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Hazardous and Solid Waste Management Planning in Select African Countries

Emily E. Wilson, Susannah C. Davidson,
Andrew W. McDermott, and Angela B. Urban

March 2024



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Hazardous and Solid Waste Management Planning in Select African Countries

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Abstract

Managing wastes produced during contingency operations in United States Africa Command (USAFRICOM) locations has historically relied on local contract disposal or open-air burn pits, which have been shown to be harmful to the health of service members. Posture locations that can find alternative ways to manage waste, specifically through contracts with the host country's waste services, can better protect the health and safety of the warfighter and the native landscapes.

African waste systems are complex, decentralized systems with considerable regional variation. The lack of government-funded waste management services leaves many residents with few options for safe disposal. The differing waste disposal strategies are described to offer guidance for military operations in the focus countries of Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda. Relevant international agreements regulating the flow of hazardous waste across borders that can impact disposal plans are also noted.

This report serves as a reference to develop waste management alternatives in the USAFRICOM area of responsibility (AOR). Official Department of Defense and Army regulations should be consulted when devising an integrated waste management plan.

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Preface

This study was conducted for US Africa Command (USAFRICOM), Engineering and Logistics Support Division, under Project “Solid Waste Management Plans,” MIPR 0011406842. The technical monitor was Mr. Garth Anderson, environmental chief at USAFRICOM.

The work was performed by the Warfighter Engineering Branch of the Operational Science and Engineering Division, US Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL). At the time of publication, Mr. Jeffrey Burkhalter was chief, Warfighter Engineering Branch; Dr. George Calfas was chief, Operational Science and Engineering Division; and Mr. Jim Allen was the technical director for Operational Science and Engineering, Office of Technical Directors. The deputy director of ERDC-CERL was Ms. Michelle Hanson, and the director was Dr. Andrew Nelson.

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COL Christian Patterson was commander of ERDC, and Dr. David W. Pittman was the director.

1 Introduction

1.1 Background

United States Africa Command (USAFRICOM), with allies and partners, counters malign actors and transnational threats, responds to crises, and strengthens security forces to advance US national interests and promote regional security, stability, and prosperity.

USAFRICOM is authorized to establish posture locations (contingency locations and cooperative security locations) to meet mission requirements. As most of these locations are austere, they can pose waste management challenges from insufficient waste infrastructure. Because of the limited options for other waste management methods in these environments, the lead service components have historically used either local contracts or open-air burn pits to dispose of solid waste. Figure 1 provides an example of solid waste being burned within the USAFRICOM area of responsibility (AOR). Discarded items can include plastics, rubber, toxic chemicals, and medical waste, which create poisonous smoke and fumes when burned and can be inhaled by service members (Shane 2022).

Figure 1. United States Africa Command (USAFRICOM) solid waste burn site. Image courtesy of USAFRICOM. Public domain.



Studies on the impacts of open burn pits have shown that toxins emitted in the burning process may have negatively affected the health of over 3.5 million individuals. The full effect of the fumes on service members' health is dependent on the types of waste discarded, proximity to fire, and exposure frequency; however, some cases revealed correlations between low air quality and rare forms of cancer in those serving after 9/11 (Shane 2022).

Department of Defense Instruction (DoDI) 4715.19, *Use of Open-Air Burn Pits in Contingency Operations*, provides DoD's policy and guidance related to procedures for the health risk assessment for the use of open-air burn pits and the prohibition of the disposal of covered waste, except in circumstances in which no alternative disposal method is feasible (OUSD[A&S] 2018).

Updated DoD implementation policy issued in 2022 allows the temporary use of burn pits only with approval from the secretary of defense if it is the only feasible short-term option. As of January 2023, there were no burn pits operated by US forces in the USAFRICOM AOR.

The negative health impacts from burn pits can be avoided by planning for integrated waste management. While data about waste management services is limited in Africa, using the resources available nearby will better protect the service member.

1.2 Objective

This study provides practical guidance on waste management in the USAFRICOM region. The solid waste management systems of seven countries are described. Using the facilities present in country to dispose of solid and hazardous waste can serve as an alternative to open burn pits.

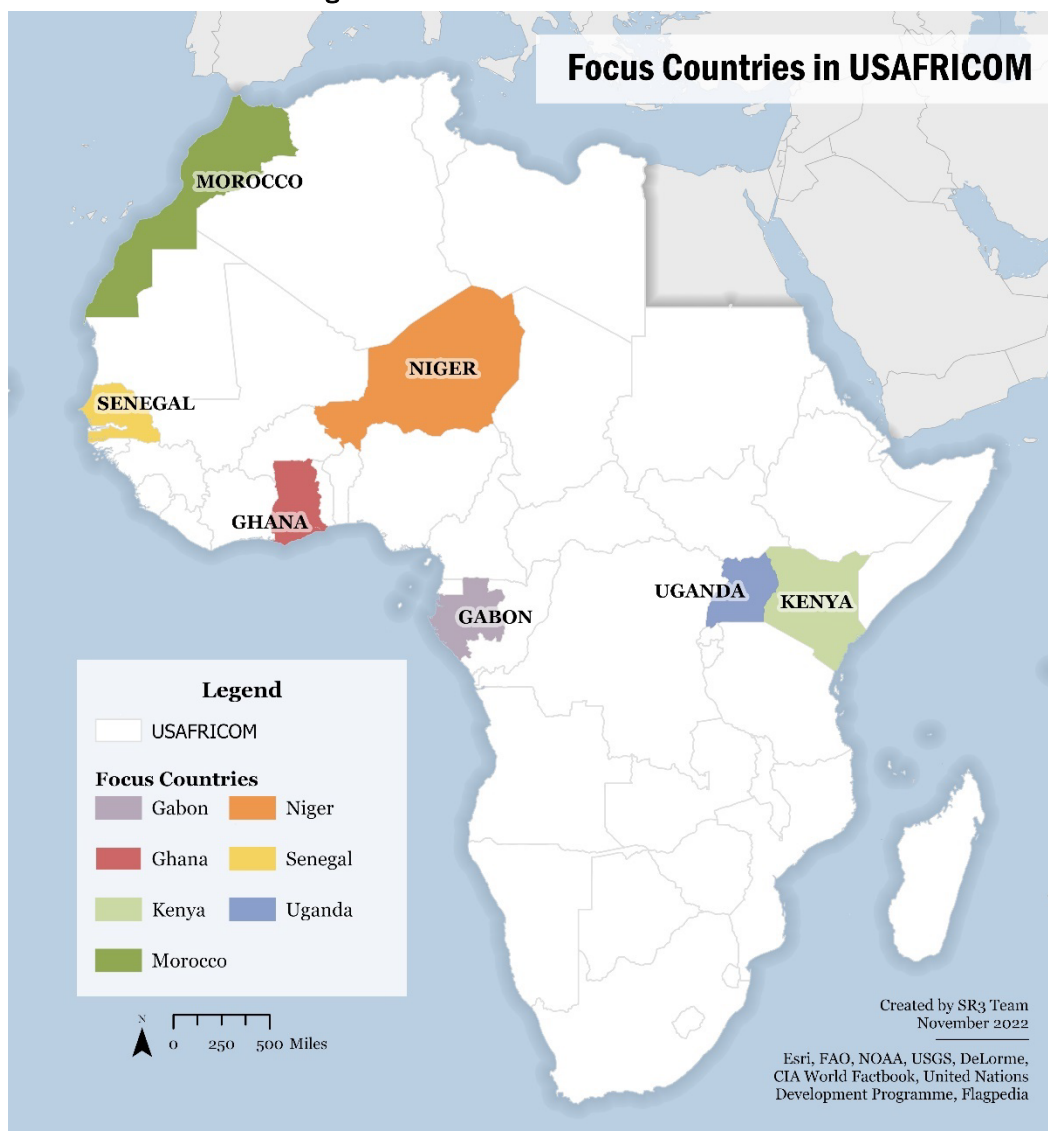
1.3 Approach

This study covers solid waste and hazardous waste management in the countries of Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda, which are shown in Figure 2. The team conducted research using academic articles, news media, nongovernmental organization research reports, internet sources, and data provided by international organizations such as the United Nations (UN) and World Bank. The topics for the study were international agreements that impact waste management, current systems

for solid and hazardous waste management in the selected countries, and the locations of waste management facilities in the selected countries.

When applicable, company names are provided for informational purposes only. The US government does not endorse any commercial company named in this document.

Figure 2. Focus countries in USAFRICOM.



1.4 Scope

The scope for this study shifted due to the COVID-19 pandemic. This study was initiated in 2019, and the research team was scheduled to travel to two locations in the USAFRICOM AOR in 2020. Because of the COVID-19 pandemic, travel was postponed and eventually canceled. The research team was planning on writing solid waste management plans (SWMPs) for each of the two locations visited and providing guidance on future SWMPs for austere USAFRICOM locations.

After it was determined that travel to Africa would not be feasible, the project manager worked with the project sponsor to determine an alternative course of action. The project sponsor identified seven countries in the USAFRICOM AOR for the research team to focus their efforts on. The countries selected for study were Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda. This study covers solid waste and hazardous waste management in the seven countries. Relevant international trade agreements that impact waste management in those countries are also included. The availability of information on waste management practices and waste disposal locations varied by country.

This study was prepared on behalf of USAFRICOM by the US Army Corps of Engineers (USACE), Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL). This work was funded by USAFRICOM.

2 International Conventions Regulating Waste Imports and Exports

Several African countries have become dumping grounds for the Global North—countries with greater advancements and higher Human Development Index (HDI) rankings typically located in the Northern Hemisphere—despite their insufficient infrastructure and management services for proper waste handling. These African countries are considered a part of the Global South, in addition to those in Latin America, Asia, and Oceania, which conversely, are countries typically located in the Southern Hemisphere (Dados and Connell 2012). They commonly rank lower on the HDI, contend with lower incomes, and are often marginalized due to cultural and political differences. Careless dumping in these countries without appropriate treatments has allowed dangerous chemicals to enter the environment and cause harmful health effects to those who live near open dumpsites or rely on water or foods grown in the vicinity.

To help track and prevent hazardous imports and exports into improperly equipped countries, several conventions have occurred to unite worldwide exporters and place restrictions on how waste can be transported. Two of these conventions, the Basel Convention and the Bamako Convention, will be covered in the following sections. While the United States is not an official party to either convention, their regulations affect hazardous waste imports or exports when being sent or received from a party of the conventions.

The Basel Convention has 187 party countries who are subject to the regulations imposed. It is made up of every country besides the United States and Haiti, meaning whenever the United States exports to any country other than Haiti, they must follow Basel regulations or enter into an agreement that meets specific criteria set by the convention (EPA 2021).

The Bamako Convention has harsher restrictions for its parties; however, only four of the seven countries in this report have ratified the convention. Despite not being party to either, the US Army is subject to the regulations set by either the Basel Convention or the Bamako Convention when exporting from a country that has ratified either one.

2.1 Basel Convention

In 1989, the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, also known as the Basel Convention, was ratified by the United Nations Environment Programme (UNEP). This was one of the first efforts to provide standards for hazardous waste trades (Benson and Mortensen 2021). The Basel Convention regulates the movement of wastes between country borders by designating standards for what can be sent and received. Each country examined in this report—Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda—are parties to the convention, along with 180 others. The convention requires that waste is subject to the following conditions. Movement can only occur if, first, the country exporting goods does not have proper disposal or recycling capabilities, second, if the exporter does not have facilities that can handle the waste in a safe or environmentally cautious way, and third, if the wastes will be used as raw materials by the importer for recycling. It also requires that the movement of waste can only occur between parties to the convention unless a separate agreement with an equally appropriate structure is arranged (EPA 2021). This is designated by Article 11 of the convention and requires that these contracts do not deviate from the convention's prescribed requirements or specify other arrangements with weaker regulations (Office of Environmental Quality, n.d.).

The convention's more technical requirements relate to notification, consent, and proper transportation requirements. The exporter must notify every country the waste shipment travels through and receive proper consent from each. An international movement document must travel with the shipment all the way until it reaches its destination. There are also rules regarding packaging, labels, and transportation processes that shipments must meet. After everything has been properly shipped, each country must submit data reports annually that summarize their waste imports and exports, destinations, and methods of disposal (EPA 2021). While the Basel Convention demonstrated international interests in proper waste handling, it has several weaknesses, particularly in Africa, that allow waste to enter ill-equipped countries.

Weaknesses to the convention primarily come from the influence the Global North has on countries in the Global South, such as those in Africa. Oftentimes, loopholes can be found in vague wording, which has been

shown in repeated examples of waste being sent as donations or as materials that can be recycled for profit. Even if waste is recycled or partially recycled, insufficient facilities and services cannot dispose of the resulting waste properly, which allows for harmful substances to enter the environment (Shukla 2020).

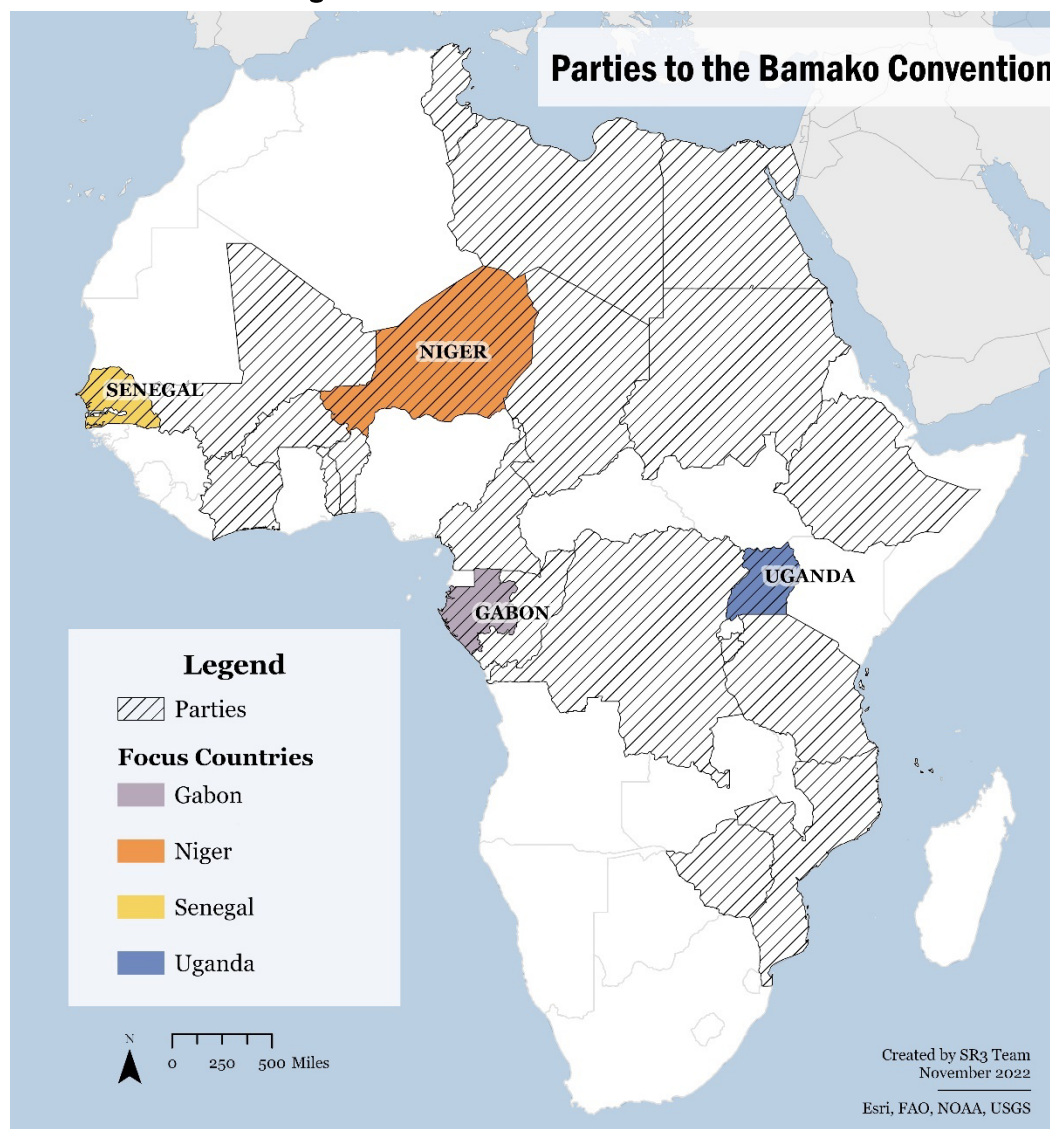
2.2 Bamako Convention

The Bamako Convention, named for the convention's first meeting in the capital city of Mali in 1991, was created as a response to the shortcomings of the original Basel Convention. It was enacted in 1998, and as of 2016, only 4 of its 25 member parties, Gabon, Niger, Senegal, and Uganda, are included in this study, which are shown in Figure 3 (UNEP 2018b).

The overarching goal of this treaty is to better protect its member countries by incorporating stronger restrictions and covering more waste, such as radioactive waste and other hazardous materials, not covered by the Basel Convention. After realizing the extent of toxic wastes that were being imported into African countries by nations in the Global North, there was a strong need for organization and regulations on hazardous waste transportation.

Unfortunately, its major drawbacks are the continuation of toxic waste imports due to a lack of enforcement and participation. The former president of the convention and the minister of the environment and sustainable development of Ivory Coast, Joseph Seka Seka, hopes that program revitalization can occur and will allow for stricter regulations and more widespread participation (Ngounou 2020).

Figure 3. Parties to the Bamako Convention.



3 Notes on Waste Management across the African Continent

3.1 Hazardous waste

Africa produces significantly less hazardous waste when compared to other countries, but the compositions are typically similar. Common examples of household hazardous wastes (HHWs) in both Africa and other countries worldwide include batteries, antifreeze, and electronics, which are of particular interest for management in Army operations. Other examples include pesticides, paints, oil and gasoline, lightbulbs, fertilizers, insect repellants, medical wastes, etc. (Edokpay et al. 2017).

Management of HHWs is important for the health and safety of the public and the environment. In the Global North, management services are more developed to safely discard potentially dangerous materials, whereas African countries do not usually have the proper infrastructure or funding for safe hazardous waste management. This leads to a lot of the hazardous materials being improperly discarded. Additionally, throughout most of Africa, the government's focus and funding is given to reducing poverty, hunger, unemployment, and other social ills, while waste management is deemed a less important consideration. Part of the problem is also a lack of knowledge and education about hazardous waste management (Edokpayi et al. 2017).

Current methods of disposal can include open dumping, landfilling, depositing at a dumpsite, and open burning or incineration. When waste is not collected from residents, households must deal with their waste and often resort to open burning or dumping in public drains, sewers, or along the road near their home (Edokpayi et al. 2017). As Africa's population, agriculture, and cities grow, so will exposure to harmful chemicals and waste. This makes hazardous waste management a crucial planning focus. Along with insufficient infrastructure, most countries do not have the capacity for full waste data reporting. Below, any available information on current practices is provided for each country, but this report cannot fully reflect how each country differs in management strategies. Missing information will be noted when applicable.

Batteries are a critical resource in Army operations, but due to their hazardous properties, their waste poses unique challenges once it reaches the

point of disposal. In Africa, proper removal and management of spent batteries is still a challenge due to a lack of reliable collection centers and recycling facilities. There are a few exceptions to this that involve businesses and industries who conduct battery management. Examples of companies involved in battery recycling and repurposing are shown below in Table 1.

Table 1. Examples of current battery recycling efforts in Africa. (Source: Anglivié et al. 2021.)

Country	Company	Method
Benin and Burkina Faso	Lagazel	Salvaging and reusing the spent batteries from off-grid solar markets
Nigeria	Hinckley Recycling	Repurposing batteries from electronic waste (e-waste) and energy access
South Africa	Eaton	Reusing batteries to power a microgrid at one of their plants to show reutilizing potentials
Kenya and Rwanda	Aceleron	Recovering batteries from solar lamps and e-waste to repurpose in solar home systems
Tanzania	Island Fraunhofer Heinrich Hertz Institute	Reclaiming end-of-life (EOL) electric vehicle batteries to power a mini grid

Lithium-ion batteries (LIBs) have not increased in volume as rapidly as they have in other countries, such as in the Global North, and do not have as many reaching end of life (EOL). As a result, infrastructure for their proper disposal is not as available as recycling for other types of batteries. There are still no widescale LIB recycling operations on the continent, which makes it very difficult and expensive to safely dispose of the batteries. Instead, there are strong financial motivations to repurpose the cells as was demonstrated by the pilots from Table 1. While the volume of LIBs is still small, it is important that these companies develop solutions for handling the waste as it is expected to grow with the increasing emphasis on stationary storage and electric vehicles. These are both newly developing applications and are not prevalent in the waste stream currently (Anglivié et al. 2021).

Lead-acid batteries (LABs) have high recycling rates due to the financial incentives from attaining their precious metals, established processes for recycling, and similar chemistries, making the process of recycling LABs from a variety of sources easier. The cells are not as valuable when repurposed and are more often broken down. The practice of recycling LABs is harmful and associated with extreme pollution and human health impacts. Many workers and residents in communities neighboring large-scale recycling plants and smaller informal sites have reportedly shown symptoms

of lead poisoning, initiating a call for better regulations for used lead-acid battery (ULAB) recycling (Angliviel et al. 2021).

3.2 Solid waste

While solid waste management in Africa can vary, there are similarities in how waste is discarded and managed across the continent. Information about waste and management practices found at the continental level will be used for assumptions about country-level management practices when sufficient data are not available.

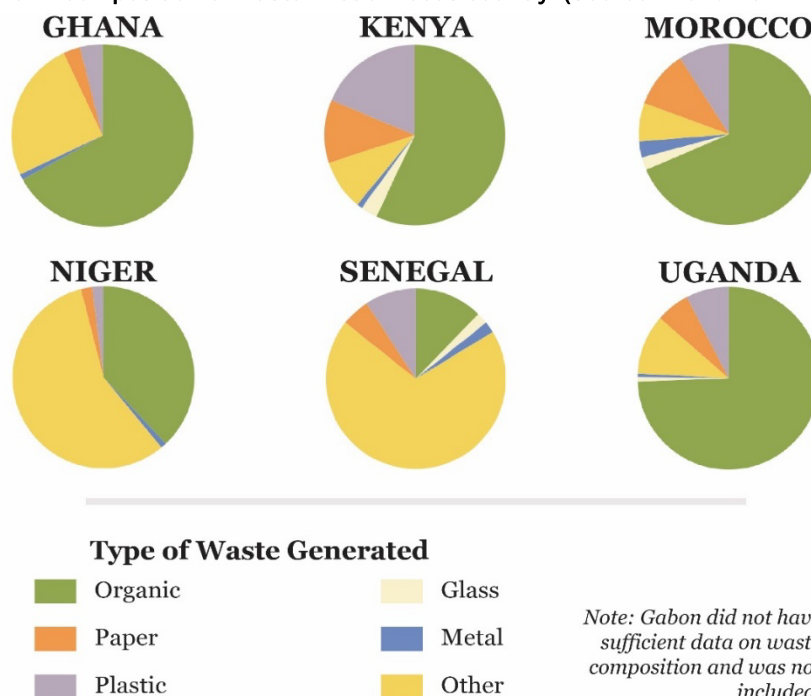
In 2012, an estimated 125 million tons of municipal solid waste (MSW) was generated on the continent with around two-thirds of this coming from sub-Saharan Africa.* The amount of MSW produced is expected to almost double by 2025 to around 244 million tons for the year. Waste is commonly broken into the following types when looking at the composition: organic, paper, plastic, glass, metal, and other. Table 2 describes what these categories include in waste characterizations. In Africa, the composition of MSW when averaged out consists of 57% organic waste, 13% plastic, 13% other, 9% paper, 4% glass, and 4% metal (UNEP 2018a). For a further breakdown of waste compositions in each focus country, see Figure 4.

Table 2. Examples of waste by category. (Source: UNEP 2018a.)

Category Name	Types of Waste
Organic	Food waste, yard waste (i.e., leaves, grass, and lawn clippings), wood, process residues
Paper	Scrap paper, carboard/paperboard, newspapers, magazines, paper bags, cardboard boxes, wrapping paper, books, and paper beverage cups
Plastic	Bottles, packaging, containers, bags, lids, and cups
Glass	Bottles, glassware, and lightbulbs
Metal	Cans, foil, tins, aerosol cans (nonhazardous), appliances, railings, and bicycles
Other	Textiles, leather, rubber, appliances, ash, inert materials, and inorganic waste

* For a full list of the spelled-out forms of the units of measure used in this document and their conversions, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office, 2016), 248–52 and 345–47, <https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf>.

Figure 4. Composition of waste in each focus country. (Source: World Bank 2019.)



As the amount of MSW in Africa grows, it will become increasingly important that waste is properly discarded with efficient and nonharmful disposal methods. This starts with proper collection and transportation, which is limited throughout the continent. Waste collection can be provided by various actors in a city, including municipal authorities, private contractors, informal collectors, community-based organizations (CBOs), and nongovernment organizations (NGOs).

The rate of collection for MSW is over 50%, around 68 million tons, and is frequently only available to wealthier residents located in city centers or higher-income neighborhoods. There is still a great disparity in collection within cities, where coverage can be around 90% in well-connected urban centers, and as low as 10% in informal settlements and lower-income neighborhoods. In areas with lower collection rates, it is not uncommon to see waste haphazardly dumped in any available open spaces. Poor road infrastructure is a serious obstacle to increasing collection rates outside the city center. The roads are not well suited for the necessary collection vehicles that could include large vehicles like dump trucks, compactor and side-loader trucks, or tractors (UNEP 2018a).

After collecting and transporting the waste, the most common method of disposal involves dumping the waste at uncontrolled dumpsites and

landfills. This accounts for over 90% of waste disposal. Dumpsites in Africa tend to be large and informal, with no treatment or environmental protection practices. This allows chemicals and toxins to seep into the ground and contaminate local soils and waters. Open burning is also common, creating smog and further environmental hazards. Waste that is not formally collected is often dumped in available open spaces near homes, next to roads, in rivers or drainage channels, and even along street corners in cities. To reduce these potential threats, many cities are looking to improve disposal practices and are trying to switch to sanitary landfills with better safety standards and contamination prevention (UNEP 2018a).

Policy and regulation regarding waste management is usually the responsibility of the state or municipality, but typically, municipalities are not equipped to provide affordable and effective services and opt to collaborate with the private sector and CBOs. Services tend to be more comprehensive and efficient when completed by the private sector and when municipalities provide oversight and management rather than set up the operations (UNEP 2018a).

Most African countries suffer from poor waste management services because of insufficient funding. The designations for income level by gross national income (GNI) per capita are shown in Table 3 below. Cities can spend between 20% to 50% of their annual funds on MSW services, most of which goes toward collection. Budget funds are paid by residents and businesses who are not always keen to pay extra for services, which directly affects the city's capacity to continue to provide waste management. It was estimated that fewer than half of all city residents throughout Africa pay for waste services (UNEP 2018a). Some funding had been granted to countries from international organizations, such as the United Nations and World Bank, which differ based on need. Some of the countries of focus in this report have been granted such funds and are discussed in their designated sections.

Table 3. World Bank economy income designations as of 2023. (Source: World Bank, n.d.)

By Income	GNI per Capita	Focus Countries
Low-income economies	\$1,085 or less	Niger, Uganda
Lower middle-income economies	\$1,086–\$4,255	Ghana, Kenya, Morocco, Senegal
Upper middle-income economies	\$4,256–\$13,205	Gabon
High-income economies	\$13,206 or higher	n/a

There are examples of recycling efforts across Africa, but the practice often occurs by individuals and informal recyclers who rely on recycling as a source of income, rather than as a waste reduction strategy. It is very inefficient as they must scavenge at a dump or landfill, searching for products already discarded with valuable materials. Moreover, without the proper technology, skills, or knowledge, recyclers can miss materials or put themselves in a dangerous situation, close to flammable materials and hazardous chemicals. Even with many people making a living off recycling, only 4% of waste is recycled, while around 75% is estimated to be recyclable (UNEP 2018).

Rural solid waste management is a challenging undertaking and affects a large number of inhabitants. Sixty percent of the entire African population resides in rural areas, which has much less access to waste management services due to the distance between houses. Households must take the initiative to discard any waste they produce through methods such as burial or incineration. This has resulted in a lack of data collection on rural solid waste since it cannot be tracked. Specifically, the amount of waste produced, composition, sources, and management are all unknown. It has been assumed that a lot of waste is reused when possible as access to resources is limited, but when it can no longer be used, waste is either dumped illicitly or burned on site (UNEP 2018).

3.3 Data reporting

Across Africa, comprehensive waste data reporting is limited, making it difficult to compile a complete guide on the current status of management services in each of the countries. Multiple scholars have supported this sentiment, expressing the lack of data at all levels of government: local, regional, and national (UNEP 2018a). This has been argued to have even further affected waste management practices as better waste data can help visualize the areas with most need. Inconsistencies in data collection have also made available data impractical for comparisons (UNEP 2018a). Inconsistencies as well as insufficient data have affected the research conducted for this project; however, any information that was not found or appeared to be greatly skewed was left out and identified as unavailable.

4 Gabon

4.1 Country data

Gabon, an African country spanning 103,000 square miles (mi²) that borders the Atlantic Ocean, has a population of around 2.3 million; 59% of which dwells in the largest two cities (CIA 2022a; World Bank 2021b). Libreville, the capital, has 419,000 people and is the largest city followed by Port-Gentil with a population of 109,000 (Nag 2017). Gabon has a very large urban population, accounting for 90% of all inhabitants (World Bank 2021c).

Gabon's per capita income is four times higher than most other sub-Saharan nations, but much of the population is still poor, with 32% of the population living under the international poverty line of US \$5.50 per day. When compared to other countries categorized as upper middle-income, the percentage of residents living below the poverty line is much higher in Gabon than the 18.4% average from 2018 (World Bank 2020b).

Oil exports are important to the Gabonese economy, making up 80% of its total exports and 45% of its gross domestic product (GDP). Whenever production has slowed down and oil prices have fallen, trade and revenues have also declined. The economy has been suppressed due to inadequate fiscal management and its dependance on oil. Hardships including power losses and water shortages frequently occur (CIA 2022a).

Using the United Nation's HDI scale to examine the progress of social and economic development, comparisons between each country in this report and other countries around the world can be made. The HDI looks at health and life expectancy; education, both mean years of schooling and expected years of schooling; and GNI per capita and produces a value for comparison (UNDP 2020). Gabon ranks 112th on the HDI scale out of 191 total ranked countries and eighth out of all 54 African countries (UNDP 2022).

As of 4 October 2022, Gabon does not have any travel restrictions, and visitors are advised to take normal precautions by the US Department of State, a Level 1 classification, when travelling to Gabon. The department urges travelers to have increased caution when going to more populated

cities like Libreville and Port Gentil as crime rates are higher (US Department of State 2022a).

4.2 Hazardous waste management

The total estimated quantity of hazardous waste produced in Gabon is unknown due to scarce data reporting on waste throughout the country.

Gabonese households, businesses, and industries likely produce much of the same hazardous wastes as the rest of Africa. The exact composition of waste is mostly unknown; however, data on electronic waste (e-waste) was available. In Gabon, an estimated 14,000 tons of e-waste is produced every year, but this number will continue to rise as the number of electronic devices rapidly increases, making the resulting waste a fast-growing concern for waste handlers (World Bank 2019; WHO 2008).

The methods of disposal for HHWs also must be assumed to be similar to those of the rest of the continent: by disposing it amongst solid waste; dumping it openly, whether in a landfill or in public streets; or into sewers and local waters.

4.3 Solid waste management

As a country, Gabon produces over 238,000 tons of MSW every year, which is generated by businesses, residents, and industries, resulting in a large amount of refuse that must be dealt with (World Bank 2019). Unfortunately, data reporting in this country regarding types of waste produced and annual production amounts is limited; however, it can be assumed that traditional wastes, such as food, glass, plastic, etc., are all being produced even if we cannot identify at what quantities. Collection services have reported amassing household waste, bulky waste, rubble and other industrial wastes, garden waste, and illegally discarded materials.

In Gabon's capital, Libreville, an international waste management company, Averda, was tasked with collecting, managing, transporting, and properly disposing of refuse, but complications arose when contract agreements were not met. A five-year contract for private waste management services through Averda ended in 2019 (Averda, n.d.). Arrangements between the state and private companies were common, but after ongoing struggles regarding agreed-on task completion, the national government opted to decentralize waste collection and give the responsibility of

managing waste at the household level to local decision makers. The localities are entrusted with creating operational plans for waste management and are supposed to receive technical and financial support from the government (Magoum 2020a).

Funding is not readily available for widespread collection services. In 2019, the introduction of a public health tax to procure community sanitation and waste management was considered; however, there is no evidence that this tax was ever implemented (Takouleu 2019).

Recycling practices are limited in Gabon, although there are a few private companies in the largest cities that have repurposed plastic waste and kept it out of the landfill. One company, Sobraga, participates in individual brewery waste collection and recycling with NAMé Recycling. They have helped to collect several tons of plastic waste to be treated and recycled (Magoum 2020b). The latter company also provides pickup and drop-off locations to make collection more convenient for residents (NAMé Recycling, n.d., “NAMé Gabon”).

Appendix A provides a map and corresponding list of dumpsite locations within Gabon.

5 Ghana

5.1 Country data

Residing along the Atlantic Ocean in Western Africa and spanning 92,098 mi², the country of Ghana has a population of 31.7 million with 58% of the population living in urban spaces (CIA 2022b; World Bank 2021b; World Bank 2021c). The largest cities are Accra, the nation's capital, with 2.2 million residents and Kumasi with 2 million. Sekondi-Takoradi is the next most populated municipality with 445,000 inhabitants (Sawe 2018).

Like most other countries, Ghana's economy took a massive hit during the COVID-19 pandemic and has yet to fully recover and will only be made worse due to the war in Ukraine. However, slow growth is anticipated and will be led by the agricultural and industrial sectors. Agriculture, forestry, and fishing provide most of the country's income and employs over 50% of the population (World Bank 2022b). Ghana has an HDI of 133 and ranks 12th out of the other African nations (UNDP 2022).

Ghana has higher crime rates and is given a Level 2 travel advisory by the US State Department, as of 4 October 2022, suggesting that visitors take greater caution when in the country. Some regions of the country are dealing with civil unrest developing from tribal disagreements, which can lead to violence (US Department of State 2022b).

5.2 Hazardous waste management

There is no current data representing the total amount of hazardous waste produced in Ghana available for the public.

For the composition of HHWs, there are no comprehensive data on every type of hazardous waste produced, but Ghana likely creates similar hazardous wastes as other African countries. Information was available for electronic and battery waste. E-waste is one of the most common wastes produced, but there is little in place to manage it. Each year, it is reported that the country produces 39,000 tons of e-waste (World Bank 2019). Ghana is known for its infamous massive e-waste dump, Agbogbloshie. In recent years, it has been demolished, but it was once the largest dumpsite for e-waste that accumulated from countries all over the world (Yeung 2019).

Battery waste is another common type of HHW produced in Ghana, specifically lead-acid batteries that are found in vehicles and power backup systems. Researchers estimate that more than 36,700 tons of ULABs are disposed of each year throughout the country (Atiemo et al. 2016). The Ghanaian Ministry for the Environment (MESTI) is interested in improving battery recycling and has requested Sustainable Recycling Industries, a program designed to incorporate small, local businesses into the recycling of secondary resources, to create standard operating procedures (SOPs) to help this developing sector (Ottiger 2020).

The only method of disposal for HHWs that has been reported in Ghana is open burning, but other common methods such as open dumping, while not reported, are assumed to be performed (Edokpayi et al. 2017). Refer to Section 3 for types of wastes disposed of and methods.

5.3 Solid waste management

Of the approximated 3.5 million tons of solid waste produced in Ghana every year, most is food waste, making up 67% of the total MSW. “Other” material follows with 25%, plastic at 4%, paper cardboard at 3%, and metal waste at 1% (World Bank 2019). An estimated 60%–70% of MSW is collected through contractual arrangements, while other waste is dealt with by burning it, dumping it publicly or indiscriminately, and burying it (Mariwah 2020). African city dwellers typically fare better than their rural counterparts regarding waste removal, but Accra still has around 4.6 million households and businesses who are without access to reliable collection services and must resort to these harmful practices (Dispose Green, n.d., “About”).

The collection services that are present are not always able to provide a consistent removal schedule, but there are a few ways for residents to have their wastes gathered and disposed of. Generally, there are waste management companies that serve different areas of the city depending on where a person resides. There are also informal waste collectors who can be found throughout the city. These are more unreliable, as they are not always easily found, and prices may vary between each collector (Dispose Green, n.d., “About”). Advances in waste collection are being made to give each resident proper access to management services; however, there is still a long way to go. One company, Dispose Green, is the first digital waste management company that gives residents and business owners the ability

to deal with their refuse online by providing online pickup scheduling, digital invoices, and virtual payments. This service connects waste producers to independent collectors rather than providing its own collection services (Dispose Green, n.d., “About”). However, only 58% of the population has internet access, and this number is likely skewed to be more available in wealthier communities that already have access to garbage collection (World Bank 2020).

Waste management policies have come from all levels of government, through different agencies and committees. Despite this all-hands-on-deck approach, there are still challenges with political entities committing to management (Mariwah 2020). This has led to a push for decentralization, but there are persisting issues with coverage, as bureaucracy and corruption in administrations have given underqualified companies areas to serve that they do not have the ability to manage. In Accra, decisions regarding treatment and disposal of solid waste fall to the Waste Management Department, who have a responsibility to enhance environmental sanitation and protect the environment and public health (Dispose Green, n.d., “About”).

While there is little information about where funding for waste management comes from, some innovative solutions have been made to provide funding for new ideas addressing these challenges. The United Nations Development Programme (UNDP) and the Coca-Cola Foundation are encouraging proposals for waste management project ideas to be submitted by university students in Ghana (UNDP 2021). Voltic Ghana Ltd. also has partnered with various companies to fund waste management and recycling projects, demonstrating the need for new solutions and funding to effectively manage the country’s waste (GhanaWeb TV 2018).

Ghana has a recycling rate of 5% and was the continent’s first country to enter the World Economic Forum’s Global Plastic Action Partnership (Meyerhoff 2020). The recycling operations existing in Ghana are privately owned and are located in the major cities. There are limited facilities operating at a large scale, and there are none that produce recyclables at a high enough quality for export (Ministry of Sanitation and Water Resources 2020).

Appendix B provides a map and corresponding list of dumpsite locations within Ghana.

6 Kenya

6.1 Country data

Kenya, a country with a current estimated population of 55 million inhabitants, is located along the Indian Ocean on the east side of Africa and spans over 224,000 mi² (CIA 2022c; World Bank 2021b). Around 28% of the population lives in an urban setting, but up to 40% of the total waste is from cities (World Bank 2021c). The urban populations could be responsible for generating approximately 5.5 million tons of waste each year by 2030 (Ministry of Environment and Forestry 2019). The three largest cities in Kenya are Nairobi with 4.3 million people, Mombasa with 1.2 million, and Kisumu with 750,000 (Wanyama 2020).

Kenya had one of the fastest growing economies on the continent before the hardships of the COVID-19 pandemic. Agriculture is central to the economy, constituting over 30% of Kenya's GDP, and is responsible for more than 40% of the total population's employment. However, productivity in the agricultural sector has slowed in the last few years and has left many rural farmers in poverty (USAID, n.d., "Economic Growth"). Overall, the country has a medium HDI and is ranked 152nd out of 191 ranked countries, but in Africa, it is ranked 20th of 54 (UNDP 2022).

Kenya can be dangerous for visitors, and the US Department of State recommends that anyone staying in the country should take greater caution. Problems such as crime, terrorism, civil unrest, and kidnapping can occur, and some places are more at risk than others. As of 4 October 2022, the US Department of State has given Kenya a Level 2 advisory, recommending that visitors use greater caution when in the country (US Department of State 2022c).

6.2 Hazardous waste management

The total amount of HHW produced in tons is not readily available digitally and was not found for this study, although there may not be any data records on this. There are data on more specific types of waste, which is included subsequently.

According to the World Bank, more than 17,000 tons of e-waste and over 900,000 tons of medical waste are produced each year

(World Bank 2019). Little has been organized for the proper management of e-waste, which has led to the National Environment Management Authority (NEMA) developing e-waste management regulations, which include producer registration and recycler licensing. Two licensed e-waste recycling facilities were operational in 2015, but it is unknown if they are still in use (NEMA 2015).

One reported type of hazardous waste produced in Kenya is florescent lamps, which are challenging to dispose of. NEMA has licensed a recycling facility specifically for florescent lamp waste, as they have increased in production and usage due to the energy savings they provide (NEMA 2015).

Battery waste is also produced throughout Kenya, but only select types can be discarded using the current waste management services in place. As of 2015, LABs could be recycled at two different licensed recycling facilities, but alkaline, rechargeable, and silver-oxide batteries could not be recycled or specially discarded and were thrown out with nonhazardous wastes (NEMA 2015).

Pesticide wastes are another type of hazardous waste produced in Kenya by both large-scale operations as well as small-scale farms that have different access to proper disposal options. Pesticide wastes generated by a large-scale operation are typically able to be exported to another country with better services in place for treatment or disposal, while small-scale operations must deal with them within their own land (NEMA 2015).

Reports on HHW management showed that most households do not have access to proper disposal services for toxic wastes and discard it with other nonhazardous household waste. In Nairobi, 86.6% of households do not separate HHW from solid waste, while in Mombasa, 75.9% discard both types of wastes together (African Population and Health Research Center 2017). Open burning is also one of the only other widely reported methods of disposal that has been recorded in Kenya (Edokpayi et al. 2017).

6.3 Solid waste management

Kenya's 5.5 million tons of MSW per year is composed of 57% food waste, 18.7% plastic waste, 11.3% paper cardboard, 9% other inorganic waste, 3% glass, 2% textile, and 1% metal waste (World Bank 2019). The status of the

country's current waste management program is inefficient and detrimental to the environment. A study completed in Nairobi, the capital, showed that between 30% and 40% of the total waste produced was not being collected for proper disposal, and less than 50% of households were provided with collection services. Likewise, Nakuru faced an even worse situation with 45% of the MSW being collected and properly disposed of, 18% was recovered, and the remaining wastes ended up in the environment (NEMA 2015). Nairobi has been working to fix their solid waste management system as many people do not have access to waste collection and must figure out how to discard it. In the past, waste management had not been prioritized by the local authorities, proper infrastructure was nonexistent, and, for those who were participating in collection and disposal, regulations were lacking. This allowed for careless disposal and unregulated costs, while many people in the city still did not have any collection services available. Currently, the Nairobi city council, private waste companies, CBOs, and the informal recyclers are all important actors in waste management working to make necessary changes (UNEP 2018a).

In 2015, the Solid Waste Management Act was passed and created a classification system for waste products and a collection program. It also designated penalties for improper disposal (Oyake-Ombis 2018).

Unfortunately, a lack of enforcement meant all advances were set back. To try to revive their recycling operations, the Kenyan Parliament passed a law in 2021, requiring residents to sort their recyclable waste to be collected for proper processing.* This time, there was an emphasis on civil education to emphasize how important recycling is but also why it is necessary to sort the waste. In addition to improved recycling, the Dandora dumpsite will be gaining a waste-to-energy (WTE) facility and will be able to use the rest of the refuse not recycled (Kinyanjui 2021).

In recent years, the county government of Nairobi has tried to pass new bills to allow and enforce waste management fees to improve the state of collection and disposal. Ultimately, the Nairobi City Council Finance Bill was passed in 2019, charging residents and businesses collection fees based on their location and dwelling type. The bill requires monthly payments of 100 Kenyan shillings (KSh) for informal settlements, 300 KSh for

* The Sustainable Waste Management Bill, (2021) Kenya Gazette Supplement No. 92. <http://www.parliament.go.ke/sites/default/files/2022-05/The%20Sustainable%20Waste%20Management%20Bill%20%28%20National%20Assembly%20Bills%20No.%2022%29%202021.pdf>.

middle-class households, and 600 KSh for high-income residents (Mutua 2019). These prices are approximately US \$0.85, US \$2.54, and US \$5.07 per month, respectively. The introduction of this bill was met with backlash from residents who were worried about the high prices. There were claims of misinterpretation of this bill though, saying that the high prices were to meet the required costs and were not set up for the county to profit from. The chief officer for environment also pointed out that there were still private options for other service providers if residents did not want to pay the city prices (Kinyanjui 2021).

Other funding has been provided to waste disposal alternatives such as a WTE project by the Sustainable Energy Fund for Africa (SEFA). Funding for this WTE plant, located in the Kibera suburb of Nairobi, will also include a full assessment of the environmental and social effects and advising services related to finances, transactions, and legal proceedings. The total allotted funding provided by the grant amounts to US \$995,000 (African Development Bank Group 2017).

As noted previously, changes to recycling practices are underway, but recycling participation used to be very uncommon, with only 4.7% of households contributing. The small amount that did participate discarded mostly plastic materials. Paper, glass, tin, and metal were also accepted for recycling, just at much lower quantities (African Population and Health Research Center 2017). There are also small- to medium-sized businesses involved in recycling processes, such as Gjenge Makers Ltd., a company turning plastic waste into strong and affordable building materials. They get some of the materials from packaging factories, who donate their excess waste, but they do have to pay for the plastic waste from other recyclers (Waita 2021).

Appendix B provides a map and corresponding list of dumpsite locations within Kenya.

7 Morocco

7.1 Country data

Morocco is a country with approximately 37.3 million people located in northwestern Africa along the Atlantic Coast (World Bank 2021b). The country covers over 276,600 mi² (CIA 2022d). The biggest city in Morocco is Casablanca, with a population of 3.3 million; followed by Fez, with 1.1 million people; and Tangier, with 1 million. The capital, Rabat, has 580,000 inhabitants and is one of the top-ten most populated cities in the country (Sheth 2019). The majority of the population lives in cities with 13.4 million people (36.3%) residing in rural regions (World Bank 2021c).

The country's economy is predominated by the services sector, which makes up over half the GDP and is followed by the industrial sector, including mining, construction, and manufacturing. Tourism, telecommunications, information technology, and textile production are among the fastest growing sectors. Economic growth is expected to dwindle as a result of declining agricultural production caused by the recent period of drought. Increasing food and energy prices worldwide initiated by the conflict in Ukraine have put further strain on the country's economy (World Bank 2022a). Morocco has an HDI ranking of 123, making it 10th out of all African countries (UNDP 2022).

The country has faced acts of terrorism recently, and future attacks are still possible. As of 5 October 2022, the US Department of State has given Morocco a travel advisory rating of Level 2, suggesting that visitors take extra precautions when in the area (US Department of State 2022d).

7.2 Hazardous waste management

There was little data on hazardous waste management in Morocco; however, it was recorded that approximately 318,600 tons of hazardous waste were generated each year by the industrial sector. Additionally, of the 23,100 tons of medical waste produced, 28% or around 6,500 tons, was considered hazardous waste (GIZ 2014). There were no available data on the other sectors' production amounts, nor information on each individual type of waste created.

Appropriate disposal services, such as proper collection, treatment, and disposal facilities, are nonexistent, so almost all the hazardous waste from the industrial sector is disposed of in landfills, dumps, or along quarries or rivers without any treatments or remediation (GIZ 2014).

Because of a lack of sufficient data reporting, general data on hazardous waste management in Africa will have to be used for this country as well.

7.3 Solid waste management

In Morocco, 6.8 million tons of MSW is generated every year and is composed of 65% organic waste, 10% paper cardboard, 10% plastic, 8% other, 4% metal, and 3% glass waste. Waste production per capita in the country's urban setting is approximately 0.76 kilograms per day, whereas its rural population produces only about 0.3 kilograms every day per capita (GIZ 2014). Only 75% of all waste is collected, and 36% is openly dumped, leading to leakage in bodies of water, hurting local fishing and tourism economies. Over 300 uncontrolled dumpsites accumulate waste and are picked through for valuable materials. Refuse burning is also a common way of dealing with waste inexpensively that brings its own health effects, which are not widely understood by the general public. While most materials are landfilled, 8% of all controlled waste is recycled (Dalberg Advisors 2019).

There are various levels of responsibility for waste management in Morocco. At the national level, limited focus and resources were given to effective waste management before the first solid waste programs were enacted in 2006. The following year, a three-phase program spanning 15 years titled the "National Program of Household Waste" (PNDM) was approved but had little funding or support. In 2009, the first two of four development policy loans (DPLs) from the World Bank were approved and totaled US \$271.3 million. These loans supported the creation of regulatory framework for integrated waste management systems in municipalities (Hoel 2013). Two more loans have since been granted to further improve accountability through enhanced monitoring capabilities and to further boost the performance of the waste sector (World Bank 2013).

At the local level, municipalities are responsible for their own waste management but are supported financially through the Water and Sanitation Department of the Ministry of the Interior and monitored and regulated

by the Department of Energy, a section of the Ministry of Energy, Mines, Water and Environment. The industrial and medical sectors are each responsible for their own wastes and supported through their designated government departments. As a result of the PNDM program, the Program Management Unit (UGP) was formed to monitor and report on the state of municipalities' waste management practices (GIZ 2014).

Recycling and composting initiatives are progressing slowly, but there have been companies to succeed in these practices. Atlas Green Recycling is one of the largest paper and plastic waste collectors in the country and supplies materials back to producers for retransformation (Atlas Green Recycling, n.d.). As of 2013, only 8% of all municipal waste was recycled, but Morocco's official goal is to achieve a recycling percentage of 20% by 2030, which has been extended from 2022 (French Press Agency 2021).

A map and corresponding list of solid waste disposal sites within Morocco can be found in Appendix B.

8 Niger

8.1 Country data

Niger has a population of approximately 25.1 million inhabitants and is in central Saharan Africa, spanning more than 489,000 mi² (CIA 2022e; World Bank 2021b). The three largest cities are Niamey, with 1.3 million people; Zinder, with 256,000 people; and Maradi, with 206,000 people (Sawe 2017a). Only 17% of Niger's population lives in urban regions with the remaining 83% living in more remote areas with less access to waste management (World Bank 2021c).

Agriculture and livestock are the largest sector in Niger's economy, and it makes up 40% of its GDP (World Bank 2022c). Much of the agricultural production is from subsistence farming, and most of the population is reliant on agriculture as their main financial means of support. The country's dependance on agriculture as the leading source of income puts extreme strain on the economy and has led to their poor HDI ranking (Jellison 2019). Low rainfall averages and frequent periods of drought often result in food shortages and insecurity, making Niger one of the countries with the highest malnutrition rates (USAID, n.d., "Agriculture"). Additionally, in 2017, Niger ranked last out of 189 countries on the UN's HDI, based on the country's health, knowledge, and quality of life status (UNDP 2020). As of 2022, Niger's HDI ranking was 189th out of 191 ranked countries, and 51st of 54 African countries (UNDP 2022).

Parts of Niger can be very dangerous, and the US Department of State has advised that any travel to the country should be reconsidered. The given advisory level, Level 3 as of 5 October 2022, is based off the high rates of crime and potential for terrorist attacks and kidnapping (US Department of State 2022e).

8.2 Hazardous waste management

Niger produces around 554,000 tons of hazardous waste every year. Almost 8,000 tons of this waste is from electronic devices (World Bank 2019). The full breakdown of hazardous wastes produced and each waste type's percentage of the overall waste was not available.

There are little data on how waste is managed in Niger due to a lack of reporting. Additionally, there was no information on how HHW is disposed of or where it ends up. Since there is little infrastructure in place for special collection and management, it is assumed that much of it is discarded alongside solid waste and either ends up in landfills, uncontrolled dumpsites, or along a roadway or river.

The only regulations on hazardous waste management in Niger come from the Basel and Bamako Conventions regulating import and export of waste. However, there are no enforcement practices in place, and healthcare waste and e-waste have no policies for handling or disposal. Some recycling is performed for e-waste, but it is carried out informally by individuals (Hammer 2018).

8.3 Solid waste management

Niger generates 1.8 million tons of MSW a year, 38% of which is made up of food waste, 2% paper cardboard, 2% plastic, and 1% metal, with the remaining 57% designated as “Other,” representing inorganic sand waste. The methods of disposal throughout the country vary, but most are inadequate. Food is often burned or buried, and it is common for other wastes to be openly dumped, creating severe public health and environmental concerns. It was reported that 64% of all waste ends up in an open dumpsite (World Bank 2019).

Collection services are sparse, even in the most populated cities. In Niamey, there is no coordinated collection service, but instead, small, local organizations, such as neighborhood associations and youth groups, partake in collection activities using donkey-pulled carts. To address such issues, one social enterprise, Niger Bioplast, was started to help provide refuse storage and collection and even developed methods for recycling and repurposing what they had collected in Niamey (SNV 2017). Maradi also has similar issues with collection and disposal, specifically with a lack of capacity and sufficient equipment for handling waste.

It is unclear if there is waste management being overseen at any levels of government in Niger. As previously stated, there are no coordinated services, and data regarding any formal organization is unavailable.

Municipal solid waste management is supposed to be funded by subsidies from the government and can be paid to private companies for their involvement. However, this payment process is often delayed due to municipal budgets being insufficiently supplied and results in a deficient waste management process (Aoike 2019).

There are no formal recycling programs instituted in Niger, but materials are commonly reused when possible, reducing the number of items sent to the landfill. Glass and plastic bottles can be cleaned and reused to package beverages or nuts produced locally, while food and other organics can be composted or fed to livestock or native animals. Small-scale recycling does take place by individual collectors who scavenge landfills, searching for valuable materials in e-waste (Hammer 2018).

There are seven disposal sites throughout Niger. A list of those sites and a corresponding map can be found in Appendix B.

9 Senegal

9.1 Country data

Senegal has a population of 17.2 million people and is located on 75,900 mi² of land along the western border of the African continent (CIA 2022f; World Bank 2021b). Of the total population, 49% dwell in urban areas (World Bank 2021c). The three largest cities are Senegal's capital, Dakar, with 1.1 million inhabitants, Pikine with 874,000 people, and Touba with 529,000 people (Mongabay, n.d.).

In the past, Senegal's economy had been largely based on peanut cultivation, but the government has emphasized agricultural diversity by incorporating cotton, garden products, and sugarcane farming. Agriculture is the main driver of Senegal's economy, but the government has successfully integrated fishing, phosphates, and tourism as important exchange sectors (Camara et al., n.d.). The nation ranks in the "Low Development" category of the UN HDI, ranking at 170th out of 189 total countries and 34th out of 54 African countries (UNDP 2022).

Most places in Senegal are relatively safe for visitors, and the US Department of State has given it a travel advisory rating of Level 1 as of 5 October 2022, recommending everyone to exercise normal precautions. Armed robbery is common in some of the more densely populated areas, and landmines from previous conflicts are still a concern. Visitors are recommended to be wary (US Department of State 2022f).

9.2 Hazardous waste management

The total amount of HHW is unknown due to a lack of infrastructure and data reporting; however, it was reported that 15,000 tons of e-waste are produced in Senegal every year (World Bank 2019). This e-waste is largely comprised of batteries, capacitors, and mercury switches that are all used in computers. Once they have been used and are ready for disposal, they are often sent to open dumps, such as Mbeubeuss, which is the largest dump in Senegal. This one contains high levels of toxins, such as dioxins, Polychlorinated biphenyls (PCBs), and hexachlorobenzene. Reports of lead poisoning in the area show that there are many children living close to the dumpsite that have gotten acute lead poisoning from ULABs dumped without proper management (Kimbi Yaah 2018).

Senegal has a program in place for management of biomedical waste to help reduce infections acquired from contact with contaminated medical waste (Kimbi Yaah 2018). There is no data available on other types of hazardous waste produced in the country, nor is there information on how any of it is disposed of. General hazardous waste data for the continent, provided in the “Hazardous waste” Section above will be used, and Senegal’s waste will be assumed to have similar composition types and disposal methods.

Hazardous waste imports into Senegal are subject to regulations by both the Basel and Bamako Conventions and are supposed to comply with all notification processes and receive consent for proper dispatch, transit, and destinations (Kimbi Yaah 2018). Regardless, illegal hazardous waste shipments are still brought in and dumped without proper procedures due to insufficient enforcement of the policies agreed on by the conventions.

9.3 Solid waste management

In Senegal, over 2.4 million tons of MSW is produced every year. Sixty-eight percent of all waste is classified as “Other” waste and consists of fine particles (53%), textile and sanitary (5%), “complex” (5%), combustible and incombustible (1% and 3%, respectively), and special waste (1%). The remaining 32% is composed of food waste (12%), plastic (9%), paper cardboard (5%), glass (2%), wood (2%), and metal (2%) (World Bank 2019). Waste management is costly as most of the waste is made of sand and dirt. Collection services are only serving around half of the population, while the rest is having to resort to open dumping and refuse burning (Ehui 2020). In Senegal, waste management infrastructure is very insufficient. Mbeubeuss, the main dump site, is overburdened and virtually no sorting occurs from collection to disposal. The tax system for waste management is also very weak, with less than a third of all households in Dakar contributing, keeping this unsustainable system moving in the wrong direction (Kimbi Yaah 2018).

Authority of waste management practices is not clearly differentiated at each institutional level, leaving roles to be interpreted and possibly forgotten (Kimbi Yaah 2018). To help fix this problem, the World Bank sanctioned an International Development Association (IDA) credit of \$125 million to help Senegal develop enhanced solid waste management services, which could benefit around 6 million residents (Ndiaye 2020).

Recycling takes place in a few different forms in Senegal. Recycling and reuse occur to transform plastic wastes and worn tires, which is beneficial as the latter are not permitted to be dumped in landfills (Kimbi Yaah 2018). The recycling sector itself is composed of small and informal enterprises, looking to expand their operations. Certain materials such as glass and plastic can be reused in local markets in the form of jars and bottles (GIZ 2021).

Six disposal sites were located within Senegal and can be found in Appendix B.

10 Uganda

10.1 Country data

Uganda has a population of 47.1 million people and is a land-locked country in central Africa, stretching over 93,000 mi² (CIA 2022g; World Bank 2021b). Its urban population makes up 26% of the total populace, with 1.6 million people living in the capital city, Kampala (Sawe 2017b; World Bank 2021c).

A large part of the Ugandan economy is based on agricultural production, which employs around 80% of the working population. The main exported cash crops are coffee and cotton, while tea and horticultural products such as flowers are also major exports. Fishing is particularly important to the economy considering the abundance of lakes and rivers in the country, which span across almost 20% of the total area (Kokole et al., n.d.). Uganda ranks 166th out of 189 countries worldwide and falls 31st out of 54 African countries. Their HDI is ranked as “Low Development” (UNDP 2022).

Travel to Uganda can be dangerous and the US Department of State suggests that visitors should reconsider travel at this time, granting the country a travel advisory of Level 3 as of 6 October 2022. It is possible for crime and terrorism to occur and impact visitors even if they are not the specific targets (US Department of State 2022g).

10.2 Hazardous waste management

The total amount of hazardous waste production in Uganda was not found due to a lack of available data and neither was the percentages of each type of waste. Any available information on composition is provided below.

Uganda generates approximately 25,000 tons of e-waste every year (World Bank 2019). Hazardous wastes such as used oil, scrap metals, e-waste and medical wastes are all commonly discarded in Uganda. There are many companies throughout Uganda that manage hazardous wastes in a variety of ways, such as transporting, storing, or treating it. NEMA has a list of these waste handlers who were licensed in Uganda in 2019, which helps residents to know how to manage their wastes (NEMA 2019).

Hazardous wastes are commonly discarded in pit latrines and, as a result, do not often appear mixed in with municipal wastes. This affects the chemical makeup of the sewage and could negatively impact surrounding vegetative landscapes. However, the lack of hazardous and medical waste dumped in illicit dumpsites or in landfills is good for the health and safety of the public and the environment. This shows that the education programs about the importance of waste separation and collection were successful (Komakech et al. 2014).

10.3 Solid waste management

Uganda's residents produce approximately 7 million tons of waste every year, 74.5% of which is organic food waste. The rest of the MSW consists of 10.6% "other" waste, including textile and inorganic wastes, followed by 7.6% plastics, 6% cardboard, 0.8% glass, and 0.6% metal (World Bank 2019). In Kampala, only 10% of households have their wastes collected by the town council, the Kampala Capital City Authority (KCCA), and the rest must rely on private waste collection companies. Any households that are not served by either must resort to disposing of their own waste through destructive practices such as dumping, burning, or burial, which creates challenges for local authorities working to manage waste. They also are facing problems with too few proper collection and transport containers and a shortage of waste transportation vehicles (Styles 2015).

Most of the actual collection and disposal of waste in Kampala is completed by three main private companies under contract with the KCCA, but in the past few years the city government has gotten more involved due to the suspected exploitation of residents by the contracted companies. This has led the town council to regulate fees initially priced by the contractors. The KCCA will directly collect and dispose of waste in low-income neighborhoods even though the prices the council has set are still unaffordable (Monitor 2020).

There are also outside funds, such as the US \$1,000,000 loan provided by the World Bank, that have helped with waste management. In this case, the World Bank provided the loan to help construct a recycling plant for plastics that can accept around 30,000 tons of waste each day (CGTN Africa 2018).

Recycling in Uganda, specifically in Kampala, takes many forms and is carried out by the aforementioned government-established recycling plant and several smaller companies. The plastic recycling plant was a major undertaking planned out in 2018. It will produce compost and fertilizers from food and organic waste, while also recycling plastics. Like other smaller recycling companies in Uganda, the plant incentivizes the public to sort and drop off their plastic waste by buying it from them (CGTN Africa 2018).

Appendix B provides a map and corresponding list of dumpsite locations within Uganda.

11 Conclusions and Recommendations

11.1 Conclusions

Each country in this study has differing waste management services and implementation strategies that have been developed and influenced by several factors, including politics, historical events, economics, native landscapes, etc. These differing solid and hazardous waste systems were described and meant to provide guidance for potential disposal needs in military operations when in any of the focus countries of Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda.

In most of these countries, proper waste management strategies are still developing, with many unhealthy and dangerous practices occurring. While there is a push toward constructing controlled sanitary landfills across Africa, very few countries have taken initiatives or have the capabilities to pursue such an investment. More commonly, uncontrolled waste dumps are prevalent in large cities with informal collection, transportation, and disposal taking place.

When deciding on how to discard of waste on military installations, international regulations on waste movements across borders including the Basel and Bamako Conventions must be accounted for and followed as each of the focus countries are party to either one or both of the aforementioned conventions. This helps to control the unauthorized dumping of waste in countries without the ability to effectively manage the waste, due to insufficient equipment, facilities, funds, and knowledge.

11.2 Recommendations

Using the information contained in this report, a general understanding of the current waste management structure in Africa can be formed. While this report does not contain a full breakdown of the requirements for managing wastes in the field, it is an excellent resource for installation managers to better plan and expedite the disposal of waste at their facilities. This is a critical capability that will increase the effectiveness of OCONUS sites. Official Army regulations pertaining to waste management should be consulted and followed to construct an integrated waste management plan. As of November 2022, the following documents were available as resources for planning waste management: DoDI 4715.23, *Integrated Recycling and*

Solid Waste Management (31 August 2018); TM 3-34.56, *Waste Management for Deployed Forces* (29 March 2019); DoDI 4715.19, *Use of Open-Air Burn Pits in Contingency Operations* (13 November 2018); “Memorandum for Senior Pentagon Leadership: Exemption from Prohibition of Open-Air Burn Pits in Contingency Locations” (11 October 2022); and “Memorandum for Senior Pentagon Leadership: Interim Policy on Solid Waste Disposal Outside the United States.”

Bibliography

- Accra Compost and Recycling Plant Limited. 2022. "Home." <http://acarpghana.com/>.
- African Development Bank Group. 2017. "Sustainable Energy Fund for Africa Improves Waste-To-Energy Electricity in Kenya with US \$1 Million Grant." African Development Bank Group, December 21, 2017. <https://www.afdb.org/en/news-and-events/sustainable-energy-fund-for-africa-improves-waste-to-energy-electricity-in-kenya-with-us-1-million-grant-17709>.
- African Population and Health Research Center. 2017. *Solid Waste Management and Risks to Health in Urban Africa*. September 30. Nairobi, Kenya: African Population and Health Research Center. <https://aphrc.org/wp-content/uploads/2019/07/Urban-ARK-Nairobi-Report1.pdf>.
- Aguko, Kabok P, Michael O Oloko, Stephen G Agong, and John Odiaga Oloo. 2018. "Kachok Dumpsite Characteristics and Its Future—A Third Kenyan City Perspective." *International Journal of Waste Resources* 8 (2): 1–11. <http://dx.doi.org/10.4172/2252-5211.1000331>.
- Alami, Youness Saad. n.d. "Green Public Street Lighting in Fez." Solutions&Co. Accessed 14 November 2022. www.solutionsandco.org/project/green-public-street-lighting-in-fez/.
- Amahdar, Loubna, Abdellah Anouar, Bouchra Ababou, Luc Verschaeve, and Abderraouf Hilali. 2009. "In Vitro Genotoxicity Of Settatt Town Landfill Leachate, Morocco." *Arhiv za Higijenu Rada i Toksikologiju* 60 (2): 179–184. <https://www.doi.org/10.2478/10004-1254-60-2009-1925>.
- Angliviell, Suzanne, Johannes Betz, Andreas Manhart, Aditi Sahni, and Shahbano Soomro. 2021. *Closing the Loop on Energy Access in Africa*. Geneva: Switzerland: World Economic Forum. https://www3.weforum.org/docs/WEF_Closing_Loop_Energy_Access_2021.pdf.
- Aoike, Utako. 2019. "Household Waste and Local Solid Waste Collection in Niamey, Republic of Niger." *African Study Monographs* 58: 93–114. <http://dx.doi.org/10.14989/244121>.
- Aquila Recycling. n.d. "Home." <https://aquilarecycling.com/>.
- Asante Waste Management. n.d. "Contact." <https://www.asantewm.com/contact-us/>.
- Asante Waste Management. n.d. "E-Waste Recycling & Collection Services." <https://www.asantewm.com/for-business/disposal-recycling-services/e-waste-recycling-collection-services/>.
- Asouam, Saadia, Farid Faik, Zine El Abidine El Morjani, and Mohamed Abioui. 2021. "The Geological and Hydrogeological Characteristics of Tamelast Landfill Site in Agadir, Morocco." *E3S Web of Conferences* 234: 1–7. <https://doi.org/10.1051/e3sconf/202123400085>.

- Atiemo, Sampson, Lambert Faabeluon, Andreas Manhart, Letitia Nyaaba, and Tobias Schleicher. 2016. *Baseline Assessment on E-waste Management in Ghana*. Accra, Ghana: Sustainable Recycling Industries. https://www.sustainable-recycling.org/wp-content/uploads/2016/07/Sampson_2016_SRI-Ghana.pdf.
- Atlas Green Recycling. n.d. "About Us." Accessed 27 June 2022. <http://www.atlasgreen.net/>.
- Atlas Green Recycling. n.d. "Home." Accessed 27 June 2022. <http://www.atlasgreen.net/index.html>.
- Averda. 2016. "Changing the Central African Landscape—Averda in Gabon." News, January 29, 2016. <https://www.averda.com/news/changing-the-central-african-landscape-averda-in-gabon>.
- Awuor, Frankline Otiende, Belinda Nyakinya, John Oloo, Michael Oloko, and Stephen Gaya Agong. 2019. "How Did Kachok Dumpsite in Kisumu City Develop into a Crisis?" *Urban Forum* 30:115–131. <https://doi.org/10.1007/s12132-018-9342-7>.
- Bedat, Maxine. 2021. "See the Horrifying Place Where Your Old Clothes Go to Die." *Fast Company*, June 1, 2021. <https://www.fastcompany.com/90640931/see-the-horrifying-place-where-your-old-clothes-go-to-die>.
- Benson, Emily, and Sarah Mortensen. 2021. "The Basel Convention: From Hazardous Waste to Plastic Pollution." *Center for Strategic and International Studies*, October 7, 2021. <https://www.csis.org/analysis/basel-convention-hazardous-waste-plastic-pollution>.
- Beri, Kimbi Yaah Velma. 2018. "Improvement of the Waste Management System in Senegal." *Mediterranean Journal of Basic and Applied Sciences (MJBAS)* 2 (3): 105–126.
- Bissell, Theo. 2020. "Mbeubeuse Waste Dump." *Off Mayflower Hill* (blog). February 12, 2020. <https://web.colby.edu/offmayflowerhill/2020/02/12/mbeubeuse-waste-dump/>.
- Bizsmart. n.d. "Residential Waste Management." Bizmart. <http://www.bsmart.co.ke/index.php/services/residential-waste-management>.
- Business & Financial Times, The*. 2021. "Engineered Landfill Site Underway in Accra — Sanitation Minister." December 15, 2021. <https://thebftonline.com/2021/12/15/engineered-landfill-site-underway-in-accra-sanitation-minister/>.
- Camara, Camille, and Andrew Clark. n.d. "Economy of Senegal." In *Britannica*, Encyclopædia Britannica. Accessed June 2022. <https://www.britannica.com/place/Senegal/Economy>.
- CGTN Africa. 2018. "Controlling Waste in Uganda's Kampala." April 14, 2018. YouTube video, 1:50. https://www.youtube.com/watch?v=HNZEEf_y0cw&t=2s.

- CGTN America. 2015. "Waste Management Issues in Ghana Beg for Private, Public Cooperation." March 3, 2015. YouTube video, 3:49. <https://www.youtube.com/watch?v=1s8ffwrlEE>.
- Chofqi, Amina, Abedelkader Younsi, El Kbir Lhadi, Jacky Mania, Jacques Mudry, and Alain Veron. 2004. "Environmental Impact of an Urban Landfill on a Coastal Aquifer (El Jadida, Morocco)." *Journal of African Earth Sciences* 39 (3–5): 509–516. <https://doi.org/10.1016/j.jafrearsci.2004.07.013>.
- CIA (Central Intelligence Agency). 2022a. "Gabon." In *The World Factbook*. CIA, June 21, 2022. Accessed June 2022. <https://www.cia.gov/the-world-factbook/countries/gabon/>.
- CIA. 2022b. *Ghana*. In *The World Factbook*. CIA, June 6, 2022. <https://www.cia.gov/the-world-factbook/countries/ghana/>.
- CIA. 2022c. *Kenya*. In *The World Factbook*. CIA, June 7, 2022. <https://www.cia.gov/the-world-factbook/countries/kenya/#geography>.
- CIA. 2022d. *Morocco*. In *The World Factbook*. CIA, June 8, 2022. <https://www.cia.gov/the-world-factbook/countries/morocco/#geography>.
- CIA. 2022e. *Niger*. In *The World Factbook*. CIA, June 7, 2022. <https://www.cia.gov/the-world-factbook/countries/niger/#geography>.
- CIA. 2022f. *Senegal*. In *The World Factbook*. CIA, June 6, 2022. <https://www.cia.gov/the-world-factbook/countries/senegal/#geography>.
- CIA. 2022 g. *Uganda*. In *The World Factbook*. CIA, June 6, 2022. <https://www.cia.gov/the-world-factbook/countries/uganda/#geography>.
- Coliba Ghana. n.d. "Services." <https://www.coliba.com.gh/our-services/>.
- Dados, Nour, and Raewyn Connell. 2012. "The Global South." *Contexts* 11 (1): 12–13. <https://doi.org/10.1177/1536504212436479>.
- Dalberg Advisors. 2019. *Stop the Flood of Plastic: How Mediterranean Countries Can Save Their Sea*. WWF Mediterranean Marine Initiative. https://wwfeu.awsassets.panda.org/downloads/05062019_wwf_marocco_guidebook.pdf.
- Dispose Green. n.d. "About." Accessed May 2022. <https://disposegreen.com/about/>.
- Dispose Green. n.d. "Home." <https://disposegreen.com/>.
- Eagle Online. 2021. *Speciosa Kazibwe, Ddundu Villagers Reject KCCA's Plan to Dump Garbage in Their Area*. October 5, 2021. <https://eagle.co.ug/2021/10/05/speciosa-kazibwe-ddundu-villagers-reject-kccas-plan-to-dump-garbage-in-their-area.html>.

EAP Consult Limited. n.d. "Decommissioning and Reengineering of Kpone & Oti Landfill Site." Projects. <https://eap.com.gh/portfolio/design-of-waste-landfill-site/>.

Eco Brixx. n.d. "Home." <https://www.ecobrixx.org/>.

Edokpayi, Joshua N., John O. Odiyo, Olatunde S. Durowoju, and Ahmed Adetoro. 2017. "Household Hazardous Waste Management in Sub-Saharan Africa." In *Household Hazardous Waste Management*, edited by Daniel Mmereki. London: IntechOpen. <http://dx.doi.org/10.5772/66292>.

Ehui, Simeon. 2020. "You Only See Trash. We See a Treasure Trove', Why Waste Management in Senegal is a Critical Step toward Sustainability." *World Bank Blogs*, March 9, 2020. <https://blogs.worldbank.org/nasikiliza/you-only-see-trash-we-see-treasure-trove-why-waste-management-senegal-critical-step>.

Electro Recycling. n.d. "About." *Electro Recycling Ghana*. Accessed September 8, 2023. <https://www.electro-recycling.com/about>.

Electro Recycling. n.d. "Contact Us." *Electro Recycling Ghana*. Accessed September 8, 2023. <https://www.electro-recycling.com/contact>.

Electro Recycling. n.d. "Plastic recycling and shredding." *Electro Recycling Ghana*. Accessed September 8, 2023. <https://www.electro-recycling.com/services/plastic-recycling>.

El Jalil, Mounaim Halim, Hind Elkrauni, Mohamed Khamar, Abdelhakim Bouyahya, Hecham Elhamri, Essediya Cherkaoui, and Abderrahman Nounah. 2020. "Physicochemical Characterization of Leachates Produced in the Rabat-Salé-Kénitra Region Landfill Technical Center and Monitoring of Their Treatment by Aeration and Reverse Osmosis." In *E3S Web of Conferences*, The Seventh International Congress "Water, Waste and Environment" (EDE7-2019), 20–22 November 2019, Salé, Morocco, 150: 1–7. <https://doi.org/10.1051/e3sconf/202015002013>.

EPA (Environmental Protection Agency). 2021. "International Agreements on Transboundary Shipments of Hazardous Waste." Hazardous Waste Generators. Last updated October 17, 2021. <https://www.epa.gov/hwgenerators/international-agreements-transboundary-shipments-hazardous-waste>.

French Press Agency. 2021. "Don't Bang on My Can! Morocco Takes Baby Steps to Recycling Waste." *Daily Sabah*, December 20, 2021. <https://www.dailysabah.com/life/environment/don't-bang-on-my-can-morocco-takes-baby-steps-to-recycling-waste>.

GhanaWeb. 2016. "Kumasi Gets New Modern Landfill Site." *GhanaWeb*, August 26, 2016. <https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Kumasi-gets-new-modern-landfill-site-465178>.

- GhanaWeb. 2018. "Voltic Ghana Ltd Partners 7 Companies to Fund Waste Recycling Projects." *GhanaWeb*. May 7, 2018. <https://www.ghanaweb.com/GhanaHomePage/television/news/Voltic-Ghana-Ltd-partners-7-companies-to-fund-waste-recycling-project-35895>.
- Gichinga, Martin. 2020. "Gioto Dumpsite—Nakuru's Dumping Site Since 1972." *Famous Nakuru*, January 4, 2020. <https://famousnakuru.co.ke/gioto-dumpsite-nakurus-dumping-site-since-1972/>.
- GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). 2021. *Sector Brief Senegal: Solid Waste Management and Recycling*. Eschborn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit. https://www.giz.de/de/downloads/SectorBrief_Senegal_Waste.pdf.
- Global Green Growth Institute. 2021. "Mayors across the Greater Kampala Metropolitan Area Meet to Discuss the Proposed Solid Waste Management Strategy." News, December 9, 2021. <https://gggi.org/mayors-across-the-greater-kampala-metropolitan-area-meet-to-discuss-the-proposed-solid-waste-management-strategy/>.
- Gravita India Limited. 2019. "Recyclers Ghana Limited Started Commercial Production of Lead from Its Plant Situated at Ghana, West Africa." News, June 4, 2019. <https://www.gravitaindia.com/recyclers-ghana-limited-started-commercial-production-of-lead-from-its-plant-situated-at-ghana-west-africa/>.
- Hammer, Christian. 2018. "Niger Waste Management." Logistics Cluster. Last updated May 11, 2018. <https://dlca.logcluster.org/37-niger-waste-management>.
- Hantchi, Karimou Dia, Oumarou Zango, Amadou Oumarou, Boubé Morou, and Moussa Konaté. 2022. "Wasteland and Empty Plots Trivialization in the Maradi City (Niger): Between Environmental Degradation and Consequent Nuisance, Quality of Life and Sustainability of Biodiversity." *Occupational Diseases and Environmental Medicine* 10 (1): 13–34. <https://doi.org/10.4236/odem.2022.101002>.
- Hoel, Arne. 2013. "Morocco: Improving Municipal Solid Waste Management through Development Policy Operations." Projects & Operations. What We Do. The World Bank, May 22, 2013. [https://www.worldbank.org/en/results/2013/05/22/morocco-improving-municipal-solid-waste-management-through-development-policy-operations#:~:text=The%20program%20consisted%20of%20two%20single-tranche%20DPL%20loans,loan%20of%20US\\$24138.6%20was%20approved%20](https://www.worldbank.org/en/results/2013/05/22/morocco-improving-municipal-solid-waste-management-through-development-policy-operations#:~:text=The%20program%20consisted%20of%20two%20single-tranche%20DPL%20loans,loan%20of%20US$24138.6%20was%20approved%20).
- Japan International Cooperation Agency. 2016. *Project for Urban Master Plan of Dakar and Neighboring Area for 2035*. Senegal: Department of Urbanization and Architecture.
- Jellison, Hayley. 2019. "10 Facts About Life Expectancy in Niger." *The Borgen Project* (blog), October 3, 2019. <https://borgenproject.org/10-facts-about-life-expectancy-in-niger/#:~:text=In%202017%2C%20Niger%20ranked%20189th,knowledge%20and%20quality%20of%20life>.

- Jordan, Steeve. 2021. "Going to Waste: The Children Who Survive on Gabon's Garbage Dumps." *eNCA*, July 6, 2021. <https://newsinfo.inquirer.net/1456279/going-to-waste-the-children-who-survive-on-gabons-garbage-dumps>.
- Kinyanjui, Maureen. 2021. "Separate and Recycle Waste, Nairobi Residents Told." *The Star*, January 4, 2021. <https://www.the-star.co.ke/counties/nairobi/2021-01-04-separate-and-recycle-waste-nairobi-residents-told/>.
- Kokole, Omari H., Kenneth Ingham, Maryinez Lyons, and M. Semakula M. Kiwanuka. n.d. "Economy of Uganda." In *Britannica*, Encyclopædia Britannica. Accessed June 2022. <https://www.britannica.com/place/Uganda/Economy>.
- Komakech, Allan J., Noble E. Banadda, Joel R. Kinobe, Levi Kasisira, Cecilia Sundberg, Girma Gebresenbet, and Bjorn Vinneras. 2014. "Characterization of municipal waste in Kampala, Uganda." *Journal of the Air & Waste Management Association* 1-9.
- Kumasi Compost and Recycling Plant Limited. n.d. "About Us." <https://kcarpltd.com/about-us/>.
- Kumasi Compost and Recycling Plant Limited. n.d. "Home." <https://kcarpltd.com/>.
- MACARPA. n.d. "Home." <https://www.macarpa.com/>.
- Madinah, Nabukeera, Ali Boerhannoeddin, and Raja Noriza Binti Raja Ariffin. 2014. "Sustainable Management of KCCA Mpererwe Landfill: History, Present, Future Possibilities and Solutions. A Qualitative Study." *IOSR Journal of Environmental Science, Toxicology and Food Technology* 8 (11): 87–95. <http://dx.doi.org/10.9790/2402-081138795>.
- Magoum, Inès. 2020a. "GABON: Municipalities to Handle Their Household Waste, Henceforth." *Afrik21*, May 21, 2020. <https://www.afrik21.africa/en/gabon-municipalities-to-handle-their-household-waste-henceforth/>.
- Magoum, Inès. 2020b. "GABON: Towards Door-To-Door Technology for Collecting Brewery Waste." *Afrik21*, April 10, 2020. <https://www.afrik21.africa/en/gabon-towards-door-to-door-technology-for-collecting-brewery-waste/>.
- Magoum, Inès. 2020c. SENEGAL: Savoie Obtains Management of the Gandigal Landfill Site. *Afrik21*, November 12, 2020. <https://www.afrik21.africa/en/senegal-savoie-obtains-management-of-the-gandigal-landfill-site/>.
- Magoum, Inès. 2021a. SENEGAL: Proplast Will Recycle 200 Tons of Plastic Per Year, in Agreement with UCG. *Afrik21*, November 24, 2020. <https://www.afrik21.africa/en/senegalproplast-will-recycle-200-tons-of-plastic-per-year-in-agreement-with-the-ucg/>.
- Magoum, Inès. 2021b. SENEGAL: The UCG Launches a Waste Collection Operation in Several Communes. *Afrik21*, April 6, 2020. <https://www.afrik21.africa/en/senegal-the-ucg-launches-a-waste-collection-operation-in-several-communes/>.

- Mariwah, Simon. 2020. *The Sanitation and Waste Management Conundrum in Ghana: The Case for High Level Prioritization and Fiscal Incentives*. IMANI Center for Policy & Education. https://imaniafrica.org/wp-content/uploads/2020/06/Sanitation-and-Waste-Management-Conundrum-in-Ghana_Final.pdf.
- Marmet Recycling. n.d. "Reception." <https://marmetre recycling.com/>.
- Meyerhoff, Robin. 2020. "Ghana's Ambitious Plan to Minimize Plastic Waste." *Forbes*, October 22, 2020. <https://www.forbes.com/sites/sap/2020/10/22/ghanas-ambitious-plan-to-minimize-plastic-waste/?sh=87e832ba3274>.
- Ministry of Environment and Forestry. 2019. *National Sustainable Waste Management Policy*. Kenya Ministry of Environment and Forestry. April 24. Accessed 28 June 2022. <https://academia-ke.org/library/download/mef-national-sustainable-waste-management-policy-draft-april-2019/?wpdmdl=7510&refresh=64b9f34a4ad291689908042>.
- Ministry of Sanitation and Water Resources. 2020. *National Solid Waste Management Strategy for Ghana*. Republic of Ghana Ministry of Sanitation and Water Resources. <https://ghanawasteplatform.org/wp-content/uploads/2021/11/National-Solid-Waste-Management-2020.pdf>.
- Misachi, John. 2017. "Biggest Cities in Senegal." WorldAtlas. <https://www.worldatlas.com/articles/biggest-cities-in-senegal.html>.
- Mongabay. n.d. "Largest Cities in Senegal." <https://population.mongabay.com/population/senegal/>.
- Monitor. 2020. "Government to Determine Garbage Fees in Kampala." September 17, 2020. <https://www.monitor.co.ug/uganda/news/national/government-to-determine-garbage-fees-in-kampala-1829044>.
- Mr. Green Africa. n.d. "Green Points." Accessed September 18, 2023. <https://www.mrgreenafrica.com/greenpoints>.
- Mr. Green Africa. n.d. "Home." Accessed September 18 2023. <https://www.mrgreenafrica.com/>.
- Mutua, John. 2019. "Nairobians to Pay New Fire, Pets and Garbage Fees." *Nairobi News*, July 17, 2019. <https://nairobinews.nation.africa/nairobians-to-pay-new-fire-pets-and-garbage-fees/>.
- Nag, Oishimaya Sen. 2017. "The Largest Cities in Gabon." World Atlas, April 25, 2017. <https://www.worldatlas.com/articles/the-largest-cities-in-gabon.html>.
- NAMé Recycling. n.d. "Home." <https://www.name-recycling.com/>.
- NAMé Recycling. n.d. "NAMé Gabon." <https://www.name-recycling.com/gabon>.

- Ndiaye, Mademba. 2020. "Senegal to Improve Governance and Solid Waste Management." Press Release. News. The World Bank. <https://www.worldbank.org/en/news/press-release/2020/03/05/senegal-to-improve-governance-and-solid-waste-management>.
- NEMA of Kenya (National Environment Management Authority). 2015. *The National Solid Waste Management Strategy*. Nairobi, Kenya: National Environment Management Authority of Kenya. <https://www.nema.go.ke/images/Docs/Media%20centre/Publication/National%20Solid%20Waste%20Management%20Strategy%20.pdf>.
- NEMA of Uganda (National Environment Management Authority). 2019. *List of Licensed Waste Handlers in Uganda*. Kampala, Uganda: National Environment Management Authority of Uganda. [http://nema.go.ug/sites/all/themes/nema/docs/2019%20\(List%20of%20Licensed%20Waste%20Handlers%20as%20at%2030th%20June%202019\).pdf](http://nema.go.ug/sites/all/themes/nema/docs/2019%20(List%20of%20Licensed%20Waste%20Handlers%20as%20at%2030th%20June%202019).pdf).
- Ngounou, Boris. 2020. "AFRICA: Bamako Convention on Hazardous Wastes 22 Years on." *Afrik21*, February 17, 2020. <https://www.afrik21.africa/en/africa-bamako-convention-on-hazardous-wastes-22-years-on/>.
- Office of Environmental Quality. n.d. "Basel Convention on Hazardous Wastes." Key Topics—Office of Environmental Quality. US Department of State. Accessed 17 October 2022. <https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/basel-convention-on-hazardous-wastes/>.
- Ottiger, Fabian. 2020. "New Collaborative Effort on Standard Operating Procedures for Battery Recycling Launched." Sustainable Recycling Industries, July 6, 2020. <https://www.sustainable-recycling.org/new-collaborative-ghana/>.
- OUSDA(A&S) (Office of the Under Secretary of Defense for Acquisition and Sustainment). 2018. *Use of Open-Air Burn Pits in Contingency Operations*. DoD Instruction 4715.19. Washington, DC: Department of Defense <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/471519p.pdf?ver=2018-11-14-103736-647>.
- Oyake-Ombis, Leah. 2018. "How Nairobi Can Fix Its Serious Waste Problem." *Quartz*, March 25, 2018. <https://qz.com/africa/1237034/how-nairobi-kenya-fixes-its-waste-management-problem/>.
- Ploch, Lauren. 2011. *Africa Command: US Strategic Interests and the Role of the U.S. Military in Africa*. Congressional Research Service. <https://sgp.fas.org/crs/natsec/RL34003.pdf>.
- PPPU (Public Private Partnerships Unit). 2018. "Kampala Solid Waste Management." Projects. <http://disclosure.pppunit.go.ug/project/14/kampala-solid-waste-management>.
- Proplast Industrie. n.d. "FAQ." <https://www.proplast-industrie.sn/faq/>.

- Sackey, Lyndon Nii Adjiri, and Kojo Meizah. 2015. "Assesement of the Quality of Leachate at Sarbah Landfill Site at Weija in Accra." *Journal of Environmental Chemistry and Ecotoxicology* 7 (6): 56–61. <https://www.doi.org/10.5897/JECE2015.0355>.
- Saghir, Mohammed, Youssef Naimi, Laila Laasri, and Mohamed Tahiri. 2019. "Energy Recovery from Municipal Solid Waste in Oujda City (Morocco)." *Journal of Engineering Science and Technology Review* 12 (1): 137–142. <http://dx.doi.org/10.25103/jestr.121.16>.
- Sawe, Benjamin E. 2017a. "Biggest Cities in Niger." World Atlas, April 25, 2017. <https://www.worldatlas.com/articles/biggest-cities-in-niger.html>.
- Sawe, Benjamin E. 2017b. "Biggest Cities In Uganda." World Atlas, April 25, 2017. <https://www.worldatlas.com/articles/the-biggest-cities-in-uganda.html>.
- Sawe, Benjamin E. 2018. "Biggest Cities in Ghana." World Atlas, November 22, 2018. <https://www.worldatlas.com/articles/the-biggest-cities-in-ghana.html>.
- Shane, Leo, III. 2022. What are Military Burn Pits? And Why are Veterans Worried about Them? *Military Times*, March 29, 2022. <https://www.militarytimes.com/news/burn-pits/2022/03/29/what-are-military-burn-pits-and-why-are-veterans-worried-about-them/>.
- Sheth, Khushboo. 2019. "The Biggest Cities In Morocco." World Atlas, April 30, 2019. <https://www.worldatlas.com/articles/biggest-cities-in-morocco.html>.
- Shukla, Nikita. 2020. "How The Basel Convention has Harmed Developing Countries." Earth.Org, March 30, 2020. <https://earth.org/how-the-basel-convention-has-harmed-developing-countries/>.
- Smahi, Driss, Ahmed Fekri, and Ouafa El Hammoumi. 2013. "Environmental Impact of Casablanca Landfill on Groundwater Quality, Morocco." *International Journal of Geosciences* 4 (1): 202–211. <https://www.doi.org/10.4236/ijg.2013.41017>.
- SNV. 2017. "Cleaning Up Niamey, One Innovation at a Time." News and Stories. SNV, August 16, 2017. <https://snv.org/update/cleaning-niamey-one-innovation-time>.
- Song'oro, Edinah, Andrew Nyerere, Gabriel Magoma, and Revathi Gunturu. 2019. "Occurrence of Highly Resistant Microorganisms in Ruai Wastewater Treatment Plant and Dandora Dumpsite in Nairobi County, Kenya." *Advances in Microbiology* 9 (5): 479–494. <https://www.doi.org/10.4236/aim.2019.95029>.
- Stoisser, Max. 2020. "Waste Pickers of Kpone Landfill Fight for Recognition and Formal Inclusion, Accra, Ghana." Environmental Justice Atlas, May 14, 2020. <https://ejatlas.org/print/waste-pickers-fight-for-recognition-and-inclusion-as-kpone-landfill-closes-accra-ghana>.
- Styles, Lucy. 2015. "Uganda Waste Management and Disposal Providers." Logistics Cluster, January 25, 2015. <https://dlca.logcluster.org/37-uganda-waste-management-and-disposal-providers>.

- Sustainable Waste Management Bill, The, (2021) Kenya *Gazette* Supplement No. 92.
<http://www.parliament.go.ke/sites/default/files/2022-05/The%20Sustainable%20Waste%20Management%20Bill%20%28%20National%20Assembly%20Bills%20No.%2022%29%202021.pdf>.
- SWEEP-Net (Solid Waste Exchange of Information and Expertise Network in the MENA Region). 2014. *Report on the Solid Waste Management in Morocco*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). https://www.retech-germany.net/fileadmin/retech/05_mediathek/laenderinformationen/Marokko_RA_ANG_WEB_Laenderprofile_sweep_net.pdf.
- Takataka Plastics. n.d. "Home." <https://www.takatakaplastics.com/>.
- Takataka Solutions. 2022. "Home." <https://takatakasolutions.com/>.
- Takouleu, Jean Marie. 2019. "GABON: Prospect of a Levy on Household Waste is Becoming Clearer." *Afrik21*, November 15, 2019. <https://www.afrik21.africa/en/gabon-prospect-of-a-levy-on-household-waste-is-becoming-clearer/>.
- Tokyo Engineering Consultants Co., Ltd., and Yachiyo Engineering Co., Ltd. 2001. *The Study on Sanitation Improvement for the Niamey City in the Republic of Niger*. Japan International Cooperation Agency. <https://openjicareport.jica.go.jp/pdf/11674348.pdf>.
- UNDP (United Nations Development Programme). n.d. Gabon dataset. United Nations Development Reports. <https://hdr.undp.org/en/countries/profiles/GAB>.
- UNDP. 2020. *Human Development Report 2020: The Next Frontier: Human Development and the Anthropocene*. New York:United Nations. <https://hdr.undp.org/content/human-development-report-2020>.
- UNDP. 2021. "Innovative Solutions for Waste Management Challenge." Ghana. <https://www.gh.undp.org/content/ghana/en/home/presscenter/pressreleases/2021/innovative-solutions-for-waste-management-challenge.html>.
- UNDP. 2022. Human Development Index (HDI) dataset. Human Development Reports. Accessed 24 October 2022. <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>.
- UNEP (United Nations Environment Programme). 2018a. *Africa Waste Management Outlook*. Nairobi, Kenya: United Nations Environment Programme. <https://wedocs.unep.org/20.500.11822/25514>.

- UNEP. 2018b. *Report by the Secretariat on the Implementation of the Bamako Convention*. Conference of the Parties to the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, Second Meeting of the Conference of the Parties to the Bamako Convention. Nairobi, Kenya: United Nations Environment Programme. <https://wedocs.unep.org/bitstream/handle/20.500.11822/22665/Report%20by%20the%20Secretariat.pdf?sequence=1&isAllowed=y#:~:text=The%20Parties%20to%20the%20convention,%2C%20Tunisia%2C%20Uganda%20and%20Zimbabwe.>
- UPMRA (Uganda Plastics Manufacturers And Recyclers Association). n.d. "Home." <https://upmra.org/>.
- Ujamaa Waste Services. n.d. "Home." <https://ujamaawasteservices.co.ke/>.
- USAID (US Agency for International Development). n.d. "Agriculture and Food Security." Niger. Accessed 17 July 2021. <https://www.usaid.gov/niger/agriculture-and-food-security>.
- USAID. n.d. "Economic Growth and Trade." Kenya. Accessed 8 June 2022. <https://www.usaid.gov/kenya/economic-growth-and-trade>.
- USD(A&S) (Under Secretary of Defense for Acquisition and Sustainment). 2019. *Open Burn Pit Report to Congress*. Washington, DC: Department of Defense. <https://www.acq.osd.mil/eie/Downloads/Congress/Open%20Burn%20Pit%20Report-2019.pdf>.
- US Department of State. 2022a. "Gabon Travel Advisory." October 4, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/gabon-travel-advisory.html>.
- US Department of State. 2022b. "Ghana Travel Advisory." October 4, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/ghana-travel-advisory.html>.
- US Department of State. 2022c. "Kenya Travel Advisory." October 4, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/kenya-travel-advisory.html>.
- US Department of State. 2022d. "Morocco Travel Advisory." October 5, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/morocco-travel-advisory.html>.
- US Department of State. 2022e. "Niger Travel Advisory." October 5, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/niger-travel-advisory.html>.
- US Department of State. 2022f. "Senegal Travel Advisory." October 5, 2022. <https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/senegal-travel-advisory.html>.

- US Department of State. 2022g. "Uganda Travel Advisory." October 6, 2022.
<https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories/uganda-travel-advisory.html>.
- US Department of Veterans Affairs. n.d. "Airborne Hazards and Burn Pit Exposures." Military Exposures. Public Health. Health Care. Accessed 18 October 2022.
<https://www.publichealth.va.gov/exposures/bumpits/>.
- Vintz Plastics. n.d. "Home." <https://vintzplastics.com/>.
- Waita, Edwin. 2021. "Kenyan Recycles Plastic Waste into Bricks Stronger Than Concrete." *Reuters*, February 2, 2021. Accessed 14 July 2022.
<https://www.reuters.com/article/us-kenya-environment-recycling/kenyan-recycles-plastic-waste-into-bricks-stronger-than-concrete-idUSKBN2A211N>.
- Wanyama, Khaosa. 2020. "List of 10 Major Cities in Kenya." *Urban Kenyans*, January 23, 2020. <https://urbankenyans.com/list-of-10-major-cities-in-kenya/>.
- WEEE Centre. n.d. "Services." <https://weeecentre.com/services/>.
- World Bank. n.d. "World Bank Country and Lending Groups." Accessed 12 July 2022.
<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>.
- World Bank. 2013. "World Bank Supports Good Governance and Environmental Practices for Solid Waste Management in Morocco." *News*, February 14, 2013.
<https://www.worldbank.org/en/news/press-release/2013/02/14/world-bank-supports-good-governance-environmental-practices-solid-waste-management-morocco#:~:text=World%20Bank%20Supports%20Good%20Governance%20and%20Environmental%20Practices,up%20to%2070%2C000%>.
- World Bank. 2019. *What a Waste Global Database*. Last updated March 4, 2019.
<https://datacatalog.worldbank.org/search/dataset/0039597/What-a-Waste-Global-Database>.
- World Bank. 2020a. *Executive Summary of the Environmental and Social Assessment (ESIA) for the Rehabilitation of the Mbeubeuss Dumpsite*. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/929951579279932576/Senegal-Municipal-Solid-Waste-Management-Project-Environmental-and-Social-Impact-Assessments-for-Mbeubeuss-and-Mbao-Executive-Summary>.
- World Bank. 2020b. *Poverty & Equity Brief: Sub-Saharan Africa*. Washington, DC: World Bank. https://databankfiles.worldbank.org/public/ddpext_download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/Global_POVEQ_SSA.pdf.
- World Bank. 2022a. *Morocco's Economic Update*. Washington, DC: World Bank.
<https://www.worldbank.org/en/country/morocco/publication/economic-update-april-2022>.
- World Bank. 2022b. "Overview." *Ghana. Where We Work*. Last updated April 7, 2022.
<https://www.worldbank.org/en/country/ghana/overview#1>.

- World Bank. 2022c. "Overview." Niger. Where We Work. Last updated April 13, 2022. <https://www.worldbank.org/en/country/niger/overview#1>.
- World Bank Open Data. 2020. Individuals Using the Internet—Ghana. Accessed 8 July 2022. <https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=GH>.
- World Bank Open Data. 2021a. GNI Per Capita, Atlas Method (Current US\$)—Gabon, Ghana, Kenya, Morocco, Niger, Senegal, Uganda. <https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=GA-GH-KE-MA-NE-SN-UG>.
- World Bank Open Data. 2021b. Population, Total—Gabon, Ghana, Kenya, Morocco, Niger, Senegal, Uganda. Accessed 8 November 2022. https://data.worldbank.org/indicator/SP.POP.TOTL?locations=GA-GH-KE-MA-NE-SN-UG&name_desc=false.
- World Bank Open Data. 2021c. Urban Population—Gabon, Ghana, Kenya, Morocco, Niger, Senegal, Uganda. Accessed 8 November 2022. https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?end=2021&locations=GA-GH-KE-MA-NE-SN-UG&name_desc=false&start=1960&view=chart.
- World Health Organization. 2008. *Health Security through Healthy Environments: First Interministerial Conference on Health and Environment in Africa*. Libreville, Gabon, 26–29 August 2008. Geneva, Switzerland: World Health Organization. <https://climhealthisafrica.org/wp-content/uploads/2015/12/Report-of-the-Libreville-Conference.pdf>.
- Yeung, Peter. 2019. "The Toxic Effects of Electronic Waste in Accra, Ghana." *Bloomberg*, May 29, 2019. <https://www.bloomberg.com/news/articles/2019-05-29/the-rich-world-s-electronic-waste-dumped-in-ghana>.
- Zineb, Hamri, Mouhir Latifa, Saafadi Laila, and Souabi Salah. 2019. "Impact of the Mohammedia Benslimane Landfill on the Quality of Groundwater and Surface Water." In, *Advanced Intelligent Systems Applied to Environment*, 12–14 July 2018, Tangier, Morocco, edited by Mostafa Ezziyyani, 280–288. Vol. 3 of *Advanced Intelligent Systems for Sustainable Development (AI2SD'2018)*. Cham, Switzerland: Springer, Cham. https://doi.org/10.1007/978-3-030-11881-5_25.

Appendix A: Location of Disposal Facilities

To assist in locating potential waste management and disposal locations, a list documenting disposal facilities found in each focus country has been created. The section for each country includes waste management sites that include landfills, waste collection companies, recycling companies, etc., and each named site is provided with its coordinate location, description of the location, type of waste they collect or manage, and amount they collect, if the information was available. These were found using company websites, Google Maps, and research articles, and the list was last updated November 2022.

A.1 Gabon

Gabon is a country located on the western coast of Central Africa on the southern edge of the Gulf of Guinea. There were only two disposal locations found in all of Gabon, which are located in Libreville in the north-western corner of the country. Figure A-1 shows the locations of disposal facilities in Gabon. Table A-1–Table A-3 provide details for each.

Figure A-1. Locations of disposal facilities in Gabon.

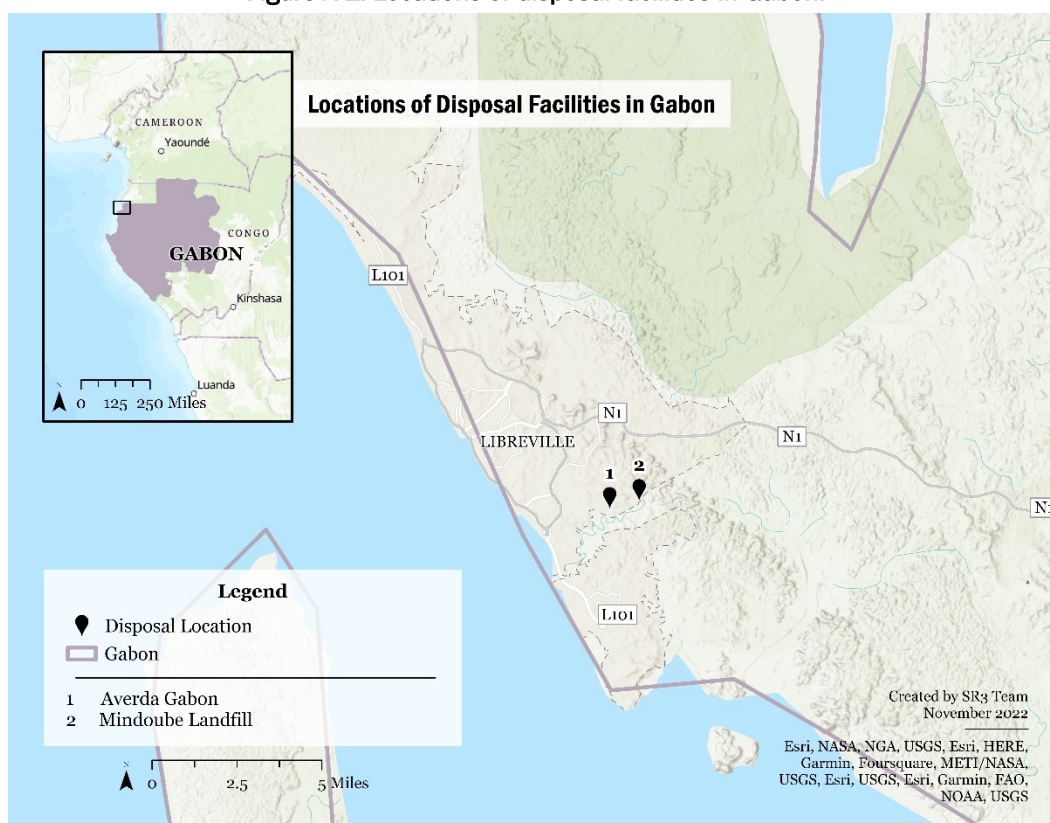


Table A-1. Averda Gabon (household waste collection company).

Coordinates	0.37104, 9.49715*
Location Description	Approximately 3.5 miles from the center of Libreville*
Waste Composition	Household waste, rubble, garden waste and refuse from informal garbage dumps, local markets, fairs, etc.†
Amount Collected	—

Sources: * Coordinates for Averda Gabon. Google Maps. Accessed 3 November 2022. <https://www.google.com/maps/place/AVERDA+GABON/@0.3710058,9.4963536,18.7z/data=!4m5!3m4!1s0x107f3d9784349a8d0:6590dda155edb67c!8m2!3d0.3710613!4d9.4971345>.

† (Averda 2016)

Table A-2. Mindoube Landfill (uncontrolled).

Coordinates	0.37445, 9.50968*
Location Description	Located on the outskirts of Libreville† near the Mindoube Cemetery
Waste Composition	Copper, aluminum, e-waste†
Amount Collected	800 tons of waste per day†

Sources: * Coordinates for Mindoube Landfill. MapCarta. Accessed 25 October 2022. <https://mapcarta.com/W542391604>.

† (Jordan 2021)

Table A-3. NAMé Recycling (not shown on map).

Coordinates	—
Location Description	Libreville, BP 1,096, Angondjé, Akanda, Gabon*
Waste Composition	Polyethylene terephthalate (PET), high density polyethylene (HDPE), low density polyethylene (LDPE)*
Amount Collected	73,900,000 bottles collected between the three plants*

Sources: * (NAMé Recycling, n.d., "Home")

A.2 Ghana

Ghana is a country located in West Africa on the north side of the Gulf of Guinea. There are many disposal locations in Ghana that can be seen in Figure A-2. Table A-4–Table A-15 provide details for each.

Figure A-2. Locations of disposal facilities in Ghana.

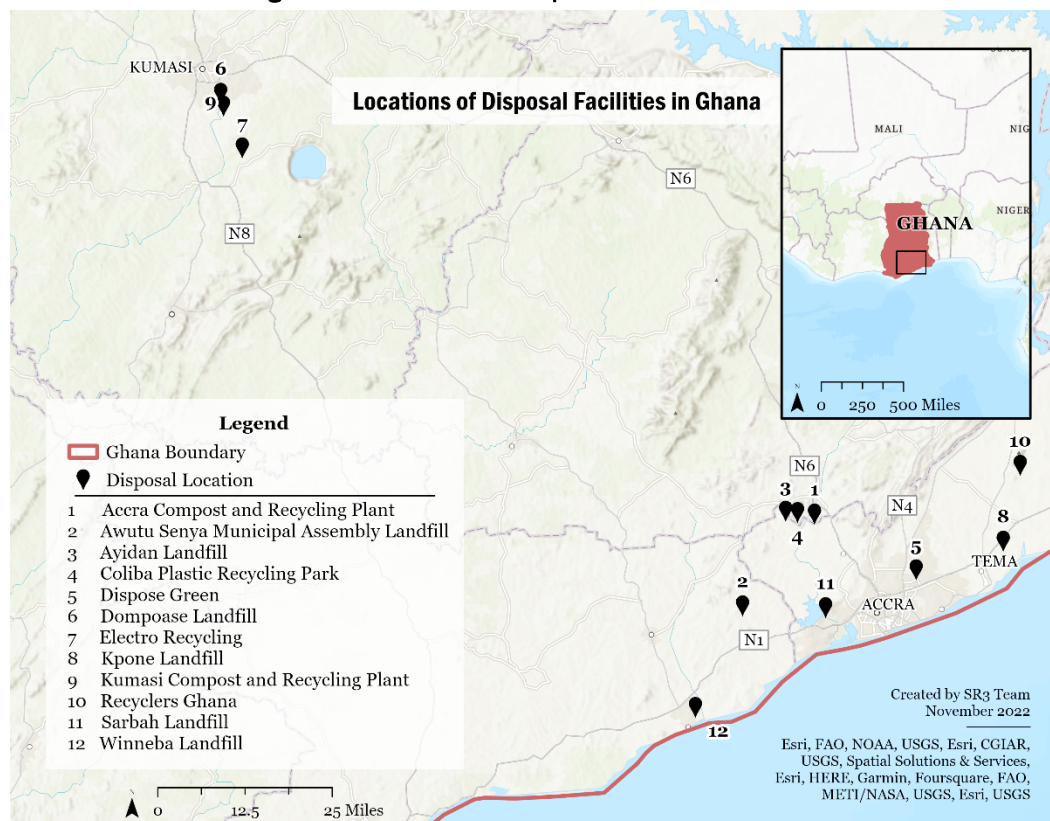


Table A-4. Accra Compost and Recycling Plant.

Coordinates	5.75982, -0.36214*
Location Description	Located in Accra, Adjen Kotoku, Near Medie, Accra-Nsawam Road†
Waste Composition	Accepts organic wastes, e-wastes, textiles, plastics, and papers, either sorted and recycled at the plant or sent to another facility‡
Amount Collected	600 tons of MSW per day, 100 tons of compost per day†

Sources: * Coordinates for Accra Compost & Recycling Plant (ACARP) Ltd. Google Maps. Accessed 3 November 2022.

[https://www.google.com/maps/place/Accra+Compost+%26+Recycling+Plant+\(ACARP\)+Ltd/@5.7596269,-0.3624957,19.75z/data=!4m5!3m4!1s0xfdf0a3a4684f5cd:0xa1a65401822e541f18m2!3d5.759689314d-0.3621606](https://www.google.com/maps/place/Accra+Compost+%26+Recycling+Plant+(ACARP)+Ltd/@5.7596269,-0.3624957,19.75z/data=!4m5!3m4!1s0xfdf0a3a4684f5cd:0xa1a65401822e541f18m2!3d5.759689314d-0.3621606)

† (Accra Compost and Recycling Plant Limited 2022)

‡ (CGTN America 2015)

Table A-5. Awutu Senya Municipal Assembly Landfill.

Coordinates	5.57086, -0.51107*
Location Description	Loye, Ghana*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Awutu Senya Municipal Assembly Landfill. Google Maps. Accessed 3 November 2022. [Awutu Senya Municipal Assembly Landfill - Google Maps](#).

Table A-6. Ayidan Landfill.

Coordinates	5.76582, -0.42188*
Location Description	Ga South Municipal of the Greater Accra Region†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Ayidan Landfill Site. Mapcarta. Accessed 3 November 2022. <https://mapcarta.com/W854265282>.

† (The Business & Financial Times 2021)

Table A-7. Coliba Plastic Recycling Park.

Coordinates	5.76308, -0.39736*
Location Description	House No 25, Dela Avenue, Adjacent NHIS office, Abe-ka Lapaz, Accra†
Waste Composition	Cans, glass bottles, paper and cardboard, and plastics such as PET, HDPE, LDPE†
Amount Collected	700 tons of waste recycled in total†

Sources: * Coordinates for Coliba Plastic Recycling Park. Google Maps. Accessed 3 November 2022. <https://www.google.com/maps/place/Coliba+Plastic+Recycling+Park/@5.7630835,-0.3999354,17z/data=!3m1!4b1!4m6!3m5!1s0x0fd09702de390fb0xaf4dd02099deb85d!8m2!3d5.7630835!4d-0.3973605!16s%2F11!337!6r?entry=ttu>.

† (Coliba Ghana, n.d.)

Table A-8. Dispose Green (digital waste management).

Coordinates	5.64523, -0.15150*
Location Description	Locations: Adenta–Madina, Ashaley Botwe–Lakeside Airport, East Legon, Pantang–Oyarifa, Osu–Cantonments, Spintex†
Waste Composition	Paper, plastic, glass, metal†
Amount Collected	9,800 pickups, 14.5 tons of plastic, 10 tons of paper, and 1.4 tons of glass†

Sources: * Coordinates for Dispose Green. Accessed 7 November 2022. <https://www.google.com/maps/place/Dispose+Green/@5.6452167,-0.1515881,21z/data=!4m5!3m4!1s0x0fd9b557a300001:0x88356c3e5beb3941!8m2!3d5.6452415!4d-0.1515102>.

† (Dispose Green, n.d., “Home”)

Table A-9. Dompooase Landfill.

Coordinates	6.62534, -1.59205*
Location Description	Kumasi, in the Ashanti Region†
Waste Composition	Solid and liquid wastes†
Amount Collected	The site reportedly receives around 1,300–1,400 tons of waste per day.‡

Sources: * Coordinates for Dompooase Landfill and Fecal Sludge Treatment Plant. Mapcarta. Accessed 3 November 2022. <https://mapcarta.com/W405214816>.

† (GhanaWeb 2016)

‡ (EAP Consult Limited, n.d.)

Table A-10. Electro Recycling.

Coordinates	6.51308, -1.54736*
Location Description	Amansie East District, Ghana*
Waste Composition	Accepts plastics including acrylonitrile butadiene styrene (ABS), high impact polystyrene (HIPS), polycarbonate (PC), and polypropylene (PP) [†] and recycles e-waste, metal scrap, and used batteries [‡]
Amount Collected	—

Sources: * (Electro Recycling n.d., “Contact Us”)

[†] (Electro Recycling n.d., “Plastic Recycling and Shredding”)

[‡] (Electro Recycling n.d., “About”)

Table A-11. Kpone Landfill.

Coordinates	5.7041, 0.0288*
Location Description	Located 25 miles away from Accra, in a municipality of Kpone-Katamanso, located in the Tema area of the Greater Accra Region [†] Located approximately 1 mile off the Accra-Aflao main road*
Waste Composition	Imported clothing, household waste, plastic bags, and food waste [‡]
Amount Collected	Initially built for 700 tons of waste each day but often receives around 1,200 tons of waste daily [†]

Sources: * (EAP Consult Limited, n.d.)

[†] (Stoisser 2020)

[‡] (Bedat 2021)

Table A-12. Kumasi Compost and Recycling Plant Limited.

Coordinates	6.59896, -1.58616*
Location Description	Essereso-Adagya in the Bosomtwe District of the Ashanti region [†]
Waste Composition	Solid and liquid waste to produce organic compost, Municipal Solid Waste (MSW) made up of plastics, papers, textiles, metals and glass [‡]
Amount Collected	1,200 tons of MSW processed daily, 3,000 compost bags produced daily [‡]

Sources: * Coordinates for KCARP Kumasi Compost and Recycling Plant. Google Maps. [KCARP Kumasi Compost and Recycling Plant - Google Maps](#).

[†] (Kumasi Compost and Recycling Plant, n.d.)

[‡] (Kumasi Compost and Recycling Plant Limited, n.d.)

Table A-13. Recyclers Ghana Limited.

Coordinates	5.86022, 0.06402*
Location Description	PW Junction, Shai Hills, Akosombo Road, Tema, Ghana [†]
Waste Composition	Lead, car batteries, acid battery and aluminum scrap [†]
Amount Collected	6,000 metric tons per acre [‡]

Sources: * Coordinates for Recyclers Ghana Limited. Google Maps. [Recyclers Ghana Limited - Google Maps](#).

[†] Recyclers Ghana Limited Facebook page. <https://www.facebook.com/Recyclersghana/>

[‡] (Gravita India Limited 2019)

Table A-14. Sarbah Landfill.

Coordinates	5.56717, -0.33910*
Location Description	Water Works Ln, Weija, Accra, Ghana*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Weija Dumping Site. Google Maps. [Weija dumping site - Google Maps](#).

Table A-15. Winneba Landfill.

Coordinates	5.36181, -0.60876*
Location Description	Off Accra Road, south of Winneba cemetery*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Winneba Landfill Site. Mapcarta. Accessed 3 November 2022. <https://mapcarta.com/W792424946>.

A.3 Kenya

Kenya is located on the eastern coast of Africa along the Indian Ocean. all of disposal facilities found are located in the southern half of country with a majority of them being near Nairobi. These locations have been laid out in Figure A-3. Table A-16–Table A-33 provide details for each.

Figure A-3. Locations of disposal facilities in Kenya.

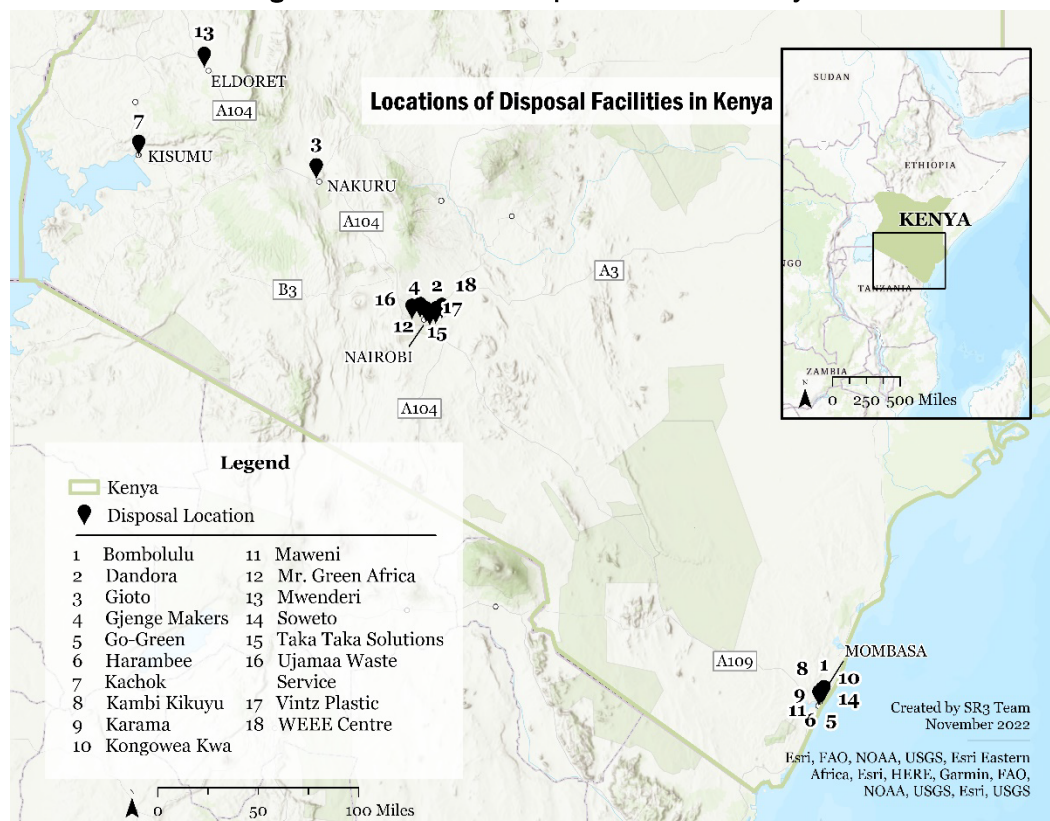


Table A-16. Bombolulu.

Coordinates	−4.02418, 39.70407*
Location Description	Along Mombasa-Malindi highway*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Bombolulu Dumpsite. Google Maps. Accessed 4 November 2022. [Bombolulu Dumpsite - Google Maps](#).

Table A-17. Dandora Municipal Dump.

Coordinates	−1.30000, 36.91667*
Location Description	Approximately 5 miles to the east of the center of Nairobi*
Waste Composition	Assortment of wastes (industrial, domestic, agricultural, medical, etc.) since it is an unregulated dumpsite*
Amount Collected	Over 2,500 tons collected per day, holds more than 1.8 million tons despite a 500,000-ton capacity†

Sources: * (Song'oro et al. 2019)

† (Kinyanjui 2021)

Table A-18. Gioto.

Coordinates	–0.27461, 36.048*
Location Description	London estate of Nakuru, less than 2 miles from Nakuru town on the way to Kabarak†
Waste Composition	Household, office, industrial, and medical waste†
Amount Collected	Collects 250 tons of waste from Nakuru each day†

Sources: * Coordinates for Gioto Dumping Site. Accessed 3 November 2022. [Gioto Dumping Site - Google Maps](#)

† (Gichinga 2020)

Table A-19. Gjenge Makers Ltd.

Coordinates	–1.30340, 36.83847*
Location Description	Butere Rd, Nairobi†
Waste Composition	They collect LDPE, or plastic #2, HDPE, PP, and polypropylene random copolymer plastic (PPR)†
Amount Collected	—

Sources: * Coordinates for Gjenge Makers Ltd. Accessed 4 November 2022. [Gjenge Makers LTD - Google Maps](#).

† (Gjenge Makers, n.d.)

Table A-20. Go-Green.

Coordinates	–4.05914, 39.66744*
Location Description	Ralli House Building, Ground Floor, Nyerere Avenue, Mombasa†
Waste Composition	Materials from households (kitchen, household, horticultural, and construction waste), small to large businesses and corporations, recycling program†
Amount Collected	—

Sources: * Coordinates for Go Green Garbage Collectors. Google Maps. Accessed 31 October 2022. [Go green Garbage Collectors - Google Maps](#).

† (Bizsmart, n.d.)

Table A-21. Harambee Dumpsite.

Coordinates	–4.04327, 39.68974*
Location Description	Close To Imara Secondary School, Off Link Road, Harambee, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Harambee Garbage Area—Kongowea. Google Maps. Accessed 2 November 2022. [Harambee Garbage Area - Kongowea - Google Maps](#).

Table A-22. Kachok Dumpsite.

Coordinates	–0.10539, 34.76949*
Location Description	Approximately 1 mile away from the center of the Central Business District (CBD) of Kisumu City,† Off Ondiek Hwy, Kisumu, Kenya*
Waste Composition	Plastics (34.7%), glass (13.8%), and organic matter (51.8%)‡
Amount Collected	300 metric tons of MSW per day†

Sources: * Coordinates for Kisumu Municipal Garbage Dumping Site. Google Maps. Accessed 2 November 2022. [Kisumu Municipal Garbage Dumping Site - Google Maps](#).

† (Awuor et al. 2019)

‡ (Aguko et al. 2018).

Table A-23. Kambi Kikuyu Dumpsite.

Coordinates	–4.03672, 39.68932*
Location Description	Off Nyali Road, Kongowea Kambi Kikuyu, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Kambi Kikuyu Dumpsite. Google Maps. Accessed 1 November 2022. [Kambi Kikuyu Dumpsite - Google Maps](#).

Table A-24. Karama Garbage Dump.

Coordinates	–4.04139, 39.68761*
Location Description	Next To Karama Stage, Off Links Road, Kongowea Karama, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Karama Garbage Dump. Google Maps. Accessed 8 September 2023.

<https://www.google.com/maps/place/Karama+Garbage+Dump/@-4.0414083,39.6828086,17z/data=!3m1!4b1!4m6!3m5!1s0x1840128c9c610665:0x6c59d9791609d490!8m2!3d-4.0414137!4d39.6876795!16s%2F1q2wbwzkd?entry=ttu>

Table A-25. Kongowea Kwa Chief Dumpsite.

Coordinates	–4.04036, 39.6883*
Location Description	Off Links Road, Kongowea Kwa Chief, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Kongowea Kwa Chief Dumpsite. Google Maps. Accessed 8 September 2023.

<https://www.google.com/maps/place/Kongowea+Kwa+Chief+Dumpsite/@-4.0403666,39.6857315,17z/data=!3m1!4b1!4m6!3m5!1s0x1840128b84330295:0xf08eae4d146dbd7f!8m2!3d-4.0403666!4d39.6883064!16s%2F1q2wgb0qd?entry=ttu>

Table A-26. Maweni Dumpsite.

Coordinates	-4.03711, 39.69242*
Location Description	Opposite Sineno Education Centre, Off Bandary Road. Maweni, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Maweni Dumpsite. Google Maps. Accessed 1 November 2022. [Maweni Dumpsite - Google Maps](#).

Table A-27. Mr. Green Africa.

Coordinates	-1.32833, 36.86562*
Location Description	Old Yana Tyres Complex, Mombasa Rd and Enterprise Rd Junction, Nairobi, Kenya†
Waste Composition	Plastic: tubs, bottles, cups/plates, households, buckets, Bottle caps, milk/rice pockets, packaging, car oil bottles, PET, HDPE, PP, and cartons†
Amount Collected	6,600 tons of plastic waste recycled‡

Sources: * Coordinates for Mr. Green Africa. Google Maps. Accessed 1 November 2022. [Mr. Green Africa - Google Maps](#).

† (Mr. Green Africa, n.d., "Green Points")

‡ (Mr. Green Africa, n.d., "Home")

Table A-28. Mwenderi Dumpsite.

Coordinates	0.52673, 35.24155*
Location Description	East of Kandie Secondary School*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Mwenderi Dumpsite. Google Maps. Accessed 31 October 2022.

<https://www.google.com/maps/dir/0.52679,35.2416227/@0.5264013,35.2415241,470m/data=!3m1!1e3!4m2!4m1!3e0>

Table A-29. Soweto Dumpsite.

Coordinates	-4.0403, 39.691*
Location Description	Soweto Estate, Off Link Road, Soweto, Mombasa, Kenya*
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Soweto Dumpsite. Google Maps. Accessed 25 October 2022. [Soweto Dumpsite - Google Maps](#).

Table A-30. Taka Taka Solutions.

Coordinates	–1.27213, 36.79647*
Location Description	Head Office Address: Laikipia Townhouses No 1 and 2, Laikipia Road† Multiple collection stations, 4-in-1 stations located in large malls (metal, plastic, paper, and PET), 2-in-1 stations in smaller supermarkets (plastic and PET bottles)†
Waste Composition	Paper, plastics, Styrofoam, glass, metal, aluminum, shoes, textiles, etc.†
Amount Collected	Manage more than 60 tons of waste per day, recycling 95% of the waste managed†

Sources: * Coordinates for Takataka Solutions—Head Office. Google Maps. Accessed 25 October 2022. [Takataka Solutions - Head Office - Google Maps](#).

† (TakaTaka Solutions 2022)

Table A-31. Ujamaa Waste Services.

Coordinates	–1.28518, 36.73773*
Location Description	Cloister's Place, Dagoretti Rd, Nairobi†, Precious Plaza, Naivasha Rd, Nairobi, Kenya*
Waste Composition	Waste from offices, restaurants, building sites, retailers, and industrial buildings†
Amount Collected	—

Sources: * Coordinates for Ujamaa Waste Services Ltd. Google Maps. Accessed 25 October 2022. [Ujamaa waste services Ltd - Google Maps](#).

† (Ujamaa Waste Services, n.d.)

Table A-32. Vintz Plastics Limited.

Coordinates	–1.31607, 36.90747*
Location Description	Off Airport North Road, Collection centers in Kisumu, Mombasa, Nairobi, and Nakuru†
Waste Composition	PET, HDPE, LDPE, PP†
Amount Collected	52,513 tons recycled†

Sources: * Coordinates for Vintz Plastics Limited. Google Maps. Accessed 31 October 2022. [Vintz Plastics Limited - Google Maps](#).

† (Vintz Plastics, n.d.)

Table A-33. Waste Electrical and Electronic Equipment Centre (WEEE Centre).

Coordinates	–1.27862, 36.95268*
Location Description	Mihango', Embakasi, Off the Eastern Bypass†
Waste Composition	E-waste: screens, TVs, monitors, tablets, small ICTs, microphones, fan, cameras, kettles, etc.†
Amount Collected	—

Sources: * Coordinates for WEEE Centre. Google Maps. Accessed 31 October 2022. [WEEE Centre - Google Maps](#).

† (WEEE Centre, n.d.)

A.4 Morocco

Morocco borders the northwestern edge of Africa overlooking the Mediterranean Sea to the north and the Atlantic Ocean to the west. The disposal facilities found are concentrated in the northern half of country near the coast. Figure A-4 shows the exact location of each of the disposal facilities in Morocco. Table A-34–Table A-43 provide details for each.

Figure A-4. Locations of disposal facilities in Morocco.

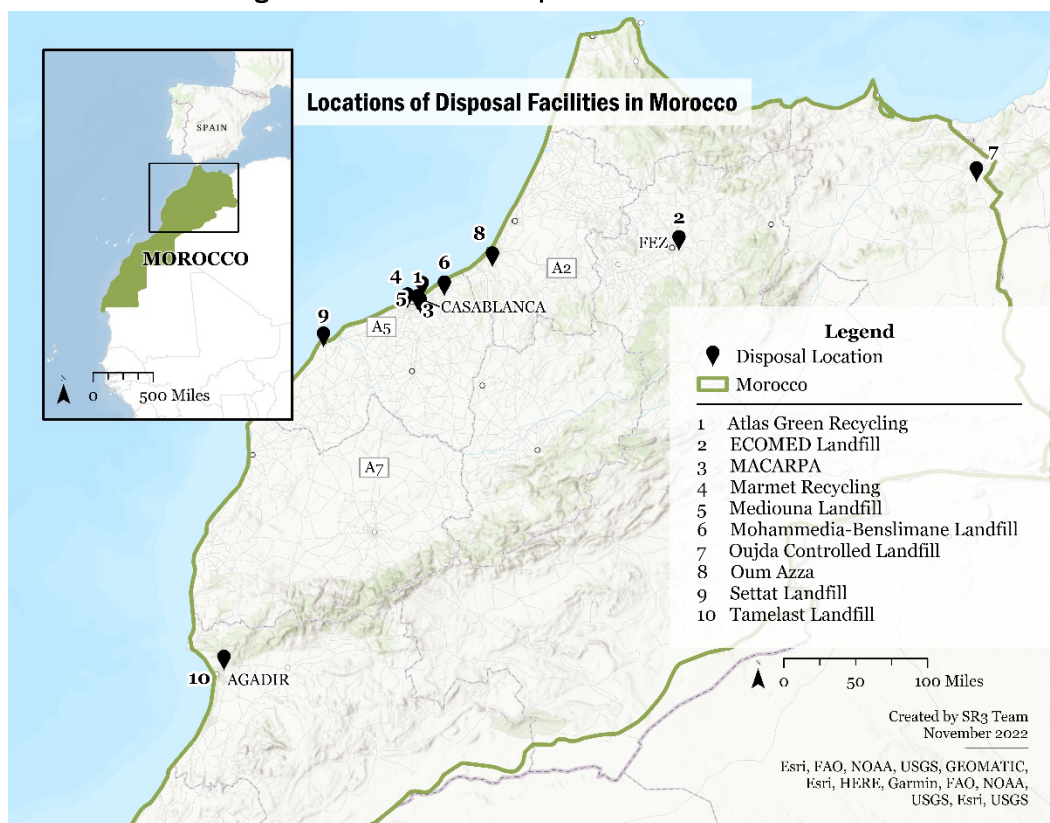


Table A-34. Atlas Green Recycling.

Coordinates	33.51283, -7.56486*
Location Description	Douar Lahfaya Km 500, 11 Ain Hallouf, Ouled Haddou, Bouskoura, Casablanca, Morocco†
Waste Composition	Plastic and paper, metals, and e-waste†
Amount Collected	—

Sources: * Coordinates for Atlas Green Recycling. Google Maps. Accessed 31 October 2022. [Atlas Green Recycling - Google Maps](#).

† (Atlas Green Recycling, n.d.)

Table A-35. ECOMED–Controlled Landfill of Fes.

Coordinates	34.00646, –4.93453*
Location Description	5 miles from center of Fes*
Waste Composition	—
Amount Collected	Between 750 and 1,000 tons of solid waste every day†

Sources: * Coordinates for EcoMed Controlled Landfill. Google Maps. Accessed 31 October 2022. <https://www.google.com/maps/place/D%C3%A9charge+contr%C3%B4l%C3%A9+EcoMed/@34.0064964,-4.9369716,17z/data=!3m1!4b1!4m6!3m5!1s0xd9f8dd5eb637a47:0x8d22025361fdcc9b!8m2!3d34.0064964!4d-4.9343967!16s%2Fg%2F11h9bp20z4?entry=ttu>

† (Alami, n.d.)

Table A-36. MACARPA.

Coordinates	33.62322, –7.51685*
Location Description	Industrial District of AIN SEBAA in Casablanca†
Waste Composition	Cardboard and paper (carton paper, duplex paper, newsprint, office paper, big store, newspapers, magazines, and advertising brochures)†
Amount Collected	4000 tons every month†

Sources: * Coordinates for MACARPA. Google Maps. Accessed 31 October 2022. https://www.google.com/maps/place/MACARPA/@33.6232343,-7.519433,17z/data=!3m1!4b1!4m6!3m5!1s0xda7cb857f0d2f6b:0x8c89d01600fb6f0b!8m2!3d33.6232299!4d-7.5168581!16s%2Fg%2F12hksvj_n?entry=ttu

† (MACARPA, n.d.)

Table A-37. Marmet Recycling.

Coordinates	33.52892, –7.66467*
Location Description	NO, 11, Property Nadir 1, Route Ouled Rahou, Z.I Sidi Maârouf, Casablanca, Morocco†
Waste Composition	Used car catalysts, collection and recovery of e-waste†
Amount Collected	—

Sources: * Coordinates for Marmet Recycling. Google Maps. Accessed 31 October 2022. [Marmet Recycling - Google Maps](#).

† (Marmet Recycling, n.d.)

Table A-38. Mediouna Controlled Landfill.

Coordinates	–7.53755, 33.48525*
Location Description	Uncontrolled waste dumping within a natural landfill that is located within 1 mile of the Mediouna center†
Waste Composition	The landfill receives waste from the city of Casablanca and its surroundings, which has a total population of 3.6 million†
Amount Collected	About 4,000 tons/day of solid wastes†

Sources: * (Public Dumping of Household Waste n.d.), Coordinates of Public Dumping of Household Waste. Google Maps. Accessed 7 November 2022. <https://www.google.com/maps/place/D%C3%A9charge+publique+de+Ordures+Ménagères/@33.4851439,-7.5380982,423m/data=!3m1!1e3!4m12!1m6!3m5!1s0xda633555d1e1b05:0xf41c7e39bddc01c8!2zTGEGZMOpy2hhcmdlIGNvbRyw7Rsw6IIIE1ZGldW5h!8m2!3d33.489792!4d-7.5376442!3m4!1s0>

† (Smahi et al. 2013)

Table A-39. Mohammedia-Benslimane Landfill.

Coordinates	33.628260640379814, -7.294597709451567*
Location Description	The landfill serving Mohammedia-Benslimane is located in a rural agricultural area. It is located around 4 miles from the center of Ben Yakhlef. The landfill covers 47 ha and serves the municipalities Mohammedia, Ben Yakhlef, Chellalate, Benslimane, Bouznika and El Mansouria, which together have a total population of 409,000 inhabitants.†
Waste Composition	They collect several types of materials, such as paper and cardboard, plastics, glass, metals (cans and paint), bones, textiles, and leather.†
Amount Collected	—

Sources: * Coordinates of Mohammedia, Morocco. Google Map. Accessed 7 November 2022. [Mohammedia - Google Maps](#).

† (Zineb et al. 2019)

Table A-40. Oujda Controlled Landfill.

Coordinates	-1.94233, 34.57822*
Location Description	The controlled landfill of Oujda is located about 6 miles south of the city.†
Waste Composition	Selective sorting, recycling, waste treatment, leachate management and treatment, energy conversion station, biogas pumping station†
Amount Collected	As of 2014: 152 873 tons of MSW†

Sources: * Coordinates of Oujda Public Landfill. Google Maps. Accessed 7 November 2022. <https://www.google.com/maps/place/D%C3%A9charge+public+Oujda,+Morocco/@34.5793274,-1.9412669,2076m/data=!3m1!1e3!4m13!1m7!3m6!1s0xd7864984106d6ef0x1d86b33244c4650!2sOujda,+Morocco!3b1!8m2!3d34.681962!4d-1.900155!3m4!1s0xd78797b0beb04e5:0x1c59556a9c1fd414>.

† (Saghir et al. 2019)

Table A-41. Oum Azza.

Coordinates	6.81097, 33.87129*
Location Description	Maghreb area, located in the Rabat-Salé-Kénitra (RSK) region around 19 miles southwest of Rabat city, between the villages of Oum Azza and Ain El Aouda. It is bordered in the north by Rabat and in the south by Ain El Aouda village.†
Waste Composition	Garbage from 13 communes, including Rabat, Salé, and Témara†
Amount Collected	850,000 tons/year (2,300 tons/day) of household and similar waste (HSW) from 13 municipalities in the RSK region of the Kingdom of Morocco†

Sources: * Coordinates of Oum Azza Dump. Google Maps. Accessed 7 November 2022.

<https://www.google.com/maps/place/D%C3%A9charge+oum+azza/@33.8711251,-6.8109519,65m/data=!3m1!1e3!4m12!1m6!3m5!1s0xda76b1f27a2bd0d:0x893e08cdd3c2b1a!2sAverda+Rabat!8m2!3d33.9913787!4d-6.7992639!3m4!1s0x0:0x1f5300c795235d7!8m2!3d33.8711563!4d-6.8109099>.

† (El Jalil et al. 2020)

Table A-42. Settatt Town Landfill.

Coordinates	33.19999, -8.51029*
Location Description	Located around 4.5 miles away from Settatt and 1 mile to the west from the road connecting Settatt to Oulad Saïd at 438 m above sea level†
Waste Composition	Untreated domestic, industrial, and hospital wastes†
Amount Collected	170 tons of waste per day†

Sources: * Coordinates for Settatt Waste Dump. Google Maps. Accessed 25 October 2022. <https://www.google.com/maps/place/%D9%85%D8%B7%D8%B1%D8%AD+%D8%A7%D9%84%D9%86%D9%81%D8%A7%D9%8A%D8%A7%D8%AA+%D8%B3%D8%B7%D8%A7%D8%AA%E2%80%AD/@33.1999872,-8.5108279,117m/data=!3m1!1e3!4m13!1m7!3m6!1s0xda91dc1b421fe47:0x307cf87fb6b01a1f12sEl+Jadida,+Morocc>

† (Amahdar et al. 2009)

Table A-43. Tamelast Landfill.

Coordinates	30.441389, -9.511111*
Location Description	East of the city of Agadir, Morocco, southwest of the High Atlas Mountains. Accessible by the asphalt road leading to the Agadir Adrar stadium and the village of Tamelast*
Waste Composition	—
Amount Collected	—

Sources: * (Asouam et al. 2021)

A.5 Niger

Niger is a large West African country in the middle of the continent. For the size of the country, the disposal facilities are extremely limited and were mostly found in the southwestern corner. The locations can be seen in Figure A-5. Table A-44–Table A-49 provide details for each.

Figure A-5. Locations of disposal facilities in Niger.

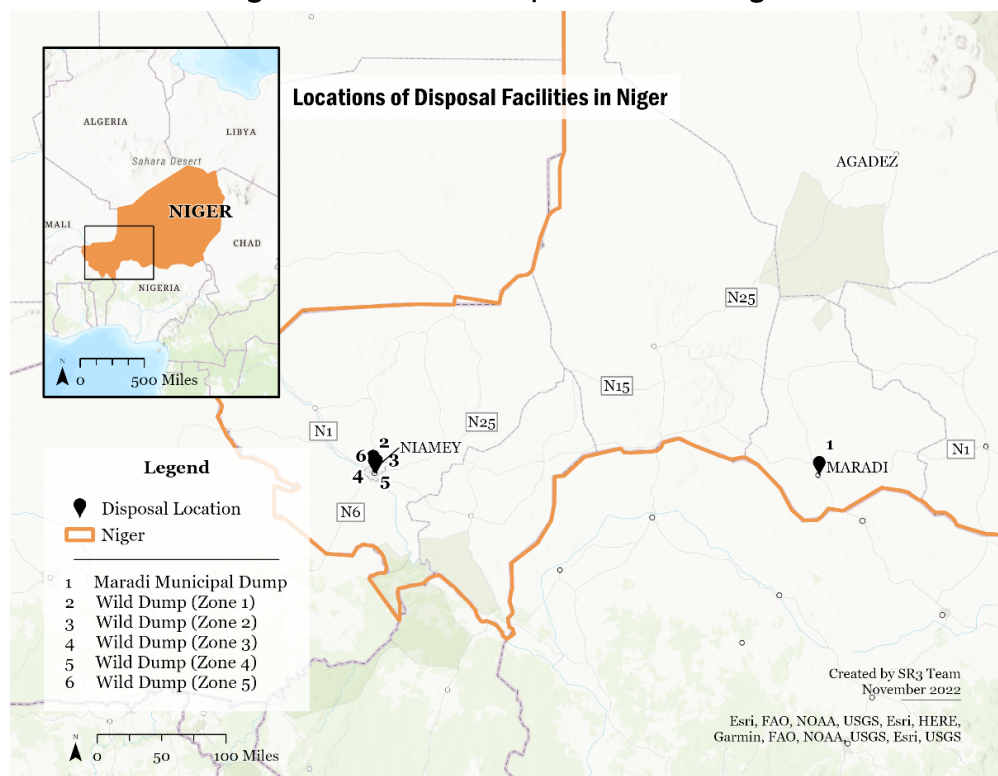


Table A-44. Maradi Municipal Dump.

Coordinates	13.47957, 7.11526*
Location Description	1.25 miles from Maradi city center, east of RN9* (approximated based off coordinates)
Waste Composition	Household waste*
Amount Collected	—

Sources: * (Hantchi et al. 2022)

Table A-45. Niamey Wild Dump (Zone 1).

Coordinates	13.50127, 2.11563*
Location Description	In Niamey, near the Olympic swimming pool†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Lavage Pro. Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/place/Lavage+pro/@13.5011206,2.1157451,130m/data=!3m1!1e3!4m5!3m4!1s0x11d075106fb8fd17:0xdc15f554c55cc3d3!8m2!3d13.5012225!4d2.1155732>.

† (Tokyo Engineering Consultants Co., Ltd. 2001)

Table A-46. Niamey Wild Dump (Zone 2).

Coordinates	13.50221, 2.13422*
Location Description	East of the mosque in the southern part of Poudriere†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Dépotoir de la Cité. Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/place/D%C3%A9potoir+de+la+Cité/C3%A9/@13.5022698,2.133711543m/data=!3m1!1e3!4m8!1m2!3m1!2zRM0pcG90b2lyGRllGxhENpdMOp!3m4!1s0x11d07543a97720b5:0x5b693154dc0fbdde!8m2!3d13.5021897!4d2.1342267>.

† (Tokyo Engineering Consultants Co., Ltd. 2001)

Table A-47. Niamey Wild Dump (Zone 3).

Coordinates	13.50333, 2.14134*
Location Description	Northern part of Poudriere, east of Sabka Lahiya Hotel†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for “Niamey Wild Dump (Zone 3). Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/dir/Abidjan,+Niamey,+Niger/13.5033361,2.1413497/@13.5033405,2.141113,352m/data=!3m1!1e3!4m9!4m8!1m5!1m1!1s0x11d0754484fe5cff:0xaad8fc41fe03dde!2m2!1d2.1278398!2d13.5260255!1m0!3e0>.

† (Tokyo Engineering Consultants Co., Ltd. 2001)

Table A-48. Niamey Wild Dump (Zone 4).

Coordinates	13.54275, 2.10689*
Location Description	Eastern part of Dar Es Salam, * 330 feet from Martaba Dar Es Salam driving school†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for Niamey Wild Dump (Zone 4). Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/dir/Dar+Es+Salam,+Niamey,+Niger/13.5427507,2.1068838/@13.5443402,2.1042637,613m/data=!3m2!1e3!4b1!4m9!4m8!1m5!1m1!1s0x11da9e3292ccdbfb:0xb79d2d15e2f6fec!2m2!1d2.1039834!2d13.5458265!1m0!3e0>.

† (Tokyo Engineering Consultants Co., Ltd. 2001)

Table A-49. Niamey Wild Dump (Zone 5).

Coordinates	13.54857, 2.10357*
Location Description	Near Dar Es Salam primary school, western part of Dar Es Salam†
Waste Composition	—
Amount Collected	—

Sources: * Coordinates for “Niamey Wild Dump (Zone 5).” Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/dir/13.5485787,2.1035841/@13.5484123,2.1034149,272m/data=!3m1!1e3!4m2!4m1!3e0>.

† (Tokyo Engineering Consultants Co., Ltd. 2001)

A.6 Senegal

The Republic of Senegal is a country in West Africa on the Atlantic Ocean coastline. Even with a population of over 16 million, only six disposal facilities were found, and all are located near the capital of Dakar as show in Figure A-6. Table A-50–Table A-55 provide details for each.

Figure A-6. Locations of disposal facilities in Senegal.

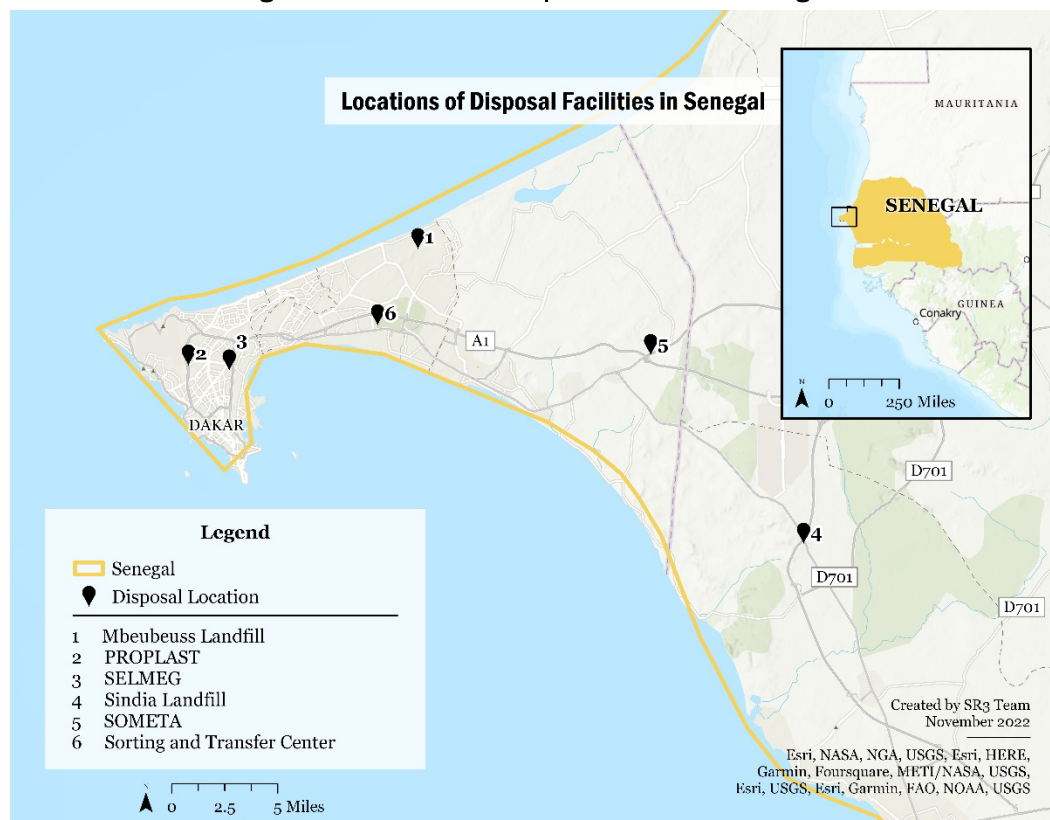


Table A-50. Mbeubeuss Dump.

Coordinates	14.80238, -17.31427*
Location Description	9.5 miles northeast of the city of Dakar, in the Atlantic littoral zone in the Niayes area†
Waste Composition	PED plastic, tires, aluminum, biomedical waste (IV equipment)‡
Amount Collected	1,300 tons of waste/day, 475,000 tons of waste per year,‡ receives around 80% of the country's waste; receives it from 3 million of Dakar's inhabitants**

Sources: * Coordinates for Mbeubeuss Landfill. Google Maps. Accessed 1 November 2022. <https://www.google.com/maps/place/Decharge+de+Mbeubeuss/@14.8023592,-17.3133681,1167m/data=!3m1!1e3!4m1!1m7!1s0x0:0xdd4a40f56922e1a5!2zMTCsDQ4JzA5LjAtIAxN8KwMTgnNDguMCJX!3b1!8m2!3d14.8025!4d-17.3133333!3m4!1s0xec10bef333cbf7:0xfdde08da0a93cb1c!8m2>.

† (Japan International Cooperation Agency 2016)

‡ (Bissell 2020)

** (Magoum 2021b)

Table A-51. Proplast Industrie.

Coordinates	14.72565, -17.47090*
Location Description	Headquarters: Thiès, Silmang behind health station/treatment plant: Thiès, Ngueyene†
Waste Composition	PE, PET, PP†
Amount Collected	200 tons/year‡

Sources: * Coordinates for Proplast Industrie. Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/place/Proplast+Industrie/@14.7257201,-17.4711371,198m/data=!3m1!1e3!4m5!3m4!1s0xec1730dd5db907d:0xfe1d73b76015a412!8m2!3d14.7256612!4d-17.4709017>.

† (Proplast Industrie, n.d.)

‡ (Magoum 2021a)

Table A-52. Selmeg.

Coordinates	14.72241, -17.44302*
Location Description	—
Waste Composition	Aluminum†
Amount Collected	6 tons†

Sources: * Coordinates for Selmeg. Google Maps. Accessed 1 November 2022. <https://www.google.com/maps/place/SELMEG/@14.7223409,-17.4432479,134m/data=!3m1!1e3!4m5!3m4!1s0xec172d1b5b8343b:0x23a01bbbb0835824!8m2!3d14.7224197!4d-17.4430212>.

† (GiZ 2021)

Table A-53. Sindia Anaerobic Sanitary Landfill.

Coordinates	14.60818, -17.05117* (approximate location based off Japan International Cooperation Agency [2016])
Location Description	Located at the border between the two communes of Sindia and Ndiass in Mbour Department, approximately 30 miles from Dakar City†
Waste Composition	—
Amount Collected	Receives approximately 550 tons of waste every day, 40% of which come from the municipality of Mbour‡

Sources: * Coordinates for Mbour, Senegal. Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/dir//14.6082974,-17.0509455/@14.608251,-17.0514309,469m/data=!3m1!1e3>.

† (Japan International Cooperation Agency 2016)

‡ (Magoum 2020c)

Table A-54. Société Métallurgique d'Afrique (SOMETA).

Coordinates	14.73251, -17.15551*
Location Description	—
Waste Composition	Iron and other metals recycling†
Amount Collected	Approximately 55,000 tons of metal are recycled each year†

Sources: * Coordinates for SOMETA. Google Maps. Accessed 1 November 2022. <https://www.google.com/maps/place/SOMETA/@14.7325251,-17.1560649,305m/data=!3m1!1e3!4m12!1m6!3m5!1s0xec199b50acb0111:0xf1823309a154e835!2sSOMETA!8m2!3d14.7325251!4d-17.1555177!3m4!1s0xec199b50acb0111:0xf1823309a154e835!8m2!3d14.7325251!4d-17.1555177>.

† (GIZ 2021)

Table A-55. Sorting and Transfer Center

Coordinates	14.75217, -17.34178*,‡
Location Description	In Mbao, located inside the Mbao Forest Reserve†, Bordered to the north by the Senegalese Water Service (SDE) access route and the Mbao Forest Reserve, bordered to the south by a relay station of the national telecommunications corporation (SONATEL) and by a stretch owned by the Pikine-Diamniadio toll highway company, bordered to the east by the Mbao Forest Reserve, and bordered to the west by the SONATEL access route and the Mbao Forest Reserve† Pikine Department, which is approximately 12.5 miles from the city of Dakar‡
Waste Composition	Recyclable waste, such as paper, cardboard, and packaging†
Amount Collected	—

Sources: * Coordinates for "Sorting and Transfer Center." Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/dir/for%C3%AAt+class%C3%A9+de+Mbao,+Senegal/14.7521823,-17.3417832/@14.7521722,-17.3419807,99m/data=!3m1!1e3!4m8!4m7!1m5!1m1!1s0xec10add1fe81b61:0xf23b2645453264ce!2m2!1d-17.3198424!2d14.7561951!1m0>.

† (World Bank 2020a)

‡ (Japan International Cooperation Agency 2016)

A.7 Uganda

Uganda is a land-locked country in East Africa with a large portion of the southern part including Lake Victoria. Only six disposal facilities were found, but these are spread out around the country. A map showing the disposal locations in Uganda can be found in Figure A-7. Table A-56–Table A-62 provide details for each.

Figure A-7. Locations of disposal facilities in Uganda.

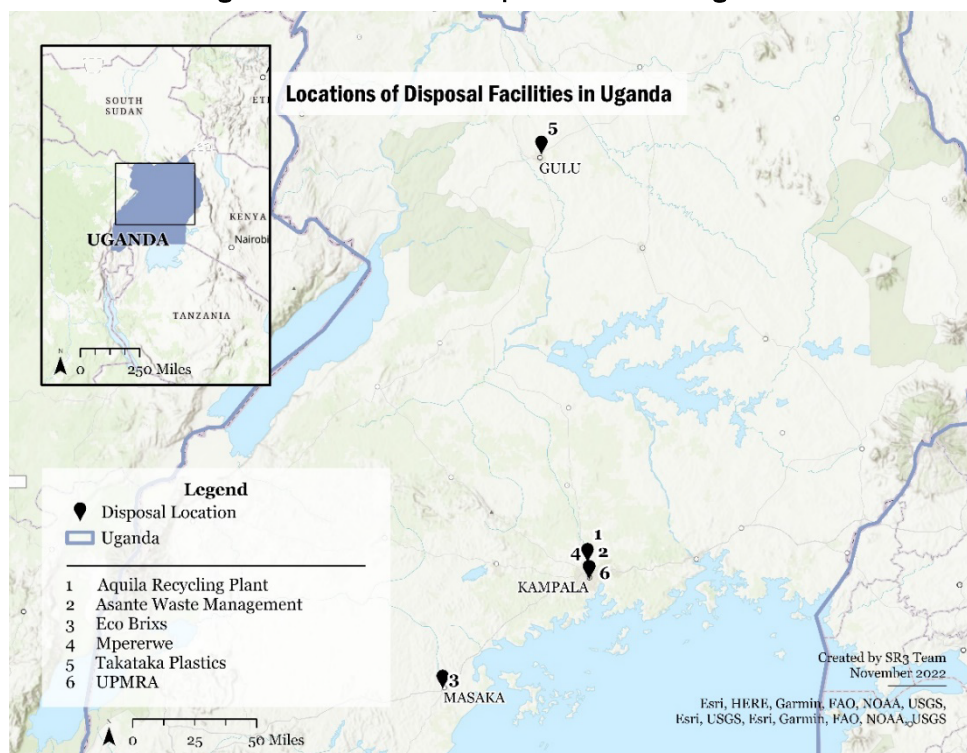


Table A-56. Aquila Recycling.

Coordinates	0.41231, 32.57576*
Location Description	Plot 127 Kiteezi, Mpererwe, Kampala, Uganda†
Waste Composition	All types of plastic, specialize in used pallets, bins, totes, boxes, metal scrap, e-waste, paper, and cardboard†
Amount Collected	—

Sources: * Coordinates for Aquila Recycling Plant. Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/place/Aquila+Recycling+Plant/@0.4123135,32.575676,70m/data=!3m1!1e3!4m13!1m6!3m5!1s0x177db1ac95e08e39:0x18148288d596022f!2sAquila+Recycling+Plant!8m2!3d0.4123187!4d32.5757777!3m5!1s0x177db1ac95e08e39:0x18148288d596022f!8m2!3d0>

† (Aquila Recycling, n.d.)

Table A-57. Asante Waste Management.

Coordinates	0.31346, 32.58381*
Location Description	Second Floor Suite A, East Africa Investment Building Block 243 Plot 2490, YK Hamied Road, Luzira Industrial Park, P.O. Box 100810, Kampala–Uganda†
Waste Composition	Hazardous and household wastes, oil and gas, e-waste (bulbs, batteries and other small electrical items, laptops, computer base units, monitors, printers, mainframes and servers, computer peripherals, photocopiers and faxes, and mobile phones)†
Amount Collected	—

Sources: * Coordinates for Asante Waste Management. Google Maps. Accessed 15 September 2022. <https://www.google.com/maps/place/Asante+Waste+Management/@0.3134635,32.5816214,17z/data=!3m1!4b1!4m5!3m4!1s0x177dbc7e37b0eef1:0xa57ee8278af751f9!8m2!3d0.3134581!4d32.5838154>.

† (Asante Waste Management n.d.)

Table A-58. Ddundu (not shown on map).

Coordinates	—
Location Description	Located approximately 25 miles from Kampala* KCCA has already purchased land for developing a new landfill at Ddundu, located in Kyampisi Sub-County, Mukono District† “140-acre site in Ddundu, Kiryamuli and Buntaba Villages in Mukono District”‡
Waste Composition	—
Amount Collected	Based on the estimated area available for the landfill cells and assuming an average filling height of 25 m, the total available capacity at Ddundu is estimated at 6.4 million m ³ with 1 m capping*

Sources: * (PPPU 2018)

† (Global Green Growth Institute 2021)

‡ (Eagle Online 2021)

Table A-59. Eco Brixs.

Coordinates	–0.32629, 31.73151*
Location Description	Near Masaka-Mbarara Bypass Rd, Masaka, Uganda*
Waste Composition	—
Amount Collected	514 tons of plastic recycled†, 21,588,000 500 ml plastic bottles recycled†

Sources: * Coordinates for Eco Brixs. Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/place/Eco+Brixs/@-0.3262665,31.7293176,17z/data=!3m1!4b1!4m5!3m4!1s0x19d78f701905c04b:0x443304155c7d13d9!8m2!3d-0.3262719!4d31.7315115>.

† (Eco Brixs, n.d.)

Table A-60. Mpererwe Landfill.

Coordinates	0.41078, 32.57616*
Location Description	Approximately 7.5 miles north of Kampala City*,†
Waste Composition	Organic material (92.1%), soft plastic (3.0%), hard plastic (1.8%), and paper (1.1%)†
Amount Collected	Approximately 1,700 tons are dumped‡

Sources: * Coordinates of Kiteezi Landfill. Google Maps. Accessed 7 November 2022. <https://www.google.com/maps/place/Kiteezi+Landfill/@0.4106747,32.5761887,79m/data=!3m1!1e3!4m5!3m4!1s0x177db0534e9ffa7d:0x561c22d91863f2e8!8m2!3d0.4107246!4d32.5761582>.

† (Komakech et al. 2014)

‡ (Madinah et al. 2014)

Table A-61. Takataka Plastics.

Coordinates	2.78474, 32.30679*
Location Description	Plot 51B, Eden Road, Laroo Division, Gulu City, P.O. Box 1017, Gulu, Uganda†
Waste Composition	PET recycling†
Amount Collected	—

Sources: * Coordinates for Takataka Plastics. Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/place/Takataka+Plastics/@2.7847435,32.3046092,17z/data=!3m1!1e3!4m5!3m4!1s0x1771a78946003c15:0xe3e66bceee66c464!8m2!3d2.7847435!4d32.3067979>.

† (Takataka Plastics, n.d.)

Table A-62. Uganda Plastics Manufacturers and Recyclers Association (UPMRA).

Coordinates	0.31279, 32.58632*
Location Description	P.O Box 50068, Jinja Road–Kampala location: Agip House Rm 28†
Waste Composition	PP/PE, PET, plastic flakes†
Amount Collected	—

Sources: * Coordinates for Uganda Plastics Manufacturers And Recyclers Association. Google Maps. Accessed 2 November 2022. <https://www.google.com/maps/place/Uganda+Plastics+Manufacturers+And+Recyclers+Association/@0.3126962,32.5860923,20.49z/data=!4m9!1m2!2m1!1suganda+recycling!3m5!1s0x177dbc7e93155555:0x36122dbd9ab0c63f!8m2!3d0.3127934!4d32.5863187!15sChB1Z2FuZGEgcmVieWNsaW5>.

† (UPMRA, n.d.)

Appendix B: Country Comparison Chart

To make it easier to draw comparisons, the Source Reduction and Resource Resilience (SR3) team compiled all numerical data mentioned in the report in concise summary charts. For reference, see Table B-1 for general country-level data and Table B-2 for country-level waste data.

Table B-1. Country data comparisons.

Country	Population*	Urbanization (%)†	Gross National Income (GNI)/Capita‡	Human Development Index (HDI), 2021**	
				Africa Ranking (out of 54)	Global Ranking (out of 191)
Gabon	2,278,829	90	7,100	8	112
Ghana	31,732,128	58	2,360	12	133
Kenya	54,985,702	28	2,010	20	152
Morocco	37,344,787	64	3,350	10	123
Niger	25,130,810	17	590	51	189
Senegal	17,196,308	49	1,540	34	170
Uganda	47,123,533	26	840	31	166

Sources: * (World Bank 2021b)

† (World Bank 2021c)

‡ (World Bank 2021a)

** (UNDP 2022)

Table B-2. Country waste data comparisons.

	Hazardous Waste	E-waste	Solid Waste
Gabon	—	14,000 tons*	238,102 tons*
Ghana	—	39,000 tons*	3,538,275 tons*
Kenya	—	17,350 tons*	5,595,099 tons*
Morocco	—	30,300 tons*	6,852,000 tons†
Niger	554,000 tons*	7,900 tons*	1,865,645 tons*
Senegal	—	15,000 tons*	2,454,059 tons*
Uganda	—	25,000 tons*	7,045,050 tons*

Sources: * (World Bank 2019)

† (GIZ 2014)

Abbreviations

ABS	Acrylonitrile butadiene styrene
AOR	Area of responsibility
CBD	Central business district
CBO	Community-based organization
CERL	Construction Engineering Research Laboratory
CIA	Central Intelligence Agency
DoDI	Department of Defense Instruction
DPL	Development policy loan
EOL	End of life
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
EV	Electric vehicles
E-waste	Electronic waste
GDP	Gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GNI	Gross national income
HDI	Human Development Index
HDPE	High density polyethylene
HHW	Household hazardous waste
HIPS	High impact polystyrene
IDA	International Development Association

IT	Information technology
KCCA	Kampala Capital City Authority
KSh	Kenyan shilling
LAB	Lead-acid battery
LDPE	Low density polyethylene
LIB	Lithium-ion battery
MESTI	Ministry for the Environment [Ghana]
MSW	Municipal solid waste
NEMA	National Environment Management Authority
NGO	Nongovernment organizations
OUSD(A&S)	Office of the Under Secretary of Defense for Acquisition and Sustainment
PC	Polycarbonate
PCB	Polychlorinated biphenyl
PET	Polyethylene terephthalate
PNDM	National Program of Household Waste
PP	Polypropylene
PPPU	Public Private Partnerships Unit
PPR	Polypropylene random copolymer plastic
SDE	Senegalese Water Service
SEFA	Sustainable Energy Fund for Africa
SOMETA	Société Métallurgique d’Afrique
SOP	Standard operating procedure
SR3	Source Reduction and Resource Resilience

SWEEP-Net	Solid Waste Exchange of Information and Expertise Network in the MENA Region
SWMP	Solid waste management plan
UGP	Program management unit
ULAB	Used lead-acid battery
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UPMRA	Uganda Plastics Manufacturers And Recyclers Association
USACE	United States Army Corps of Engineers
USAFRICOM	United States Africa Command
USAID	US Agency for International Development
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment
WEEE Centre	Waste Electrical and Electronic Equipment Centre
WTE	Waste to energy

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14. ABSTRACT Managing wastes produced during contingency operations in United States Africa Command (USAFRICOM) locations has historically relied on local contract disposal or open-air burn pits, which have been shown to be harmful to the health of service members. Posture locations that can find alternative ways to manage waste, specifically through contracts with the host country's waste services, can better protect the health and safety of the warfighter and the native landscapes. African waste systems are complex, decentralized systems with considerable regional variation. The lack of government-funded waste management services leaves many residents with few options for safe disposal. The differing waste disposal strategies are described to offer guidance for military operations in the focus countries of Gabon, Ghana, Kenya, Morocco, Niger, Senegal, and Uganda. Relevant international agreements regulating the flow of hazardous waste across borders that can impact disposal plans are also noted. This report serves as a reference to develop waste management alternatives in the USAFRICOM area of responsibility (AOR). Official Department of Defense and Army regulations should be consulted when devising an integrated waste management plan.								
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