehicle maintenance costs are not within the competence of private enterprises but fall into the power domain of governmental authorities. Additionally, municipal authorities remain responsible as the contracting body and must have sufficient understanding and capacity to perform their client function. Therefore, a sound alliance between the municipality and the private enterprise is crucial to developing and implementing appropriate solutions that enhance the SWM system's financial sustainability.

SECTION 9

THE CHALLENGES FACING THE WASTE INDUSTRY IN ACCRA

Key Takeaways

- Only 10 per cent of waste is collected and disposed of safely. Ineffective collection and disposal processes are primarily attributed to poor waste conceptualisation, conflicting policies, overlapping regulatory functions, and financial and infrastructural gaps.
- Accra needs dedicated employees to conduct research and analysis to gather nuanced data on the volume and content of waste in Accra to enhance management strategies. Additionally, health, environment, and enforcement officers need to be involved to ensure compliance and public awareness of SWM practices.
- Overlapping responsibilities and unimplemented guidelines for environmental protection, composting, and waste valorisation initiatives limit the ability of service providers to meet demand and work effectively.
- Accra should explore sustainable financing mechanisms and comprehensive economic incentive policies, as limited financial support is a setback for companies and individuals engaged in recycling and reuse.
- Municipal authorities and service providers should increase incentives to standardise treatment and sustain waste pickers, thus improving their conditions and efficiency in resource recovery. Further, there is a need to develop inclusive and sustainable SWM governance against the systemic and institutional discrimination faced by informal service providers.

Our research has revealed several challenges that hinder the sustainability of MSWM in Ghana. For instance, Ghana generates about 12,710 tonnes of solid waste daily. Unfortunately, the prevalent SWM practices involve mixing household and commercial waste with hazardous waste during storage and handling. Waste storage facilities, such as storage containers, are often old and poorly managed, while the transportation system is inadequate and informal. We discovered that only 10 per cent of the waste generated is collected and properly disposed of. This means that most of the waste is disposed of predominantly through uncontrolled dumping, open-air incinerators, and landfills, which lead to air, water, and soil pollution. This poor waste management system has also been a significant cause of floods in major cities in Ghana.

Ghana has made significant progress at the national level in addressing the growing waste menace. In 2020, the country developed a SWM Strategy to achieve progressive, high-quality, cost-effective, and sustainable SWM services, providing all environmental, public health, and economic benefits. The government has also established a Circular Economy Roadmap and Action Plan and the National Action Roadmap to provide guidelines for managing plastics throughout their lifecycle. The UNDP has played a crucial role in promoting a zero-waste and circular economy and supporting the government's efforts. UNDP helps municipalities adopt integrated planning and programming for SWM through its Zero Waste Offer programme. As discussed, UNDP has established the Waste Recovery Platform, which has over 500 members and promotes waste recovery in a larger circular economy context, working with stakeholders across the SWM value chain (Adodoadji-Dogbe, 2023).

Despite the many initiatives, waste disposal remains a major challenge for most city authorities. The ineffective collection and disposal processes are primarily attributed to poor waste conceptualisation, conflicting policies, overlapping regulatory functions, and financial and infrastructural gaps. To achieve a zero waste and circular economy, deliberate and systematic measures, some of which are discussed below, must be taken. This will not only help to create job opportunities but also conserve resources and reduce greenhouse gas emissions.

9.1. Poor conceptualisation of and disparate waste initiatives

> *Cities should respect nature, consider the urban ecological environment as an asset, integrate environmental issues into urban planning and administration, and accelerate the transition to sustainable development. They should promote the use of renewable energy sources and build low-carbon eco-cities. They should strongly advocate for the conservation of resources and promote environment-friendly manufacturing. Cities and their citizens should unite to create sustainable lifestyles and an ecological civilisation in which people and the environment coexist harmoniously.*
>
> Shanghai Declaration on Better Cities, Better Life

Our analysis shows that the city authorities' approach to (or conceptualisation of) MSWM tends to regard waste as a problem that must be resolved with funds and logistics instead of seeing waste as a

resource to harness. Such misconception significantly explains why stakeholders in the waste industry blame the scarcity of funds and logistics as the main obstacles to MSWM. Undoubtedly, securing adequate funding to guarantee access to basic infrastructure is essential for the industry's day-to-day operations. Nevertheless, we demonstrate that, aside from finance and logistics, the SWM challenge is also about having the requisite qualified human capital and professional personnel to execute critical tasks along the waste value chain of activities.

Officials of the WMD, in particular, attributed the paucity of human resources to the industry's current supervisory roles and responsibilities, which 'oscillate' between several ministries (MLGRD, MSWR, and MESTI, etc.). The participants alleged that their waste department had been denied retooling since that unholy alliance with the MSWR. The lack of crucial waste management personnel, including civil and chemical engineers, makes it difficult for them to operate effectively. The situation has negatively affected the WMD's ability to proffer professional advice on, for example, the suitability of planned MSWM equipment or the sitting, design, construction, and maintenance of appropriate disposal facilities. These are expert-led capital investments, but most assemblies lack this requisite expertise.

City authorities must not only build the human resource capacity of the staff but also try to encourage a fundamental change in the mindsets and attitudes of the citizenry toward waste. Public information campaigns need to encourage residents to help reduce the waste stream and to turn what used to be considered "waste" into "resources." This must be guided by the fact that resources can be recovered from waste (see Table 9.1) if they are separated at the source and treated correctly. Authorities must promote sustainable production and consumption practices to separate economic growth from waste generation. Educating citizens on reducing and reusing resources, segregating and recycling waste, and adopting sustainable lifestyles are equally important. Indigenous knowledge and practices that promote reduced waste production and nature regeneration should also be utilised. Moreover, investments should be directed towards businesses and public initiatives prioritising waste

prevention, redesigning, reuse, recycling, recovery and regeneration. Such activities are often underfunded but vital in achieving zero waste and a circular economy.

For several reasons, cities should strive to improve resource efficiency in their local economies. From an environmental standpoint, efficient use of resources can reduce environmental burdens such as urban air and water pollution, floods caused by solid waste clogging drainage canals, reduced availability and quality of freshwater supplies, and land degradation. High pollution levels that may pose a public health risk and result in economic costs can also be minimised. Efficiency measures can significantly decrease greenhouse gas emissions from energy generation and use, materials extraction and processing, transportation, and waste disposal. This implies that cities and countries that excel in resource efficiency can benefit from win-win solutions to meet international obligations on climate change.

9.1.1. Lack of disaggregated (updated) data for planning purposes

From our study, the lack of more nuanced data on the volume and content of waste constrains the planning and organisation of municipal waste operations. To overcome this challenge, our study revealed that the WMD needs more qualified officers who routinely undertake waste-related research and update relevant data. The department must constantly gather and update its data regarding the volumes and content of waste generated and residents' characteristics and disposal practices. Thus, acquiring accurate waste generation and composition data would help determine appropriate SWM strategies. Indeed, the continuous preponderance of organic materials and recyclables in the waste streams suggests that composting and recycling are both appropriate disposal options for the bulk of Accra's waste.

Other professionals, including environmental health, administrative, and legal officers, must enforce existing by-laws to promote these waste disposal options. Additionally, mixed-waste disposal must be discouraged, while households must be encouraged to separate waste at source. When local authorities cannot undertake local research, partnering with local research institutions may be a plausible option to generate data for planning purposes. As much as possible, the local authorities

must resist situations where MSWM strategies are based on siloed waste quantity and composition values acquired from poorly structured sampling points. The authorities must implement appropriate plans to promote source separation and reduce waste at generation points (World Bank, 2018).

Suffice it to add that though the WMDs need more qualified technical staff, the current conditions of service, coupled with their continuous stigmatisation and marginalisation, make jobs there unattractive. Our analysis revealed that the relationships between the authorities, waste generators, and other stakeholders leave much to be desired. On the ground, the waste generators had knowledge limitations on MSW matters. This contradicts the tenets enshrined in the Local Government Act (Act 924 of 2016), which mandates the local authorities to effectively involve all the stakeholders in creating proper environmental management. The study found weak law enforcement on the part of the city authorities, which, more appropriately, could be a cause-consequence factor in the public's obedience and participation and, thus, an indicator of the system's accomplishments rate.

Developing inclusive and sustainable SWM governance in cities is crucial to tackling waste-related challenges and unlocking the potential of waste as a resource. To achieve this, governments should create inclusive governance systems by partnering with and strengthening the capacity of stakeholders in the MSWM sector. These partners can include the private sector, waste pickers, and waste entrepreneurs. By actively engaging with these groups, sustainable MSWM practices can be implemented. Furthermore, the establishment of multi-stakeholder platforms like UNDP's flagship Waste Recovery platform and the National Plastics Action Partnership (NPAP) provide the necessary spaces for different stakeholders to come together and collaborate towards achieving zero waste and a circular economy.

9.2. Overlapping (mixed) responsibilities and guidelines

There is a growing concern about poor environmental sanitation in sub-Saharan Africa. In particular, South Africa, which has 11 out of the 15 most polluted cities on the continent, is a warning sign for countries in the region (Olowole, 2022). According to the polluted cities' rankings, Bamako in Mali is the most polluted city in Africa, followed by Sebokeng in South Africa and Accra, Ghana. Accra's

position was alarming, compelling the city authorities to respond by implementing several strategies to reverse the trend. These include formulating a national waste regulatory framework, generating waste data and inventories, and improving infrastructure and capacity building. While these initiatives represent positive steps towards improving the waste industry, our analysis indicates potential fundamental obstacles that may limit their effectiveness. These include the creation of overlapping ministries, an over-reliance on legislation, and the adopting of policies from developed countries without considering the local political, cultural, and socio-economic context of SWM issues.

Functionally, Accra's SWM framework is anchored on 'multiple ministries' with varied roles, responsibilities, competencies, and interests. As discussed earlier, this fragmented governance institutional structure comprises MESTI, MSWR, and MLGRD, each with specific responsibilities for different aspects of SWM, albeit not necessarily based on specialisation. These ministries technically work on waste-related matters independently. The MESTI, for instance, is responsible for plastic and e-waste handling, which is also bestowed exclusively to MSWR, which, per their mandate, is "to act and play a significant role in the national, regional and global effort to provide the needed support to the sanitation and water sectors". Until its establishment, the water sector was part of the Ministry of Water Resources, Works and Housing, and the sanitation sector was part of the Ministry of Local Government and Rural Development. The goal of the new Ministry is "to contribute to improvement in the living standards of Ghanaians through increased access to and use of safe water, sanitation and hygiene practices and sustainable management of water resources."

Granted, MESTI is only playing a policymaker role, as argued by some public officials, which unit at the local level is expected to implement the ministry's (MESTI) policies since, administratively, MESTI has neither regional nor local structures. The fragmented structural approach inadvertently affects the industry's governance framework and the human resources, policies, budgets, and efforts to manage waste sustainably at the local level. Further, with the present framework, the need to strengthen the human resource capacity at the local level where MSWM policies are to be implemented and monitored becomes imperative. However, according to the present arrangements,

only the metropolitan assemblies are legally entitled to establish WMDs for implementing waste policies. Based on this directive, of the 25 MMDAs forming GAMA, only two (2) [AMA and TMA] qualify for WMDs. The others rely on their environmental health units for addressing MSWM issues as if, technically, competencies do not matter in such jurisdictions. Today, we have assemblies like Tema West, Osu, Adabraka, etc., whose solid waste issues are handled by environmental health officers who may need more capacity and skill. For these 23 MMDAs, the mandatory call on the assemblies to retain a 20 per cent in-house capacity enshrined in the NESP becomes an elusive wish.

Our findings further exhumed policy gaps within the legal regime, which can only hinder the quest for sustainable MSWM. For example, despite the inclusion of waste valorisation measures as a significant component of the National Strategic Document (NSD) of 2020, the requisite legislative instrument (LI) needed to actualise the strategy remains a dream. The same can be said of the absence of guidelines to help institute compost as an alternative waste disposal strategy and establish and enforce waste separation at the household level as a policy. The irony is how these strategies have been given space in the NESP document, which generally described these as indispensable pre-conditions for efficient waste valorisation. The situation appears paradoxical because the AMA's climate change action plan advocates for source separation and material recovery. Operationally, the signs do not exude confidence. Despite the many political mantras regarding the indispensability of waste segregation in our quest for sustainable MSWM, our study revealed that very little has been implemented on the ground as service providers do not provide separate containers for separate waste or different collection vehicles for all waste streams. Our analysis raised genuine questions regarding whether the existing recycling and composting companies can handle the amount of waste generated within the city. Per the current architecture, Accra risks a waste glut.

9.2.1. Public-private partnership

The public-private partnership in MSWM in Accra is not practical. Our analysis has revealed that there are only formal contracts between the public and private sectors for waste collection and disposal services. Awarding such contracts is not transparent and lacks a laid down procedure. The

MMDAs, which are legally supposed to monitor the service providers at the local level, are separate from the process. The award of contracts is done at the national level without the officers, including the "Municipal CEOs," being informed of the contract terms before they are signed. This practice is unhealthy, leading to a state-sponsored monopoly by one company with direct access to the presidency and the power brokers on the Ghanaian waste industry scene. The informal waste operators who were interviewed also emphasised this point. Any waste policy that does not benefit this company is likely to fail.

Recycling in Accra is mainly done by informal waste collectors who use outdated techniques and ignore environmental protection. This makes waste recycling a complex process requiring skilled human resources, advanced technologies, reverse logistics, and recycling targets. Adopting environmentally friendly approaches, promoting public-private partnerships and fostering stakeholder collaboration is necessary to achieve this. Despite the importance of waste recycling, it has yet to gain priority in Accra and is still in its nascent stage. Only a few waste streams, such as cans, paper, PET bottles, and metals are processed. Accurate data on the quantity of waste recovery and recycling is necessary for planning purposes, but unfortunately, such quantitative data is lacking. This makes it difficult to understand the magnitude of the waste problem and gauge the efficiency of the recycling industry. As a result, waste policymakers need help making informed decisions regarding the recovery and recycling of waste in Accra.

Our research emphasised the precarious situation and tenacity of waste pickers. Our respondents shared stories of how the city's institutional systems discriminate against or completely disregard informal service providers or waste pickers. Even though official reports state that 99 per cent of SWM in Accra is officially franchised to formal service providers, these providers seem to be struggling due to the city's rapid urbanisation, changing waste volume and content, and the government's inability to pay for the services they provide. This has hurt their service provision. On the other hand, the evidence shows a thriving informal waste sector that expertly handles the mess and fills the gap created by the receding formal sector at almost no cost to the authorities. However,

this sector is still marginalised, negatively labelled, and disrespected. This lack of recognition for waste pickers' contribution prevents them from unleashing their full potential towards modernising the MSW system. It leaves them in constant fear of losing their livelihoods and means of survival at any time.

According to a recent study by Oduro-Kwateng et al. (2021), the informal sector (including waste pickers) contributes significantly to waste collection in Accra by accounting for about 51 per cent of the total waste collected. While some interviewees advocate integrating the informal operators into the city's SWM arrangements, others criticise the authorities for their negative perception of the sector. Integrating these informal waste pickers into the system could create more opportunities for local government support, ensure reliable data flows, and facilitate inclusive decision-making (Oduro-Appiah et al., 2019). Unfortunately, policymakers have not supported this sector, neglecting infrastructure and service contracts. This lack of support has resulted in the waste pickers being marginalised and increasing their precarity. Moreover, they are often unfairly labelled as thieves, unimportant, and dirty.

Accra has made some progress in developing policies for SWM, but implementing these policies could be improved. To ensure practical recycling activities, it is necessary to provide industry staff with adequate training and involve all stakeholders in the process. Suitable incentive packages can help improve the basic MSWM infrastructure, such as waste sorting facilities, which may help respond to the anticipated future growth in waste generation. The city can learn from the experiences of other countries, such as Brazil, Colombia, Chile, and the Philippines, where policies and legal frameworks towards formalising and integrating the informal waste sector have been translated into successful organising. This has often resulted in the forming co-operatives, business associations or waste picker unions (Medina, 2000; Silva et al., 2017). Integrating the informal waste sector into the formal SWM system can be a sustainable, win-win solution, as modest success in organising and external support has been demonstrated.

9.2.2. Lack of economic incentives and financial sustainability

Managing solid waste is an expensive process, especially in developed economies. Governments offer subsidies, impose levies, and set up drop-off centres to promote recycling. Companies are also given grants to establish recycling plants, and efforts are made to ensure that treatment plants can handle enough waste for cost-effective treatment. In Ghana, a 2013 UNDP report revealed that $3.45 million is spent annually on waste collection and transportation for disposal. Similarly, every year, illegal disposal issues cost about $290 million, equivalent to 1.6% of Ghana's GDP (Adodoadji-Dogbe, 2023). Proper financing of the waste sector would facilitate efficient SWM processes, sharing of technological knowledge and expertise, and ultimately reduce these costs.

Our study highlighted the need to establish sustainable financing mechanisms for waste management. This could involve exploring innovative financing methods, including public-private partnerships and joint ventures for micro, small, and medium-sized SWM businesses. Extended producer responsibility should also be implemented, and various tax mechanisms and differentiated waste tariffs should be explored. The limited financial support in Accra's SWM roadmap is a significant setback for companies and individuals involved in waste recovery and recycling activities. Although recycling plastics, PET bottles, beverage cans, paper, etc., has gained popularity, informal waste pickers and scavengers need recognition. As a result, only private recovery companies that buy recyclables from waste pickers and scavengers provide some incentives.

Our analysis reveals that the incentives provided by the service providers need to be increased to sustain the livelihoods of waste pickers. Moreover, these incentives need to be standardised in terms of their amount. The absence of recycling buy-back centres established by city authorities leaves waste pickers disorganised and unrecognised. These challenges hinder the establishment of efficient recycling initiatives, even though there needs to be a consistent incentive system for recycling activities to improve the environment sustainably. The inadequate economic incentives pose a challenge to enhancing efficiency. This makes implementing recycling guidelines even more crucial. Although the government has developed recycling policy guidelines, there are still some difficulties

in implementing them. As a result, the informal sector and a few formal companies continue to dominate resource recovery. All relevant stakeholders must make concerted efforts to change the industry's fortunes. This could be achieved by introducing a comprehensive economic incentive policy that must be periodically updated to respond to the dynamics in the industry, especially for recycling and reuse.

After analysing the fiscal sustainability of the waste industry in Accra, it has become clear that the current system could be more sustainable. The industry heavily relies on the generosity of development partners who provide capital investments and unreliable transfers from the Central Government. The city's environmental conditions would worsen without the informal operators working selflessly. The formal sector operates under contracts with financial releases from the government; however, their performance could be better and more reliable. Additionally, the cost of providing their services outweighs the compensation they receive. In contrast, the informal operators who face policy and infrastructural inadequacies fund themselves through client fees and operate more resiliently.

Notably, achieving a Zero Waste and Circular economy is crucial for addressing the Sustainable Development Goals (SDGs). In particular, it is essential to accomplish goals 12 on sustainable production and consumption, 13 on climate action, and 14 and 15 on life below water and land. The transformative shift towards this goal involves redirecting our focus from linear resource consumption to circular and regenerative practices. We can achieve this through efficient recycling, innovative product design, and collaborative partnerships across all levels of society. This approach can significantly reduce waste generation and conserve resources, creating a harmonious balance for people and the planet.

SECTION 10

RECOMMENDATIONS FOR POLICY CONSIDERATION

Key Takeaways

- Creating dedicated policy frameworks with systematic laws for SWM is crucial in ensuring that there are clear guidelines and objectives for waste management systems. This requires collaboration between both national and municipal authorities to harmonise policies and match best practices in the sector.
- Governance mechanisms must create opportunities for waste valorisation, integrate circular economy principles, and recognise and protect the informal sector in order to create an effective waste management approach.
- Limited data on SWM and the informal sector limits the ability of Accra to understand and assess its waste management needs. Implementing proper data collection will provide a more complete picture of SWM in the municipality, which will then lead to informed policy prescriptions that respond to citizen needs.
- Informal pickers play a crucial but underappreciated role in Accra's SWM. City authorities should work to reduce stigma around the informal sector while ensuring that workers are paid a fair price for their unique skills and flexibility, which complements the formal sector.
- City authorities need to improve public awareness about waste management regulations, environmental protection, and participation in waste segregation and recycling initiatives.

Further research is needed to explore the role of the informal sector as well as how private sector actors are addressing the limitations of traditional SWM models. Our study shows that MSWM is a critical responsibility of city administrators and an effective way to ensure good governance. Proper MSWM practices mitigate adverse health and environmental impacts, conserve resources, and improve the livability of cities. However, our research indicates that unsustainable MSWM practices, exacerbated by unplanned rapid urbanisation, financial constraints, and institutional limitations, hurt public health and environmental sustainability. In light of some of these challenges, city authorities in Accra are still struggling to manage their waste effectively. The authorities must adopt appropriate policy options to work towards long-term goals and provide an enabling framework to promote integrated SWM.

To save the city's environment from being engulfed by waste, especially plastics, and to improve their standing on the league table of polluted cities, the authorities have undertaken several initiatives with limited success. Our study has identified several reasons for these failures, as discussed earlier. As a result, we propose policy recommendations for consideration by the government and city authorities in search of an effective strategy that mitigates adverse health and environmental impacts, conserves resources, and improves the city's liveability. Since any functional SWM chain ultimately relies on interdependent linkages, the government and the city authorities must preserve a level-playing field that does not disrupt or impede the inclusive and impartial operationalisation of the tenets of the waste hierarchy in the long run. These policy recommendations include the following:

10.1 Create comprehensive and responsive policy and regulatory infrastructure

A recent study conducted in Ghana revealed that even though the country has various policies, institutions, and regulations to manage the environment, very few laws focus explicitly on SWM. Most legal frameworks besides the local bylaws established by MMDAs are based on aspects of the Public Health Act, which is inconsistent with international best practices and does not yield the desired outcomes. The city lacks comprehensive laws for managing the municipal solid and healthcare waste at national and local government levels. The absence of such laws makes implementing strategic, operational, and controlling practices for efficient SWM challenging. Strategic level practices show the direction for operational level practices, while controlling practices act as monitoring and evaluation mechanisms for strategic and operational level practices.

In 2020, Ghana developed the National Waste Management Strategy to lead the country towards efficient, cost-effective, and sustainable SWM services. The strategy is commendable in its ambition to improve SWM and transition towards a more advanced circular economy model. However, the actual performance and achievement of the targets and objectives remain limited. The strategy's success depends on the ability of local authorities to provide reliable SWM services. Many local authorities require assistance to achieve national aspirations and the inherent environmental, financial, and social objectives. To achieve the targets and objectives set by the national SWM

strategy, it is essential to extend services to underserved areas, increase recovery and recycling, and curb pollution quickly.

When the central-level waste policy goals cannot be achieved through SWM services at the local level, it becomes challenging to meet the set objectives. Such a gap can indicate a failure in institutional frameworks and the enabling environment. Often, central authorities consider SWM as a local function and beyond their mandate. As a result, line ministries do not see it as their role or practical to provide the necessary guidance, support, and resources to local authorities to implement national policy. However, central governments are responsible for setting the overall institutional, policy, and legislative framework of the MSWM sector.

To avoid power wrangling and overlapping roles and responsibilities among sister ministries, reduce duplication of efforts, and improve accountability, the study recommends reversing the SWM sector strategy to the previous single policy-making umbrella approach. Previous studies in Accra have shown that singling out plastic and electronic waste for tailor-made policies under a ministry (MESTI) negatively affects the holistic solid waste architecture (waste hierarchy). Therefore, it is imperative to harmonise the sector's policies to create a coherent and comprehensive approach to SWM that is progressive and aligned with modern SWM and recovery practices. Achieving this feat will help avoid power wrangling and overlapping roles and responsibilities, reduce duplication of efforts, and improve accountability.

Box 10. 1: Decentralised local government system and SWM arrangements in Ghana

Ghana is divided into administrative regions, each of which is further subdivided into district assemblies. These assemblies serve as the second-level administrative units. The assemblies are classified as Metropolitan, Municipal and District Assemblies (MMDAs) based on population size. Metropolitan areas have over 250,000 people, municipal areas have over 95,000 people, and district areas have a population of 75,000 or more. The MMDAs work under a decentralised local government system that is supervised by the MLGRD.

The Local Government Act (Act 462 of 1993, later replaced with Act 936 of 2016) mandates the MLGRD to entrust various MMDAs with SWM responsibility. However, the regulation of the environment, including SWM, falls under the purview of the EPA, which operates under the MESTI. The Assemblies are expected to create suitable by-laws to govern their local environment and establish local unit committees in their communities to effectively protect and manage their environment based on their local conditions.

To manage environmental sanitation services, including SWM, the Waste Management Department (WMD) was established in 1985. Figure 2 illustrates Ghana's decentralised

10.2. Instituting Sound Waste Governance

Effective waste management decision-making is a matter of governance. However, due to the lack of proper implementation of solid waste management (SWM) policies in the country, there are deficiencies in the governance of municipal waste. According to the MSWM policies, waste service providers from either the public or private sectors are involved in the governance of MSWM. Unfortunately, in most cities, the governance of MSWM is sub-optimal due to adverse political interference and weak bureaucratic structures in waste service providers.

Governance mechanisms must work collaboratively to address waste management challenges. At the national level, the Ghana National Plastics Action Partnership has developed a National Action Roadmap to guide managing plastic waste across the product lifecycle. The UNDP has also mobilised private operators in the waste management value chain to establish the Waste Recovery Platform, which aims to promote waste recovery in a larger circular economy. The platform convenes and integrates the interventions of the government, private sector, waste entrepreneurs, and waste pickers, mostly women and young people, to ensure no one is left behind. The platform is working with partners to unblock challenges in the sector by supporting innovation and entrepreneurship.

Furthermore, it is essential to form a working group comprising experts in the industry to assess the entire architecture, particularly the policy framework, and recommend appropriate legislative instruments and policies for waste valorisation. The legislative gap on waste separation and composting must be urgently addressed with all key stakeholders involved. An inclusively drafted legislative instrument on waste separation will attract the community's acceptability and buy-in and empower local authorities to enforce compliance and punish non-compliant households.

Furthermore, the city authorities should be allowed to create WMDs to build the needed human resource base and capacities for sustainable MSWM locally to implement the planned waste management policies. This could include but is not limited to retraining and retooling of existing staff or local personnel. There is a need for financial and logistical support for the formal and informal service providers to ensure the fiscal sustainability of the industry. In addition, the government must create a market for products such as compost to provide the industry's survival. For example, compost could be part of the inputs for the 'Planting for Food and Jobs' and the 'Greening Ghana' projects.

10.3. Increasing use of data and technology

Access to information, data, technology, and innovations in the waste industry is crucial for adopting an efficient and effective MSWM strategy. Collaborative partnership arrangements can be used to transfer technology, while multi-stakeholder platforms such as the UNDP Waste Recovery Platform and the Ghana National Plastic Action Partnership can be used to share data and information. The central government is also seeking to establish an Innovation Centre for a circular economy through the MESTI to harness and promote innovation in the circular economy, which will facilitate the process.

However, our study found that there is limited information on waste in general, and specifically, data on the informal recyclable value chain activities. Despite this, understanding waste generation rates, on-site handling, storage systems, collection and transport, processing, recovery, recycling and reuse, treatment, and final disposal is essential for an efficient MSWM system. Reliable estimates of waste generation rates and types are necessary for effective planning and better financial, regulatory, and institutional decisions. Such information is better guaranteed from sources where data collection is transparent and consistent over time, which is the link between good planning and good results. Inadequate data can provide misleading information, resulting in inadequately informed and even severely misinformed policy prescriptions.

Under the current circumstances and dispensation, there is over-glorification of landfills as a preferred waste disposal option without much attention to their associated highly potent methane emissions,

which are currently inadequately regulated. The city authorities should establish the necessary infrastructure or improve and optimise the existing ones for waste valorisation. Our study shows that relying mainly on landfills is not a sustainable measure. Additional bins for waste separation with colour codes, collection equipment for separated waste, and plants for composting, recycling, and waste-to-energy conversion must be available. For example, compost and recycling plants could be part of the One District, One Factory policy.

10.4. Creating the right institutional structures

Establishing an effective SWM system requires a well-defined network of roles and responsibilities across all levels of government and local authorities. This network should include policy-making, strategic planning, regulatory enforcement, service operations, and finance. The institutional structure of a SWM system is critical to its success. Such a structure provides a framework that enables different institutions to work together to deliver services and infrastructure that align with national objectives while addressing local needs and limitations. Two fundamental components of an effective institutional structure for MSWM are a clear definition of roles and responsibilities at different levels of government and open collaboration, coordination, and communication between institutions.

Our research has shown that many informal workers, including waste pickers and scavengers, are involved in the downstream packaging waste recycling industry. However, a lack of documented information on their activities makes determining their contribution to waste diversion rates difficult. Therefore, it is essential to integrate the informal sector into the formal sector to improve their efficiency in collecting and recycling waste. Local authorities can use the informal sector's broader coverage and more efficient waste collection methods to implement a waste separation policy. This policy should incentivise the informal sector to collect waste only from households that have separated their waste.

To make this approach work, targeted educational campaigns must sensitise families on source separation. Before implementing this policy, guidelines, policies, and colour codes for different waste

streams must be developed. This initiative will encourage the adoption of a comprehensive SWM system and prevent concerns of unequal treatment within the industry. Local authorities are responsible for managing solid waste, including collection and disposal services. Bylaws and regulations define the role of local governments in SWM, and their success depends upon user satisfaction, approval from higher authorities, and financial feasibility. Local authorities must prioritise the needs and demands of SWM and consider the needs and priorities of all sectors. This way, they can ensure efficient and effective management of solid waste. To achieve proper MSWM, city authorities should enhance public awareness, create a constituency for environmental protection, and encourage active participation from users and community groups in local waste management.

10.5. Public participation and stakeholder engagement

Managing solid waste is crucial to maintaining a clean and healthy environment. The success of SWM relies heavily on the participation of all stakeholders, including citizens, waste collectors, and policymakers. Active involvement from these parties ensures that waste management policies and services receive the necessary support for effective implementation. Establishing a "social contract" between the public and authorities is crucial, where citizens accept and participate in SWM by following waste-handling guidelines and paying for services. Developing an effective SWM system requires considering all stakeholder perspectives. Local authorities can promote positive behaviours and attitudes that enable the system to function smoothly.

The ultimate goal is to create a sustainable and equitable public service that serves all stakeholders and produces positive social, environmental, and economic outcomes in the long run. To improve waste quality, involving all stakeholders in the decision-making process is necessary. This approach will help identify effective local interventions that reduce biodegradable waste and promote sustainable handling and treatment options. Furthermore, involving all stakeholders is vital to reduce the impact of climate change on the environment. To develop an effective waste management strategy, it is important to efficiently separate waste at the source and conduct a cost-benefit analysis of available options for collecting and treating organic waste. This will have a positive impact on reducing organic waste and minimizing biodegradation in landfills.

10.6. Adopt integrated policy instruments

To achieve the objectives of any MSWM system, it is necessary to take practical actions at all levels. Strategic policy measures and a favourable legislative environment are required, but the policies must be context-appropriate. Before implementing progressive policies towards sustainable resource management, it is important to establish an essential foundation for a SWM system by moving away from traditional disposal and towards reuse and prevention. It is feasible to address the market failures associated with poor SWM by integrating informal waste sectors. Many Latin American and Asian cities have successfully integrated their informal waste sectors by developing appropriate policies

and legal frameworks, leading to the formation of co-operatives, business associations, and waste picker unions.

Our research supports the integration of the informal sector in Ghana's MSWM architecture. The informal sector can be highly effective in collecting and diversifying waste away from landfills when provided with a supportive legal framework and working collectively. By harnessing the power of the people to increase recycling and diversion rates, it reduces the need for expensive, fixed, high-tech solutions. Recognising that MSWM varies between regions and neighbourhoods, it is crucial to consider the context and look for the simplest solution. In our view, the greenest cities of the future may be those that use adaptable and flexible approaches while taking advantage of the work the informal sector is already doing.

The differences in SWM drivers between the Global North and South are also apparent within cities. There are often two different contexts within cities. In low-income areas, waste collection services are often not provided, and individuals and families accumulate and then sell their recyclables for additional income. In contrast, residents in high-income areas receive a waste collection service, and their motivation for recycling is often related to greater environmental awareness. These differences must be noted when designing MSWM solutions. Imported systems, and even locally derived systems based on examples from the Global North, generally focus on only one SWM scenario, making it challenging to manage the multiple competing scenarios in many cities. There is often a bias towards the automation of MSWM services, with the application of the high technology solutions used in the Global North. Regardless of the practicality or scientific evidence against specific high-tech solutions, these are often sought after, thought to raise the city's bar and make it appear more sophisticated and modern. This leads to a misconception that working with the informal sector is a step backwards in urban development and modernisation.

Conflicts between private SWM companies, municipalities, and informal recyclers are common. Private companies prefer not to have waste-pickers on the landfill, which leads the waste-pickers to approach the municipality for help. However, municipalities usually lack experience supporting the

integration of formal and informal waste sectors. Despite the conflicts between these groups, new systems can emerge. For instance, the United Nations Development Programme (UNDP) initiated the Multi-Stakeholder Waste Recovery Initiative, demonstrating that public policies supporting organised waste pickers are crucial in promoting sustainable consumption and production patterns. Waste pickers possess unique skills and knowledge related to resource recovery, reuse, and recycling. Therefore, involving them in local SWM planning and partnerships for participatory waste governance is essential.

The insights show that policymakers must prioritise inclusive forms of MSWM to address poverty reduction, gender equality, safe and sustainable cities, human settlements, and sustainable consumption and production patterns. In addition, paying a fair price for the services provided by waste pickers, such as collecting and separating recyclables, will promote decent work and help achieve several United Nations Sustainable Development Goals. The UNDP's Initiative has shown that inviting waste pickers to the SWM planning and implementation table is vital to ensure participatory waste governance. This approach recognises waste pickers' resource recovery, reuse, and recycling skills and knowledge. It also involves paying them for the social and environmental services provided to the city and their communities. Inclusive practices can help achieve the ILO's seven essential securities for decent work and address several UN SDGs, including poverty reduction, gender equality, and sustainable consumption and production patterns. We believe policymakers can effortlessly implement low-hanging fruit measures such as prioritising the transition to inclusive forms of MSWM, negotiating contracts with waste picker organisations, and paying them a fair price for their services in collecting and separating recyclables, among other tasks in the short term. This will help them address legislative needs and infrastructural deficits in the medium to long term.

10.7. Adopt a Camp-Size Model (CSM) to MSWM

The CSM is a planning approach that aims to improve service delivery in marginalised urban areas by integrating waste management processes such as source separation, collection, recycling and disposal. It involves a participatory, bottom-up approach where planners engage with stakeholders to

facilitate democratic planning. The CSM is particularly important in integrating the informal sector, which provides waste collection and recovery services in communities with limited access to such services. These informal recyclers are rarely compensated for their services, even though they offer cost savings and form the foundation of the recycling supply chain, benefiting formal businesses and local economies.

The CSM provides a structured framework beyond waste collection to ensure quality and sustainability at a reasonable cost. It emphasises the need for socially, economically, and environmentally acceptable SWM that goes beyond traditional skip-picking. Unlike current arrangements, where service operators only haul waste containers to dumpsites without sweeping the surroundings, the CSM addresses household SWM problems and involves the public in waste management. It aims to promote environmental sustainability through circular resource management systems by reducing waste and conserving resources.

Under the CSM, areas with high waste generation, such as slums, markets, and stadia, are identified and segregated. Each area is then contracted out to a service provider or group of service providers to undertake constant waste collection, sweeping, clearing of gutters, and occasional fumigation to expel rodents. The operational cost is financed through crowdfunding, which is directly or indirectly passed on to all who reside in or use the services of the area. In low-income areas such as lorry stations or markets, all prospective beneficiaries may be mapped with the intent of roping them into the funders' network.

It is essential to adopt waste minimisation strategies, encouraging us to rethink our buying habits and help control unnecessary purchases. We should collectively refuse to buy over-packaged products or materials packaged in plastic bags and instead carry reusable bags while shopping. We can also reduce waste in our homes by using less plastic, buying in bulk, and packing with recycled paper. Reusing discarded items and reducing waste saves energy, time, and cost and protects the environment. If we cannot refuse, reduce, or reuse certain products, we should repurpose them and strive to repair items to decrease material consumption. Proper segregation of waste is also crucial and facilitates easy

decomposition. Composting biodegradable waste can transform it into nutrient-rich soil, which benefits individuals, the government, and nature. It is important to find solutions that apply to our unique problems in Ghana rather than always relying on solutions from the West. By appreciating and addressing our own challenges, we can create effective solutions tailored to our experiences and realities.

The above policy options and measures are actions that city leaders can consider to improve their MSWM practices. By implementing these measures, cities can enhance the living conditions of their citizens. Although each city may have unique SWM needs based on geography, population, and waste streams, universal policy directions can be applied. The options listed are not exclusive, and there could be more available. However, the focus is on the critical, cost-effective, low-hanging fruits, fundamental goals, and policy options that could significantly improve citizens' lives and improve cities.

Areas for Further Studies

The national sanitation strategic framework aims to set Ghana toward progressive, high-quality, cost-effective, and sustainable waste management services that deliver environmental, public health, and economic benefits to all. In pursuance of this objective, this study has shed light on how informal waste pickers are growing exponentially but still remain marginalised, unrecognised, and poorly understood. Indeed, the informal waste pickers' real potential within the waste industry (regarding economic benefits and environmental costs) and in supporting local authorities' desire for sustainable MSWM to guide long-term healthy urban development and living must be comprehensibly explored. Put differently; waste management has traditionally provided employment opportunities to the many urban poor in the informal sector.

Future studies must interrogate how these traditional models, which work mainly in parallel with state-led interventions, are faring today having come under pressure because they have failed to address the waste management crisis. This failure, coupled with the obvious lack of capacities of local authorities, has paved the way for formal private sector participation, where a complex interplay of

competing approaches have accompanied efforts of urban local bodies, civil society and the private sector (informal and formal) at finding a sustainable working solution. Analysing such complex relationship within the private sector players, and between private and public actors, will provide novel insights into the potential contribution of public–private partnerships for effective waste management in Accra and within the sub-Saharan region in general.

In appreciating the multiple logics, actors, and interests driving the MSWM conception, preparation, and implementation, we conceptualised MSWM as an integrated process through which diverse investment, planning, and governance arrangements are produced and mobilised in ways that transcend the city scale. Future studies should illuminate these dynamics by building on the analysis of the history of MSWM and drawing on case studies of informal waste management practices in Ghana. This is important because the co-production of strategies in the waste industry reflects the logic of togetherness, an ingredient needed for sustainable social service delivery. Future studies should help streamline the roles and responsibilities of state actors to eliminate duplications, as, in the long run, duplications are costly with little or no efficient results.

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Figure 11.1: Distribution of proposed landfill development sites for Ghana

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APPENDICES

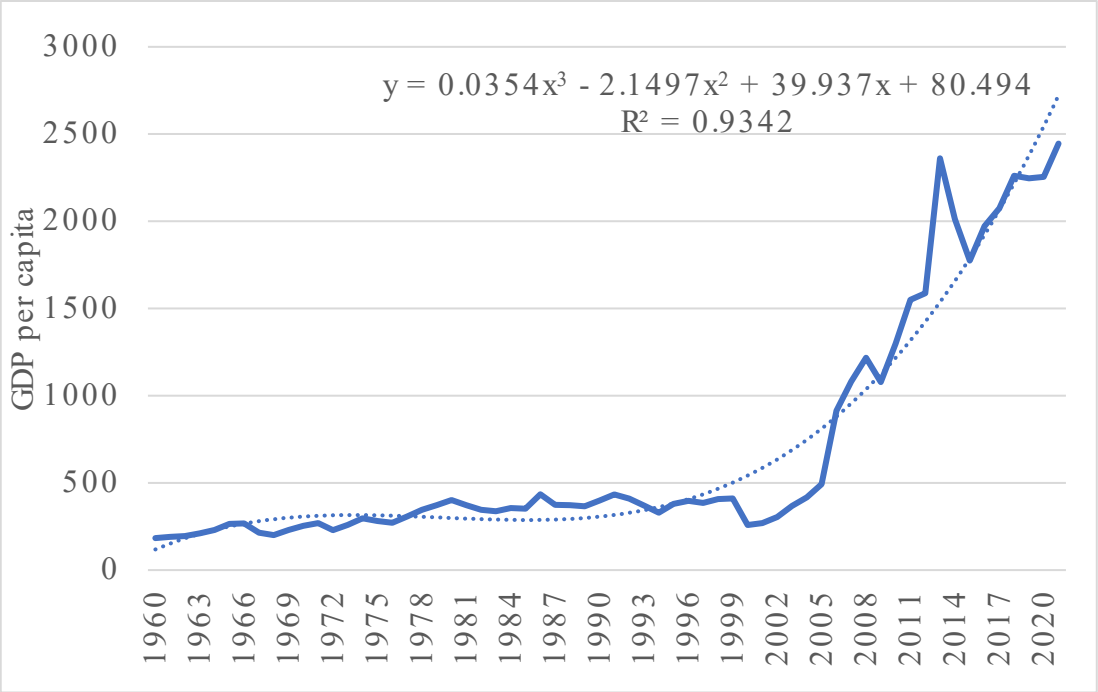
Appendix A: Potential risks associated with improper solid waste management

Improper handling of solid waste and indiscriminate disposal in open spaces, road margins, and tank beds can give rise to numerous potential risks to the environment and human health. Direct health risks mainly affect those working in the field without wearing gloves and uniforms. Many waste workers and individuals living near or on disposal sites are infected with gastrointestinal parasites, worms, and related organisms.

Indirect health risks to the public are related to poor water, land, and air quality. Infrequent collection of waste provides an attractive breeding ground for flies and rats. The most obvious environmental damage caused by solid waste is aesthetic, i.e. waste that litter public areas is unsightly and malodorous. A more serious risk is the transfer of pollution to groundwater and land and air pollution from improper waste burning. Many waste activities generate greenhouse gases; landfills produce methane and refuse fleets are significant carbon dioxide and nitrous oxide sources. Open-burning dumpsites produce volatilised heavy metals (e.g. mercury and lead), dioxins, and furan.

Leachate from unlined and uncovered dumpsites contaminates surface and groundwater. A damaged local environment will first hit the most vulnerable groups of society, those who lack the resources needed to reduce the adverse effects of a degraded environment. In addition, people living under poor circumstances are also directly dependent on their close natural environment for their daily survival.

Appendix B: Model for calculating the Trend of Ghana's GDP per capita from 1960 to 2020



Ghana's GDP per capita from 1960 to 2020. NB: 1960 is the base year ($x = 1$).
Data Source: World Bank.

The non-linear regression equation (Figure A) was used to project the GDP per capita for the years 2021 to 2050. The proxy waste generation rate per cap (PWG_{cap}) was estimated using Equation 1 from Kaza et al. (2018, p 26).

$$PWG_{cap}\ (kg/yr/cap) = 1647.14 - 419.73\ln(\text{GDP per capita}) + 29.43\ln(\text{GDP per capita})^2 \quad \text{Eq. 1}$$

The projected waste generation for a target year was estimated using Equation 2.

$$\text{Projected waste generation}_{\text{target year}} = \frac{PWG_{\text{cap (target year)}}}{PWG_{\text{cap (base year)}}} \times \text{Actual waste generation}_{\text{base year}} \quad \text{Eq. 2}$$

The actual waste generation (base year) was obtained from Miezah et al. (2015).

Appendix C: Projected tonnages and proportions of waste fractions in the GAMA from 2015-2050

Year	Daily quantity (tonnes/d)	Organics	Paper	Plastics	Metals	Glass	Textiles	Leather and Rubber	Inert	Miscellaneous
2015	2,869	1864.5	152.0	298.3	88.9	80.3	57.4	60.2	149.2	117.6
2016	3,043	1978.1	161.3	316.5	94.3	85.2	60.9	63.9	158.2	124.8
2017	3,234	2102.2	171.4	336.4	100.3	90.6	64.7	67.9	168.2	132.6
2018	3,365	2187.3	178.4	350.0	104.3	94.2	67.3	70.7	175.0	138.0
2019	3,446	2239.6	182.6	358.3	106.8	96.5	68.9	72.4	179.2	141.3
2020	3,539	2300.4	187.6	368.1	109.7	99.1	70.8	74.3	184.0	145.1
2021	3,637	2363.7	192.7	378.2	112.7	101.8	72.7	76.4	189.1	149.1
2022	3,741	2431.3	198.2	389.0	116.0	104.7	74.8	78.6	194.5	153.4
2023	3,851	2503.3	204.1	400.5	119.4	107.8	77.0	80.9	200.3	157.9
2024	3,967	2578.2	210.2	412.5	123.0	111.1	79.3	83.3	206.3	162.6
2025	4,064	2641.3	215.4	422.6	126.0	113.8	81.3	85.3	211.3	166.6
2026	4,162	2705.2	220.6	432.8	129.0	116.5	83.2	87.4	216.4	170.6
2027	4,261	2769.8	225.8	443.2	132.1	119.3	85.2	89.5	221.6	174.7
2028	4,362	2835.2	231.2	453.6	135.2	122.1	87.2	91.6	226.8	178.8
2029	4,464	2901.5	236.6	464.2	138.4	125.0	89.3	93.7	232.1	183.0
2030	4,567	2968.6	242.1	475.0	141.6	127.9	91.3	95.9	237.5	187.2
2031	4,672	3036.5	247.6	485.8	144.8	130.8	93.4	98.1	242.9	191.5
2032	4,778	3105.4	253.2	496.9	148.1	133.8	95.6	100.3	248.4	195.9
2033	4,885	3175.2	258.9	508.0	151.4	136.8	97.7	102.6	254.0	200.3
2034	4,994	3246.0	264.7	519.4	154.8	139.8	99.9	104.9	259.7	204.8
2035	5,104	3317.8	270.5	530.9	158.2	142.9	102.1	107.2	265.4	209.3
2036	5,216	3390.7	276.5	542.5	161.7	146.1	104.3	109.5	271.3	213.9

Year	Daily quantity (tonnes/d)	Organics	Paper	Plastics	Metals	Glass	Textiles	Leather and Rubber	Inert	Miscellaneous
2037	5,330	3464.7	282.5	554.3	165.2	149.2	106.6	111.9	277.2	218.5
2038	5,446	3539.7	288.6	566.4	168.8	152.5	108.9	114.4	283.2	223.3
2039	5,563	3616.0	294.8	578.6	172.5	155.8	111.3	116.8	289.3	228.1
2040	5,617	3651.3	297.7	584.2	174.1	157.3	112.3	118.0	292.1	230.3
2041	5,737	3729.2	304.1	596.7	177.9	160.6	114.7	120.5	298.3	235.2
2042	5,859	3808.3	310.5	609.3	181.6	164.1	117.2	123.0	304.7	240.2
2043	5,983	3888.8	317.1	622.2	185.5	167.5	119.7	125.6	311.1	245.3
2044	6,109	3970.7	323.8	635.3	189.4	171.0	122.2	128.3	317.7	250.5
2045	6,237	4054.0	330.6	648.6	193.3	174.6	124.7	131.0	324.3	255.7
2046	6,367	4138.7	337.5	662.2	197.4	178.3	127.3	133.7	331.1	261.1
2047	6,500	4224.9	344.5	676.0	201.5	182.0	130.0	136.5	338.0	266.5
2048	6,635	4312.7	351.6	690.0	205.7	185.8	132.7	139.3	345.0	272.0
2049	6,772	4402.0	358.9	704.3	209.9	189.6	135.4	142.2	352.2	277.7
2050	6,912	4493.0	366.4	718.9	214.3	193.5	138.2	145.2	359.4	283.4

Appendix D: Projected population and waste generation in GAMA from 2015-2050

Year	Projected daily waste generation (tonne/d)	Projected population			Projected waste generated (tonnes/day)		
		AMA	Ga Rural	TMA	AMA	Ga Rural	TMA
2015		2,076,546	1,086,268	483,745			
2015	0.699	2,343,240	1,226,827	535,781	1,638	858	375
2016	0.724	2,402,282	1,253,823	547,545	1,739	908	396
2017	0.752	2,462,215	1,281,356	559,555	1,852	964	421
2018	0.764	2,522,873	1,309,379	571,761	1,927	1,000	437
2019	0.765	2,584,191	1,337,891	584,182	1,977	1,023	447
2020	0.768	2,646,059	1,366,838	596,796	2,032	1,050	458
2021	0.777	2,698,335	1,382,344	601,643	2,097	1,074	467
2022	0.783	2,749,521	1,412,238	613,468	2,153	1,106	480
2023	0.791	2,799,584	1,442,637	625,484	2,214	1,141	495
2024	0.800	2,848,502	1,473,537	637,692	2,279	1,179	510
2025	0.804	2,896,255	1,504,942	650,095	2,329	1,210	523
2026	0.809	2,942,839	1,536,847	662,693	2,381	1,243	536
2027	0.814	2,988,252	1,569,256	675,488	2,432	1,277	550
2028	0.819	3,032,495	1,602,165	688,480	2,484	1,312	564
2029	0.825	3,075,583	1,635,574	701,671	2,537	1,349	579
2030	0.830	3,117,531	1,669,479	715,062	2,588	1,386	594
2031	0.836	3,158,361	1,703,878	728,654	2,640	1,424	609
2032	0.841	3,198,099	1,738,770	742,447	2,690	1,462	624
2033	0.847	3,236,773	1,774,150	756,443	2,742	1,503	641
2034	0.853	3,274,418	1,810,015	770,641	2,793	1,544	657

Year	Projected daily waste generation (tonne/d)	Projected population			Projected waste generated (tonnes/day)		
		AMA	Ga Rural	TMA	AMA	Ga Rural	TMA
2035	0.859	3,311,066	1,846,362	785,043	2,844	1,586	674
2036	0.865	3,346,756	1,883,185	799,649	2,895	1,629	692
2037	0.871	3,381,529	1,920,482	814,460	2,945	1,673	709
2038	0.878	3,415,424	1,958,245	829,475	2,999	1,719	728
2039	0.884	3,448,480	1,996,471	844,696	3,048	1,765	747
2040	0.891	3,407,964	2,035,155	860,122	3,036	1,813	766
2041	0.898	3,438,574	2,074,285	875,752	3,088	1,863	786
2042	0.905	3,468,482	2,113,864	891,587	3,139	1,913	807
2043	0.912	3,497,729	2,153,878	907,627	3,190	1,964	828
2044	0.919	3,526,358	2,194,325	923,872	3,241	2,017	849
2045	0.927	3,554,407	2,235,196	940,320	3,295	2,072	872
2046	0.934	3,581,918	2,276,483	956,972	3,346	2,126	894
2047	0.942	3,608,931	2,318,180	973,826	3,400	2,184	917
2048	0.950	3,635,482	2,360,279	990,882	3,454	2,242	941
2049	0.958	3,661,608	2,402,772	1,008,138	3,508	2,302	966
2050	0.966	3,687,346	2,445,649	1,025,594	3,562	2,362	991

Appendix E: Projected waste generation rates

Year	GAMA	Ghana	SS Africa	Global
2010	-	-		
2015	0.699	0.467		
2016	0.724	0.474	0.460	0.740
2017	0.752	0.481		
2018	0.764	0.488		
2019	0.765	0.496		
2020	0.768	0.503		
2021	0.777	0.511		
2022	0.783	0.518		
2023	0.791	0.526		
2024	0.8	0.534		
2025	0.804	0.543		
2026	0.809	0.551		
2027	0.814	0.559		
2028	0.819	0.568		
2029	0.825	0.576		
2030	0.830	0.585	0.500	0.825
2031	0.836	0.593		
2032	0.841	0.602		
2033	0.847	0.611		
2034	0.853	0.620		
2035	0.859	0.629		
2036	0.865	0.638		
2037	0.871	0.647		
2038	0.878	0.656		
2039	0.884	0.665		
2040	0.891	0.674		
2041	0.898	0.683		
2042	0.905	0.692		
2043	0.912	0.701		
2044	0.919	0.711		
2045	0.927	0.720		
2046	0.934	0.729		
2047	0.942	0.738		
2048	0.95	0.747		
2049	0.958	0.757		
2050	0.966	0.766	0.630	0.951

Appendix F: Waste fractions from a number of informal collectors

City Name	Nima & Kaneshie	Accra Central	Ablekuma Central			Labadi & Abbosey Okine	Ashiedu Keteku & Dansoman	Agbogbloshie Market
Mode of Transport	**Tricycle (%)**	**Borla Taxi (%)**	**Compactor (%)**	**Tricycle (%)**	**Borla Taxi (%)**	**Borla Taxi (%)**	**Compactor (%)**	**Market Waste (%)**
Organic Material	28.84	21.6	15.5	25.51	11.98	50.70	53.85	80.10
Wood	0.19	0.0	0.0	0.00	0.00	0.00	0.00	0.29
Plastics								
Plastic Film	22.41	23.7	24.6	18.25	13.31	18.47	19.08	6.57
PET	3.21	0.9	2.4	1.02	2.62	1.48	3.41	0.51
HDE	0.63	0.1	0.7	1.02	1.12	0.70	0.78	0.07
PP Rigid	0.05	0.1	0.4	0.00	0.00	0.43	0.36	0.27
PS	0.39	0.1	0.0	0.00	0.00	0.98	0.25	0.00
PVC	0.00	0.0	0.0	0.00	0.00	0.00	0.20	0.00
Metals								
Ferrous	0.49	0.6	1.5	0.34	0.79	0.00	0.14	0.27
Non-Ferrous	0.15	0.0	0.3	0.56	0.00	0.92	1.20	0.02
Glass / bottles	3.12	3.2	1.8	0.25	0.00	3.89	1.79	0.19
E-Waste	0.97	0.3	0.0	0.19	1.41	0.18	0.06	0.00
Paper & Cardboard	9.79	10.1	11.1	2.82	1.41	6.19	6.21	3.31
Leather & Rubber	0.49	0.0	1.1	1.55	2.50	2.54	0.62	0.02
Textiles	7.26	4.7	4.7	4.41	4.66	6.48	2.21	3.57
Inert material	20.70	26.2	32.0	40.10	58.65	5.78	9.85	4.23
Other waste	1.32	8.5	4.0	3.97	1.54	1.27	0.00	0.58
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

NB: Organic material consists of food and garden water; inert material consists of sand, ash, fine organics and demolition was

Appendix G: The Government of Ghana and the Plastic Industry

Interestingly, there is an Environmental Excise Tax in place in Ghana. This 10% levy on semi-finished and raw plastic materials and also some plastic products can be considered a form of Extended Producer Responsibility. Together with its predecessor (a 20% Ad Valorem on Plastics) it has been in place since 2011 and has by now accrued some GHC 912 million (about 157 million euros). The problem is, to date a fund secretariat has not been set up so the funds have been paid into the Consolidated Account of the Government. Efforts are underway to get the funds released so the plastics recycling industry can be supported as was originally intentioned. On May 7, 2019, the Ghana Plastics Manufacturers Association issued a press release to this effect. However, it is doubtful whether these funds will ever be released as they have probably been used for other purposes. Further demands included a ban on imports of flexible plastic bags and packaging and passing a Legislative Instrument on PET.

A noteworthy development is the Ghana Recycling Initiative by Private Enterprises (GRIPE), established in November 2017. The enterprise is a coalition formed under the Association of Ghana Industries (AGI) of eight multinational companies with a stake in the plastics sector to integrate sustainable waste management solutions, particularly around plastics. Member companies are Coca-Cola, Voltic, Unilever, Nestlé, PZ Cussons, DOW, Guinness Ghana, and Fan Milk. Activities include a public awareness campaign and education about plastic waste issues; placing waste containers in Accra and Tema; construction of a sorting centre in Tema; and a pilot project around plastic-modified concrete. Although these activities are laudable in themselves, the impression cannot be avoided that GRIPE was established partially to hold off a formal Ghanaian EPR system in packaging for as long as possible.

So, the situation in Ghana is: that there is a 10% Environmental Excise Tax on plastics, the proceeds of which do not feed into the plastics recycling sector. The Government does not have a timetable for the introduction of a formal EPR system on the packaging, and the big bottling companies appear to be holding off such a system (although rumour has it that they have suggested setting up a voluntary EPR system, but they wanted the Government to oblige all companies (including SME's) to become part of it). A solution may be to replace the 10% Tax with an EPR system monitored by Government and managed by the private sector. In that case, the funds could be channeled towards strengthening the plastics prevention and recycling sector.

Appendix H: A global overview of the plastic industry

Today's plastics are virgin – or primary from crude oil or gas. Global production of plastics from recycled – or secondary – plastics has more than quadrupled from 6.8 million tonnes (Mt) in 2000 to 29.1 Mt in 2019, but this is still only 6 percent of the size of total plastics production. More must be done to create a different and well-functioning market for recycled plastics, which are still considered substitutes for virgin plastic. Setting recycled content targets and investing in improved recycling technologies could help to make secondary markets more competitive and profitable.

Some key findings include the following:

- Plastic consumption has quadrupled over the past 30 years, driven by growth in emerging markets. Global plastics production doubled from 2000 to 2019 to reach 460 million tonnes. Plastics account for 3.4 percent of global greenhouse gas emissions.
- Global plastic waste generation doubled from 2000 to 2019 to 353 million tonnes. Nearly two-thirds of plastic waste comes from plastics with lifetimes of under five years, with 40 percent coming from packaging, 12 percent from consumer goods, and 11 percent from clothing and textiles.
- Only 9 percent of plastic waste is recycled (15% is collected for recycling, but 40% is disposed of as residues). Another 19 percent is incinerated, 50 percent ends up in landfill, and 22 percent evades waste management systems and goes into uncontrolled dumpsites, is burned in open pits, or ends up in terrestrial or aquatic environments, especially in poorer countries.
- In 2019, 6.1 million tonnes (Mt) of plastic waste leaked into aquatic environments, and 1.7 Mt flowed into oceans. There is now an estimated 30 Mt of plastic waste in seas and oceans, and a further 109 Mt has accumulated in rivers. The build-up of plastics in waterways implies that leakage into the sea will continue for decades, even if mismanaged plastic waste could be significantly reduced.
- Considering global value chains and trade in plastics, aligning design approaches and the regulation of chemicals will be vital to improving the circularity of plastics. An international approach to waste management should lead to all available sources of financing, including development aid, being mobilised to help low and middle-income countries meet estimated costs of EUR 25 billion a year to improve waste management infrastructure.

Appendix I: Total Cost for waste collection and disposal as captured by Jekora Ventures

JEKORA VENTURES

Transportation Cost of Waste Disposal

ESPA May 2022

A Main Independent Variables

a.1	**Location of Final Disposal Site:**	**Adipa/Nsumia in the Eastern Region**
a.2	Round Trip to Final Disposal Site (Multi-Lift):	94 kM
a.3	Round Trip to Final Disposal Site (Roll-On/Off):	94 kM
a.4	Round Trip to Final Disposal Site (Compaction Truck):	96 kM
a.5	Round Trip to Odorna Holding Point (Borla Taxi):	8 kM
a.6	Pump Price of Diesel as at 22nd September 2021	11.24 GHC/Ltr.
a.7	Average Density of Solid Waste:	0.50 MT/Cub. M

B Cost Calculation (Haulage Alone)

Item	Description	Multilift	Roll-On/Off	Compactor	Borla Taxi to Holding Point
b.1	Av. Laden Weight (MT)	6.00	11.50	13.50	2.50
b.2	**Rate per Tonne, GHC/MT**	**260.30**	**204.92**	**312.03**	**82.88**
b.3	**Cost per Trip to Adipa/ Nsumia (Long haulage Trucks) or Odorna (Borla Taxi), GHC**	1,561.82	2,356.57	4,190.77	207.19

C Cost Calculation [Combined Haulage (Borla Taxi + Long Distance Haulage Truck) to Final Disposal site]

Item	Description	Multilift	Roll-On/Off	Compactor	Borla Taxi to Holding Point
c.1	No. of Borla Taxi Trips Equivalent to Capacity of 1 Trip Long Haulage Truck	2.4	4.6	5.4	
c.2	Cost per Trip of Borla Taxi to Holding Point, GHC/Trip	207.19	207.19	207.19	207.19
c.3	**Cost of Borla Taxi Trips to Holding Point transported by Long Haul Equipment, GHC**	497.25	953.07	1,118.82	
c.4	**Cost per Trip of Long Haulage Truck GHC/Trip**	1,561.82	2,356.57	4,190.77	
c.5	**Total Combined Haulage Cost (Borla Taxi + Long Haulage Truck), GHC**	2,059.08	3,309.64	5,309.60	

D Combined Haulage to Final Disposal Site Calculation per Borla Taxi Trip

Item	Description	Multilift	Roll-On/Off	Compactor	Average
d.1	1 Long Haulage Truck Trip is Equivalent to Borla Taxi Trips	2.4	4.6	5.4	
d.2	**Total Combined Haulage Cost (Borla Taxi + Long Haulage Truck),GHC**	2,059.08	3,309.64	5,309.60	
d.3	**Service Charge per Borla Taxi Trip, GHC/Trip**	857.95	719.49	983.26	853.56

ISKORA VENTURES

SUMMARY: COST BUILD-UP FOR SOLID WASTE MANAGEMENT SERVICES HAULAGE ONLY ESPA May 20

A PRICE (GHC) OF EQUIPMENT INCLUDING CIF, DUTY, PORT HANDLING CHARGES AND FIRST REGISTRATION (Ready to Work)

	SOURCE	MULTILIFT (Double Axle) (441HP/324kW)	ROLL-ON-OFF (Double Axle) (340HP/250kW)	COMPACTION (Double Axle) (320HP/235kW)	Mini Dump Truck (Borla Taxi) (40HP/41kW)
a.1	EUROPE	1,000,000.00	1,080,000.00	1,320,000.00	
	CHINA				76,712.33

B. MONTHLY TOTAL COST (GHC) FOR SERVICE DELIVERY PER EQUIPMENT TYPE

	ELEMENTS OF COST BUILD-UP	MULTILIFT (Double Axle) (441HP/324kW)	ROLL-ON-OFF (Double Axle) (340HP/250kW)	COMPACTION (Double Axle) (320HP/235kW)	Mini Dump Truck (Borla Taxi) (40HP/41kW)
b.1	Fuel & Lubricants	25,841.55	39,231.71	30,511.91	2,195.96
b.2	Personnel (Direct Labour)	5,434.72	4,351.39	10,833.33	4,658.33
b.3	O & M (Operations & Maintenance)	13,804.08	16,845.92	14,686.76	2,674.99
b.4	Overheads	4,508.04	6,042.90	11,206.40	1,905.86
b.5	Working Capital Cost	14,876.52	19,941.57	20,171.52	3,430.54
b.6	Truck & Equipment Investment Cost	16,666.67	18,000.00	22,000.00	1,278.54
b.7	Pre-Tax Profit Margin including CSR	20,282.89	26,103.37	27,352.48	4,036.05
	TOTALS/AVERAGE	101,414.47	130,516.86	136,762.40	20,180.26
	Average Cost per Lifting (240 Ltr)	31.24	24.89	37.28	Highest due to added on
	Average Mthly Service Charge (240 Ltr)	138.82	106.92	161.98	cost from double handling

C. PROPORTIONAL BREAKDOWN OF COST BUILD-UP PER EQUIPMENT TYPE

	ELEMENTS OF COST BUILD-UP	MULTILIFT (Double Axle) (441HP/324kW)	ROLL-ON-OFF (Double Axle) (340HP/250kW)	COMPACTION (Double Axle) (320HP/235kW)	Mini Dump Truck (Borla Taxi) (40HP/41kW)
c.1	Fuel & Lubricants	25.5%	30.1%	22.3%	10.9%
c.2	Personnel (Direct Labour)	5.4%	3.3%	7.9%	23.1%
c.3	O & M (Operations & Maintenance)	13.6%	12.9%	10.7%	13.3%
c.4	Overheads	4.4%	4.6%	8.2%	9.4%
c.5	Working Capital Cost	14.7%	15.3%	14.7%	17.0%
c.6	Truck & Equipment Investment Cost	16.4%	13.8%	16.1%	6.3%
c.7	Pre-Tax Profit Margin including CSR	20.0%	20.0%	20.0%	20.0%
	TOTALS/AVERAGE	100.0%	100.0%	100.0%	100.0%

D. ELEMENTS OF COST BUILD-UP

d.1 Fuel & Lubricants — Diesel, Petrol, Engine Oil, Hydraulic Oil, Gear Oil, Grease, ATF, Brake Fluid etc

d.2 Personnel — Emoluments for Driver, Sanitary Labourer, Container, Labourer, Revenue Collectors, etc

d.3 O & M (Operations & Maintenance) — Tyres, Batteries, Preventive Maintenance, Repairs, Truck & Equipment Hire, Refuse Container Maintenance, Provision of Wooden Steps, Hand Tools, Protective Clothing, Tapauline, Insurance, Permits etc

d.4 Overheads — Administration, Management, Training, Public Sensitization, Public Relations & Education, Local Travels, Utilities, Legal & Audit Fees, Property Rates, Workmens Compensation, Rent for Office Space & Yard for Parking Equipment, Revenue Collection & Cost of Enforcement of Compliance etc

d.5 Working Capital — Bank Loans, Overdraft, Credit Facilities etc.

d.6 Truck & Equipment Replacement — Investment - Trucks, Solid Waste Containers etc.

d.7 Pre-Tax Profit Margin — Includes provision for Corporate Tax and Social Responsibility etc.

E. INDEPENDENT PRICES & RATES

e.1 Fuel Price

e.2 Minimum Wage

e.3 Cedi - Dollar/Euro Rate

e.4 Utilities Rates

e.5 Insurance Rates

e.6 Lending Rates

F. EFFECTS OF CHANGES IN INDEPENDENT PRICES & RATES ON ELEMENTS OF COST BUILD-UP

f.1 Fuel Price Change — Fuel & Lubricants Cost Adjustment

f.2 Minimum Wage Change — Personnel (Direct Labour) Cost Adjustment

f.3 Dollar Rate to Cedi Change — O & M (operations & Maintenance), Truck & Equipment Replacement Cost Adjustment

f.4 Utilities Rates Change — Overheads Cost Adjustment

f.5 Insurance Rates Change — Overheads Cost Adjustment

f.6 Lending Rates Change — Working Capital & Amortisation Cost Adjustment

1. Calculation excludes Cost of standard Refuse Bins, Transfer Station Fees, Landfill Disposal Fees & mtalic Refuse Containers

PROPOSAL FOR INCREAMENT IN SOLID WASTE COLLECTION RATES FOR YEAR 2022

Item	Description	Unit	Multilift (ML)			Roll-On/Off (R/O)			Refuse Compactor (RE)		
			2018	2021	% Increase.	2018	2021	% Increase	2018	2021	% Increase.
1	Average Round Trip	Km	72.00	94.00	31%	72.00	94.00	31%	74.00	96.00	30%
2	Average Round Trip Time	Min	140.00	180.00	29%	140.00	217.50	55%	280.00	360.00	29%
3	No. of Round Trips per Day	Trp	3.40	3.33	-2%	3.40	2.84	-16%	1.70	1.67	-2%
4	Average Working Hrs/Day	Hrs.	8.00	10.00	25%	8.00	10.00	25%	8.00	10.00	25%
6	Pump Price of Fuel	GHC/Ltr	4.50	7.00	56%	4.50	7.00	56%	4.50	7.00	56%
12	Annual Travel Distance	Km/Yr	72,131.70	91,556.00	27%	72,131.70	78,091.88	8%	43,568.60	46,752.00	7%

Notes

1 Normal Working Hours: 8 hrs/day

2 The ever increasing distance to the landfill may call for increase in the normal working time by 25% to 10hrs. /Day.

3 Minimum freequency of lifting refuse containers is once weekly

4 Imposed Rates are based on once weekly lifting

5 Since 2018 there has been no increament in the Imposed rates which otherwise. should have been by min 10% on an annual basis

OPTION 1

Rates (Ghc/Mth)		Base Year										
A	Commercial	2018		2019		2020		2021		2022		
	120/240 Litres	165.00		181.50		199.65		219.62		241.58		1.46
	1,100 litres	600.00		660.00		726.00		798.60		878.46		1.46
	12,000 litres	3,200.00		3,520.00		3,872.00		4,259.20		4,685.12		1.46
	23,000 litres	4,875.00		5,362.50		5,898.75		6,488.63		7,137.49		1.46
B	Domestic (240litre Bin)	2018		2019		2020		2021		2022		
	1st Class	110.00		121.00		133.10		146.41		161.05		1.46
	2nd Class	70.00		77.00		84.70		93.17		102.49		1.46
	3rd Class	30.00		33.00		36.30		39.93		43.92		1.46

PRICE ESCALATION

The price escalation formula to be used shall be as follows:

$$P/Po = 0.10(LL/LL_o) + 0.15(F/F_o) + 0.25(CO/CO_o) + 0.50(FE/FE_o)$$

Where:

- P, Po are the rates payable currently and as at the date of commencement of the Agreement respectively;
- LL, LLo are the indices for Local Labour, as published by the Ministry of Roads and Transport, currently and as at the date of commencement of the Agreement respectively;
- F, Fo are the indices for Fuel, Including Lubricants, as published by the Ministry of Roads and Transport, currently and as at the date of commencement of the Agreement respectively;
- CO, COo are the indices for Combined Consumer Goods, as published by the Ministry of Roads and Transport, currently and as at the date of commencement of the Agreement respectively;
- FE, FEo are the indices for Foreign Exchange, as published by the Ministry of Roads and Transport, currently and as at the date of commencement of the Agreement respectively.

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BENCHMARK Calculation of Fee/Rates (320HP/ 235kW Compaction Trk) ESPA May 202

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Type of Service	Door-to-Door		
Type of Equipment	Compaction TRUCK	Cont. (1,350x0.24m3)	
A **Annual Cost (¢) per Unit of Equipment**			(¢/Yr)
a.1 Fuel & Lubricants	366,142.89	0.00	366,142.89
a.2 Tyres & Battery	36,629.28	0.00	36,629.28
a.3 Preventive Maintenance	40,079.25	0.00	40,079.25
a.4 Repairs	25,742.57	0.00	25,742.57
a.5 Truck & Equipment Hire	5,400.00	0.00	5,400.00
a.6 Hand Tools, etc.	0.00	4,320.00	4,320.00
a.7 Driver (Pay, O'time, SSF, Tax & Bonus)	29,900.00	0.00	29,900.00
a.8 Sanitary Labourer (Pay, O'time, SSF, Tax & Bonus)	67,600.00	0.00	67,600.00
a.9 Container Labourer (Pay, T&T, Communication etc.)	0.00	0.00	0.00
a.10 Industrial Safety	9,750.00	0.00	9,750.00
a.11 Insurance, Rd. Worth, Permits etc.	50,000.00	0.00	50,000.00
a.12 Supervision	32,500.00	0.00	32,500.00
a.13 Miscellaneous	4,320.00	0.00	4,320.00
Sub-Total (Direct Expenses)	**668,063.99**	**4,320.00**	**672,383.99**
a.14 Overheads including cost of collecting Revenue (20%)	133,612.80	864.00	134,476.80
Working Capital Required	**801,676.79**	**5,184.00**	**806,860.79**
a.15 Cost of Working Capital/Interest on Working Capital (30%)	240,503.04	1,555.20	242,058.24
a.16 MVP Replacement	264,000.00	0.00	264,000.00
Sub-Total	**1,306,179.83**	**6,739.20**	**1,312,919.03**
a.17 Profit Margin (25% of Cost or 20% of Revenue)	326,544.96	1,684.80	328,229.76
a.18			0.00
Sub-Total (Sales Value)	1,632,724.78	8,424.00	1,641,148.78
a.19			0.00
a.20 **Grand Total Service Delivery Cost**	1,632,724.78	8,424.00	1,641,148.78
B **Unit Charges**			
b.1 Tonnes/yr	5,259.60	5,259.60	5,259.60
b.2 Cost per Tonne (¢)	310.43	1.60	**312.03**
C **Fees/Rates**			
c.1 Rate per Tonne, Haulage (¢)	310.43	1.60	**312.03**
c.2 Rate per Tonne, Transfer Station (¢)	0.00	0.00	**0.00**
c.3 Rate per Tonne, Landfill (¢)	0.00	0.00	**0.00**
c.4 Total Rate per Tonne, Haulage Only (¢)	310.43	1.60	**312.03**
c.5 Rate per Trip (¢)	4,190.77	0.00	**4,190.77**

D	Proportional Breakdown (Haulage Only)		
d.1	Fuel & Lubricants (a.1)/a.20	**22.3%**	
d.2	Direct Labour (Personnel) (a.7+a.8+a.9+a.12)/a.20	**7.9%**	
d.3	Other Operational Cost (a.2+a.5+a.6+a.10+a.11+a.13)/a.20	**6.7%**	
d.4	Repair & Maintenance Costs (a.3+a.4)/a.20	**4.0%**	
d.5	Overheads including cost of collecting revenue (a.14)/a.20	**8.2%**	
d.6	Cost of Working Capital (a.15)/a.20	**14.7%**	Based on Bills Payment 2 Mths after prefinance
d.7	MVP Replacement (a.16)/a.20	**16.1%**	
d.8	Pre-Tax Profit Margin (a.17)/a.20	**20.0%**	
	TOTAL	**100.0%**	

NOTES

1 240Ltr. collected Av. 4.35 x Monthly is equivalent to 240Ltr x 4.35 = 1,044Ltr = 1.044M3/Mth x 0.5 MT/M3 = 0.52MT/Mth

2 Mthly Svc. Charge = ¢4,116.66/ 112.5 x 4.35 = 161.98 GH¢/Mth Excl. cnt.cost

3 **Calculation excludes Cost of standard Refuse Bins, Transfer Station Fees, Landfill Disposal Fees & mtalic Refuse Containers**

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STANDARD OPS. PARAMETERS	Qty	Unit
Average Round Trip		km
Average Round Trip Time		min.
Average Working Hrs./Day		hrs.
Average Tonne per Trip		T
Pump Price of Fuel		GHC/ltr

	Qty	
Fuel Consumption		ltr./km
Tyre useful life span		km
Service Interval		km/svce.
No. of Working Days		d/mth
Availability		km/yr
Traffic Condition Factor		
Normal Traffic Flow condition Factor = 2		
Heavy Traffic Flow condition Factor = 1		

PREVENTIVE MAINTENANCE	Qty	Unit	Cost (GHC)/ Unit
Engine Oil (Change & Top Up)		ltr.	
Engine Oil Filter		pcs	
Secondary Fuel Filter		pcs	
Hydraulic Oil Filter		pcs	
Primary Fuel Filter		pcs.	
Long Shaft Bolts & Nuts		pcs	
Grease		kg	
Gear Oil (Change & Top Up)		ltr.	
Brake Fluid		ltr	
Engine Coolant		ltr	
Primary Air Cleaner Element		pcs	
Secondary Air Cleaner		pcs	
Washing incl. blowing radiator		wsh	
Blowing Air Cleaner		blw	
Workmanship (service)		svcs	
Miscellaneous			
ATF		ltr.	
Hyd. Oil (Change & Top Up)		ltr.	
Electrical Works		svcs	
Hoses & Pipes (Hyd. Air, Water etc)		svcs	
No. of Tyres (Set)		pcs/change	
Allignment & Repairs (Vulcanizing)			
No. of Batteries Used & Service		pcs	
PeriodicBody Works & Spraying:		GHC/mth	
Labour (Repairs)		GHC/mth	
Contigency (0%):		GHC/mth	
Total Monthly Figure:		GHC/mth	
DIRECT LABOUR			
Driver Salary			
sanitary labourer Salary			
Supervisor salary			
OVERHEADS RATE		%	
COST OF EQUIPMENT			
Compaction Truck		GHC	
Roll-On/Off		GHC	
Multilift		GHC	
Borla Taxi		GHC	
Refuse Container		GHC	
BANK INTEREST RATE		%	
PROFIT MARGING		%	

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Appendix J: Proposed Potential Landfill (Dumpsites) Site in Ghana

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