

# SLURC/DPU Action-Learning Alliance

## Understanding urban risk traps in Freetown

MSc Environment and Sustainable Development  
Practice Module 2017-18

### POLICY BRIEF No 4: Multi-hazards of poor solid waste management

#### Key points

- Past government strategies have focused primarily on waste collection; however, to mitigate waste-related hazards more attention should be given to analysing the nature of waste produced by each actor, the sources of contamination, and the need for separating different types of waste.
- Hazards are spread throughout the city as garbage flows, pools, and moves through the waterways and streets into the ocean. Proximity to landfills, official and unofficial skips and waterways is a main determinant of risks, especially during flooding episodes.
- There is an opportunity for the government to acknowledge and support community-level waste management, e.g. composting at the household level, using waste as construction material, and waste pickers collecting recyclables.
- Operation Clean Freetown (OCF) requires everyone to pay for garbage collection services, regardless of their capacity to pay. The current incentives should be revised and tailored to fit the different stakeholders.



Freetown City Dumpsite

Photo Credit: Mustafah Abdulaziz

#### Summary

This policy brief analyses how past and present waste management practices in Freetown have led to the accumulation of risk throughout the city. After the different actors and stakeholders are identified, a spatial analysis describes how risk is situated throughout the city and describes which segments of the population are most vulnerable to the burdens associated with solid waste management. In relation to the mitigation, prevention and reduction of risk accumulation cycles, this policy brief acknowledges existing regulatory initiatives, policies and practices that could potentially be harnessed to build a more comprehensive solid waste management system for all citizens of Freetown.

#### Authors

Elifnaz Aslaner, Alejandra Bernal Guzman, Sophie Bordat, Yuqiao Rachel Liu, Martica Otto, Maria del Mar Rojas Posada, Tang Tsz Ki, and Andrea Wyers.

## Introduction

Municipal solid waste management is one of the most serious environmental and public health issues in Freetown, Sierra Leone. Indiscriminate dumping of waste, coupled with deficiencies in waste collection, transportation and disposal, create a multiplicity of daily and episodic hazards that affect the city's entire population at different scales. Recurrent changes in management entities, lack of data, rapid urbanisation and a transformation of the city's spatial layout have all contributed to risk accumulation across Freetown. Two events, the Civil War and the Ebola crisis, played a role in disrupting on going efforts to implement effective waste management systems. The start of the Civil War in 1991 displaced a large portion of the population in Sierra Leone, leading to a significant increase in the city's population and therefore an increase in the amount of waste generated. Likewise, the Ebola outbreak in 2014 exacerbated existing waste management problems, as officials were forced to dispose of bodies in the Kingtom dumpsite.



Freetown City Dumpsite

Photo Credit: Mustafah Abdulaziz

For ease of reference, this policy brief is organised into four main sections. It begins with a brief overview of the historical background of waste management in Freetown, including the timeline of the multiple authorities that have been in charge of managing the solid waste systems in the city. The historical analysis also covers current waste management practices among the inhabitants of Freetown and the recent policies implemented by the local government. The urban metabolism of solid waste is analysed to understand how waste moves within the city as a corollary to how related risks are spatially distributed throughout Freetown. After describing how daily and episodic hazards associated with solid waste can lead to risk traps overtime, the policy brief then concludes with a review of gaps in data and remaining questions.

## I. Historical Background

The historic management of solid waste in Freetown can be characterised by its recurrent changes in responsibility and ownership. Figure 1 (on the next page) depicts how the delegation of solid waste management has continuously changed from one organisation to another, contributing to the deterioration of the system's effectiveness. International cooperation has played a relevant role in shaping Freetown's solid waste management history. Since the early 1980s the city has received donations of technical equipment from various governments, including Germany, France and the United Kingdom as well as financial and data support of various degrees from The World Bank.

Year	Authority in charge and International Cooperation
<b>Before 1971</b>	<ul style="list-style-type: none"> <li>Department of Health and Human Services</li> </ul>
<b>1971-1987</b>	<ul style="list-style-type: none"> <li>Freetown City Council (FCC) → Ministry of Health and Sanitation (MoHS)</li> <li>Donation of skip trucks, and other technical equipment by German KfW (1980-1990)</li> </ul>
<b>1987-2003</b>	<ul style="list-style-type: none"> <li>Environmental Division of the MoHS</li> <li>Freetown Infrastructure Rehabilitation Program and Donation of technical equipment by the World Bank (1995) and the UK Government (1999)</li> </ul>
<b>2003-2005</b>	<ul style="list-style-type: none"> <li>National Youth Multi-Purpose Cooperative Society (NYMCOS) under the Ministry of Youths and Sports (MoYS)</li> <li>Engagement of the youth in the waste management of the city</li> <li>World Bank Report (2004)</li> </ul>
<b>2005-2008</b>	<ul style="list-style-type: none"> <li>Freetown City Council (FCC)</li> <li>World Bank loan for USD\$3mm (2008)</li> </ul>
<b>2008-2012</b>	<ul style="list-style-type: none"> <li>Freetown Waste Management Company (FWMC)</li> <li>Privatization of the waste management</li> <li>Creation of Klin Salone with the support of Germany's agency for overseas development (GZD) and services agreement with FWMC. This programme aimed at the rehabilitation and private organisation of the waste management system while at the same time contributing to youth employment. 42 youth groups, employing a total of 260 youths, operate the labour-intensive, door-to-door waste collection and cover their operational costs through subscription fees.</li> </ul>
<b>2012- 04/2017</b>	<ul style="list-style-type: none"> <li>Masada Waste Management Co SL Ltd. (2012)</li> <li>Services agreement with Klin Salone</li> <li>Ebola outbreak</li> <li>Agreement with the Dutch company the Waste Transformers (2016)</li> </ul>
<b>04/2017 - present</b>	<ul style="list-style-type: none"> <li>The agreement with Masada is terminated and FCC takes control over the waste management</li> <li>Operation Clean Freetown is launched as part of the President's Recovery Priorities.</li> </ul>

## II. Current Waste Management Practices and Policies



Freetown City Dumpsite

Photo Credit: Mustafah Abdulaziz

The Freetown City Council (FCC) regained responsibility for solid waste management in 2017, with a new initiative called Operation Clean Freetown (OCF), which was created as part of an alliance with international organisations. OCF's predominant aim is to reduce the risk of epidemics through improved solid waste management, achieved through the integration of organised waste collectors, a practice that other entities have tried with various degrees of success in the past. Furthermore, the OCF is part of the President's Recovery Priorities, a multi-stakeholder programme led by the Sierra Leone government, which focuses on education, energy, governance, health, private sector development, social protection and water.

Available information on the Sierra Leone government web page describes OCF as comprised of three main strategies. The first seeks to improve waste management infrastructure such as flattening and compacting the Kingtom and Granville Brook landfill sites to make more space, temporarily increasing transit/waste collection points and installing litter bins in the Central Business District. The second strategy focuses on equipping and training youth groups as door-to-door waste collection micro-enterprises. All households are required to participate in an intensive ward-by-ward cleaning process and in the future, it will be compulsory for all households to subscribe to regular paid waste collection from either youth groups operating in their wards or from an alternative waste management provider. In the final phase of the programme, the sustaina-

bility of the system will be enhanced by enforcing bylaws, raising awareness among the community, discussing with the manufacturers and distributors of plastic bags, sachets and bottles, and hosting an annual competition to reward the cleanest ward in Freetown.

The OCF strategies focus on improving the waste management collection, however there is no official initiative tackling waste separation, recycling or composting. Not having a system for waste classification and separation contributes to the soil and groundwater contamination that affects local residents. The ongoing contribution of unsorted waste, even if collection practices have improved, ensures continued risk from contamination. Furthermore, according to the OCF's official social media pages, the government is enforcing punitive policies to punish residents who commit 'anti-social waste behaviour' with six years of prison and a significant fine. This strategy can have the opposite effect by preventing people who are already struggling to pay for waste collection, from working and earning money to access waste management services.

Kingtom and Granville Brook, Freetown's two formal landfill sites, lack disposal regulations or restrictions on who can enter. These sites are visited freely by informal waste pickers and livestock. They are the site for multiple informal settlements. Residents of these communities have reclaimed land using scavenged materials from solid waste and often grow their own food on-site. Re-using and re-sel-

ling waste is critical to the livelihoods of many, whether it be the household-level recycling of collected waste or the more entrepreneurial scavenging and re-selling of waste collected from the homes of people paying for removal.

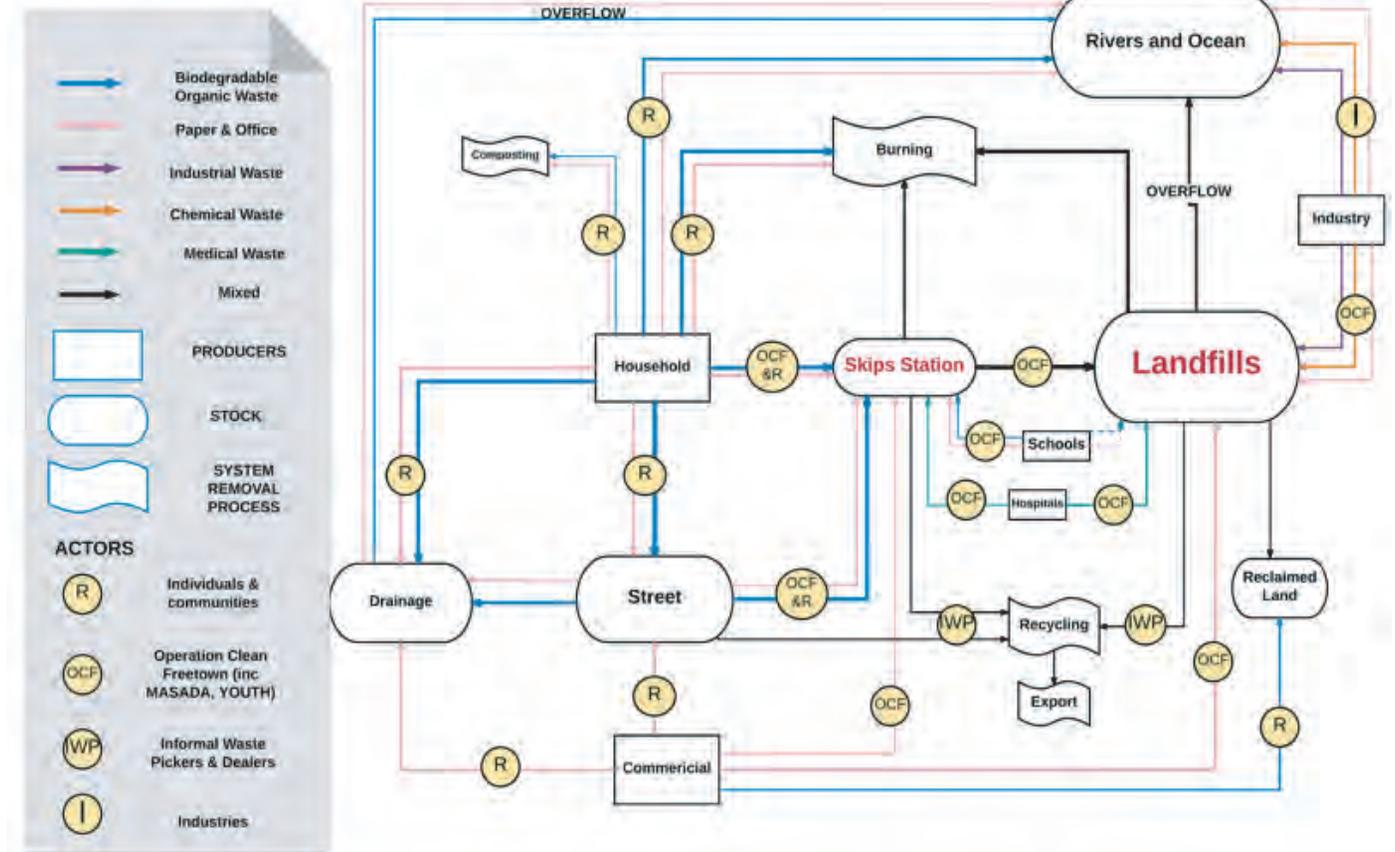
While OCF helped rectify problems of inadequate equipment with the youth it employs, there has been a historic absence of gloves and bags in the formal and informal handling of solid waste. Without gloves, waste pickers are at risk from exposure of radioactive chemicals, healthcare waste, sharp objects, and human and animal faecal matter, increasing overall risk to physical injury, skin problems, and vector-propagated diseases. Waste pickers with OCF are provided with basic equipment, such as gloves and bags, but other waste pickers and scavengers are likely still at risk. Furthermore, burning solid waste is a common practice in Freetown, which is dangerous to those inhaling toxic fumes. It also increases the risk of uncontrolled settlement fires if not done properly.

Composting is another way residents have contributed to the reduction of waste accumulation. Given that over 70% of solid waste in Freetown is organic, composting could be a useful mitigation strategy; however, if it is taking place in dumpsites or is otherwise contaminated, residents risk illness and other health problems from the ingestion of harmful toxins.

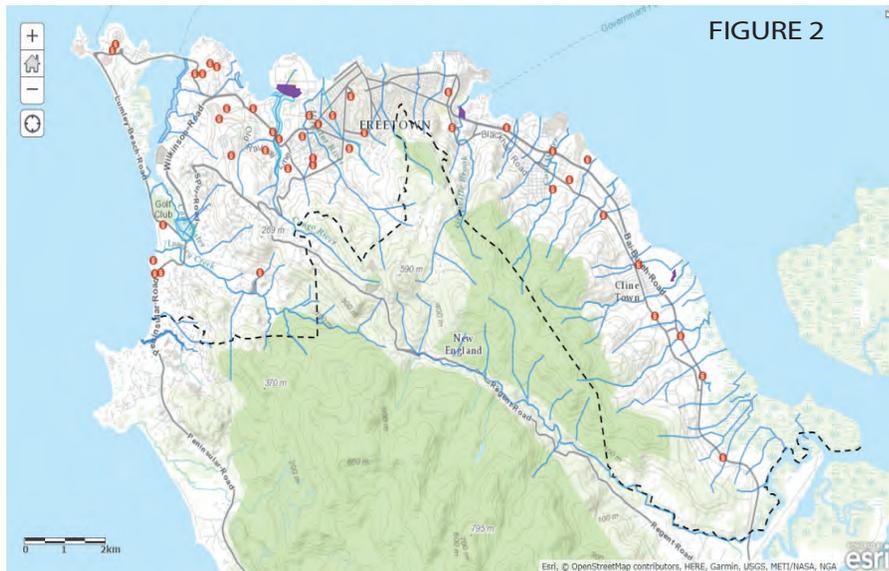
### III. Spatial Analysis of Freetown's Solid Waste Metabolism

The ubiquity of waste build-up in Freetown's streets makes it a city-wide problem, but to effectively address the multi-hazards of poor solid waste management in Freetown (see Figure 1), it is critical to understand the physical settings in which localized hazards are situated today. Freetown is a coastal city, bound by the Sierra Leone River and Atlantic Ocean in the north and the Western Area Peninsula Mountains in the south. Mangroves, swamps and mudflats are found mainly along the north-eastern coast, but they also appear in inlets near the raised beaches extending out from of the north-western side. Freetown's tropical, savanna climate has a rainy season that lasts from May to December, bringing annual monsoons and torrential rainfall. Increased precipitation during this period contributes to the formation of many high-volume, seasonal streams that carve up the mountains and beaches as they flow down from the peninsula towards the sea. Concerns over climate change are also relevant as sea level is forecasted to rise and the intensity of storms is predicted to increase. These ecological factors all facilitate annual, widespread flooding, which in turn allow for the spread of waste and the propagation of disease throughout the city (Figure 2).

FIGURE 1



While Freetown has geographic characteristics that make it prone to flooding, hazards from poor solid waste management are also intensified by the city's built environment. As mentioned previously there are two official landfill sites in Freetown: Kingtom in the West and Granville



Brooke in the East. Household waste is collected and brought to skips, which are not distributed equally throughout the city (Figure 2). The main reason for this is that narrow streets in informal settlements limited the movement of waste collection trucks, resulting in fewer pick-up points. As a result, most skips are located in West and Central Freetown, which is problematic because rapid urbanization has pushed most of the city's expansion eastward, into the already densely populated zone of East Freetown. Generally speaking, this area is less affluent and more industrial than the rest of the city, with West Freetown being more affluent, with lower population density and more public spaces. Central Freetown has very diverse land use, with pockets of densely populated neighborhoods surrounding the city's government and commercial buildings. Prior to the mandatory pay-for-pick-up policy brought in with the President of Sierra Leone's recovery plan, it was common for

most people to leave their waste in the street or dump it into the city's main drainage system. Wealthier residents could pay private individuals to collect their garbage and take it to skips, or landfill sites. The absence of formal collection services in the past and varied levels of informal collection related to city-wide and zone-wide socioeconomic diversity make it difficult to immediately assess where localized problems can be addressed to solve a city-wide problem.

### III. Spatial Analysis of Freetown’s Solid Waste Metabolism (continued)

Figure 1 illustrates the urban metabolism of solid waste in Freetown by showing who produces different types of waste, where it travels and how it gets there. Waste production in Freetown is divided between households, industry and services, with various collection actors meant to bring it either directly to landfills or indirectly through a skip or transfer point. Furthermore, as described previously and depicted here, historical issues with actors moving waste from one place to another has led to situations where stocks have many flows going in and very few coming out, indicating hazard hotspots where risks from high accumulation of mixed waste are higher, particularly in landfill sites and around skips (Figure 3). Known skips are indicated in Figure 3, but there are thought to be an additional 500 informal waste accumulation points throughout the city, allowing waste to build up in the streets and in the drainage systems, facilitating the spread of risk throughout the city.



Photo Credit: Mustafah Abdulaziz

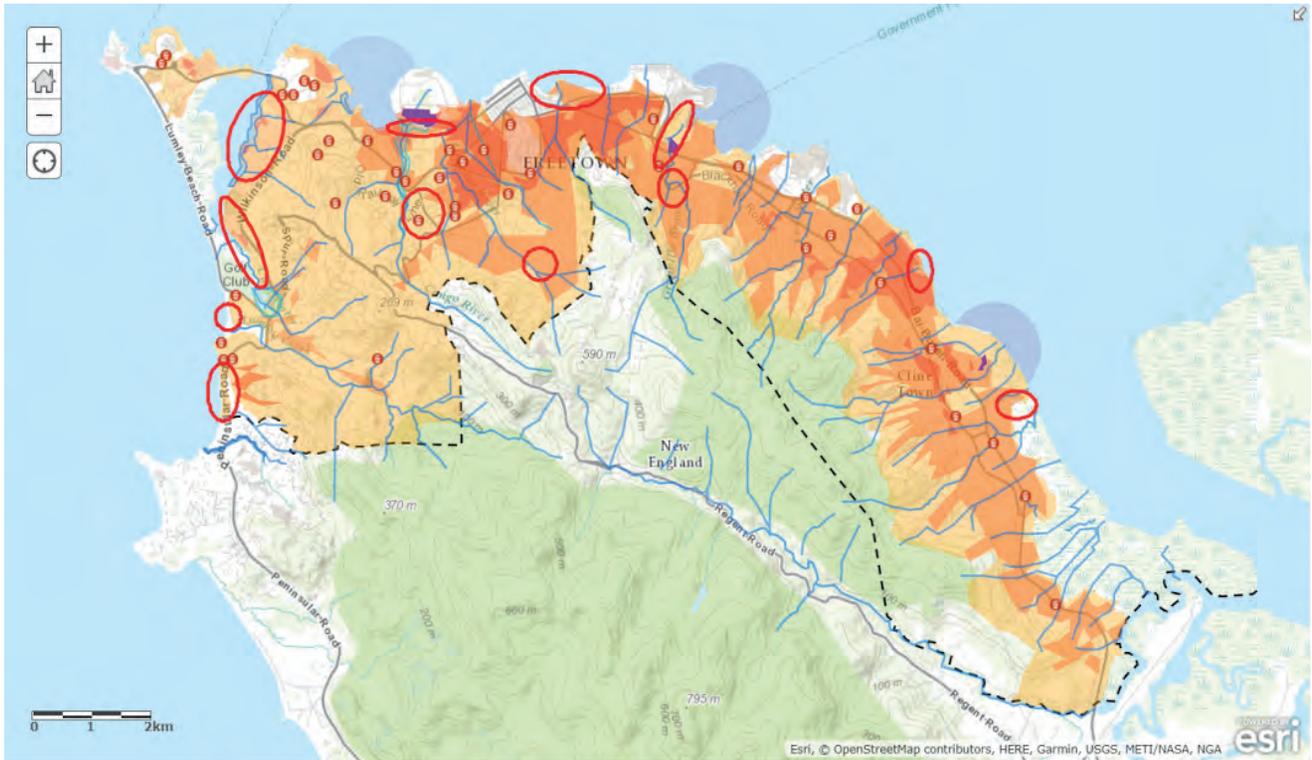
FIGURE 3

Type	Contents
Organic	Mainly food scraps; largest share of waste city-wide
Office	Paper, cardboard and plastic; second largest category
Industrial	E-waste, glass, materials from demolition, mining and packaging.
Chemical	Solid and liquid chemicals; could also include biodegradable, hazardous gases
Medical	All waste generated by medical facilities; biohazardous waste, as well as food and office waste
Mixed	Mixed waste in unknown proportions

OFC and subsequent policies have improved upon this, but as existing landfills are already over capacity, newly added waste can overflow into natural waterways or lead to increased risks from landfill fires and dump slides. The only ways in which waste is being removed from the overall system are through recycling, composting, land reclamation and burning, all of which are associated with other hazards if not done safely; specifically, the absence of on-site waste sorting can create occupational hazards for those looking to scavenge waste from landfills; using compost to grow food in contaminated areas can lead to serious health issues; homes built on reclaimed land made of compacted waste is at higher risk of collapse and rising sea level; burning waste increases health risks from the ingestion of fumes, while also creating the possibility for uncontrolled fires. Contextualizing these hazards with the waste metabolism described in Figure 1 suggests that the level of risk is highest for people living near, working with, or generally contacting waste. Health risks from exposure to waste is higher in densely populated areas, where viral infections are more easily spread and living vectors of disease like mosquitoes and rodents will likely go in search for food.

### III. Spatial Analysis of Freetown's Solid Waste Metabolism (continued)

FIGURE 4



With this analysis in mind, we can posit that risks to the widest range of waste-related hazards falls upon those living in high density areas, in close proximity to water and waste collection points, or who may not have enough money to pay for collection services and are forced to live in close proximity to waste. While the ubiquity of solid waste throughout Freetown generates certain city-wide risks, mapping this analysis provides insight as to where risks are localized and where further intervention may be useful.

Due to their higher rates of poverty and population density, residents of informal settlements are often at disproportionate risk from the multi-hazards of poor solid waste management; however, because informal settlements are located throughout the city, it is easier to group them by ecosystem characteristics rather than by zone. Communities most at risk are those found along the coast and in flood-prone areas inland.

Because of their location in or adjacent to landfill sites in flood-prone areas, households in the informal settlements near Kroo Bay, Susan Bay, and Granville Brooke are at an extremely high risk from episodic hazards like dumsplides, floods and fires, while daily health risks are also significantly higher from the more contaminated environment. Continuous exposure to toxins and fumes from mixed waste make it impossible for residents in these sites to fully mitigate risk over time.

Other coastal informal settlements are found all along the coast, from the West behind Lumley Beach, all the way to the mangroves on the eastern bank. Many of these settlements are built from garbage and excavated materials scavenged from landfills and taken from upstream. Moa Wharf and Kanikay are some of the older settlements, while Cockerill, Banana Water, Congo River and Portee settlements are relatively recent developments.

All these informal settlements are extremely susceptible to flooding and higher risk of contamination from water spreading waste and around the sites. Many of these risks carry through to the inland Valley communities that extend off of the settlements in Granville Brook, Greybrooke, Kroo Bay and Congo River. They are constructed from excavated materials and other waste that has washed down from mudslides and are thus also highly prone to flooding, landslides and sometimes rockfalls.

Within these settlements, women and children are most at risk from the multi-hazards of poor solid waste management. Women are more frequently responsible for household chores, like cooking, cleaning, gardening or burning waste. This puts them at greater risk from direct exposure to waste or contaminated water, potentially leading to respiratory, skin, or viral infections. If they do have gardens, they could be at risk of disease if food grown on land poisoned by leachate from the landfill. As primary scavengers, children are often tasked with collecting recyclable materials from dumsites, skips or just around. This direct exposure to waste also puts them at risk from respiratory, skin and viral infections. Those who go directly into the landfill to scavenge are also at risk from other physical hazards, like dumsplides, fires, and injury from dangerous objects. As the main dumsite for medical waste, the Kingtom landfill site presents greater health risks to people working there; the amount of medical waste is relatively small due to the city's limited amount of healthcare establish, but working there requires special attention for their infectious risk, especially following the Ebola crisis.

## IV. Hazards and Risk Traps

Previous waste management systems have led to large amounts of waste accumulation throughout the city. Not all waste is contained in specific designated dumps and is therefore subject to spreading throughout the city, both through human and environmental forces (water cycle, landslides, wind patterns, slopes, etc.) As waste is dispersed throughout the city so are health and environmental hazards that affect everyone in Freetown, but disproportionately affect vulnerable populations- the poor, those living closest to official and illegal dumping sites and transition points, and those with

previous health conditions. These hazards are exacerbated by episodic events such as heavy storms, ocean surge, and landslides, which move great masses of waste, cause waste to accumulate and increase daily threats to health and well-being. Previous government strategies have not prioritized separation of waste which leads to cross-contamination. Medical waste and faecal matter are particularly problematic and the source of many health concerns. Analysis of the current existing hazards is based on the data available but moving forward needs to account for the more

than 500 unofficial dumping sites and skips that are primarily found in the less well-off eastern part. This lack of data and large percentage of uncontrolled dumped waste has implications on elaborating adequate policies. As past experiences have shown, continued project failures over the years have led to waste accumulation worsening the health and environmental situation in Freetown.

### DAILY HAZARDS

#### Health Threats

- Main health concerns related to waste management : bacterial and viral diseases , chest and respiratory illness , reproductive health, and dermatological issues .
- The waste in dumpsites is composed of toxic and non -toxic refuse, causing cross -contamination. For instance, the untreated pollutant effluents from industries and contaminated medical waste are dumped in oversaturated landfills.
- Leaching from open dumps enter the adjacent surface and ground waters that carry out the diseases. Off -gassing from the accumulated waste can lead to respiratory diseases and air pollution mainly to the population surrounding the area.
- Anywhere waste collects can become a breeding ground for carriers of disease, such as flies, mosquitos, rodents, cats, dogs, and farm animals.

#### Fires

- Due to limited space and oversaturated landfills, waste is often burned to allow more refuse dumping. Burning on the dumpsite releases toxic gases into the atmosphere, which can lead to respiratory disease.
- Waste is also burned at a household level, primarily in informal settlements because there is a lack of waste management collection. Informal settlements that are crowded and have limited space are not ideal places for burning waste as there is a propensity for fire to spread. The toxic gases are also contained and toxic to those nearby.

#### Physical Hazards

- Physical hazards such as cuts and injuries happen when scavengers, some of them children, look for materials and sellable products wherever trash is.
- The lack of equipment delivered to trash collectors affect their physical conditions as they directly collect waste, often with no gloves or protection of any sort.
- Another physical hazard that is caused by saturated dumpsites is that as waste keeps piling -up the 'dunes of trash' collapse and deteriorate properties and people around the sites.
- Finally, as waste is accumulated all over the city over 40 -50% of the garbage is illegally disposed in parts in the streets affecting daily traffic and causing harmful accidents.

### EPISODIC HAZARDS

#### Floods

- The rainy periods increase the propagation of diseases as contaminated waste circulates through streets and waterways.
- After flooding episodes waste collects, clogging drainage systems, which can lead to more flooding and pooling of contaminated water, creating a breeding ground for water -borne diseases.
- Wet waste can be harder to collect and transport.

#### Landslides

- Freetown is prone to landslides. Landslides push waste downstream.
- Landslides can also interrupt waste collection.

#### Coastal Land Collapse

- As the population grows and people are confronted with the geographical constraints of Freetown, options to build safe housing are limited; those with low economic resources are forced to build new land on the sea using waste. This sea encroachment with untreated waste is unstable and prone to collapsing leading to asset loss and high amounts of waste being deposited in the ocean. The collapsing structures lead to injury and pollute the ocean.

## Conclusion

While positive strides in bringing about cleaner streets and wider stakeholder involvement have been made, further steps must be taken to achieve a more sustainable system of solid waste management in Freetown. As with many development initiatives, there is a need for more comprehensive data, particularly to understand the amount of waste produced by commercial, industrial, healthcare or other private entities, as well as by households in formal and informal communities. Government strategies thus far have focused on waste collection, but as existing landfills are already over capacity, diminishing the most dangerous hazards associated with solid waste will require analysing the nature of waste produced by each actor, the sources of contamination, and the need for separating different types of waste. Some information regarding waste production is available, but it has been published in broad qualitative terms. Undertaking a more robust study of what waste is produced and where could help to make more strategic interventions in reducing the amount of waste produced and in closing the loop with more appropriate disposal or recycling methods. If progress made with OCF is not sustained, waste-related hazards may continue to spread throughout the city as garbage flows, pools, and moves through the waterways and streets into the ocean.

The sustainability of progress made by OCF will require the continued involvement of all stakeholders. As it stands, OCF requires everyone to pay for garbage collection services, regardless of their capacity to pay. It might be useful to create more tailored options to fit the different stakeholders. In that regard, more acknowledgement and support toward waste management happening at community-level, like composting at the household level, using waste as construction material, and waste pickers collecting recyclables could be safely integrated into ongoing efforts. Participatory mapping of informal dump sites and OCF collection routes could assist in understanding where more community efforts could be encouraged, particularly in high density areas. Questions regarding incentivisation could also be of use, especially with regard to the sorting of waste. It was unclear if these had been used in the past or if they could work in the future. That said, the introduction of any incentive programme should strive to include representation from all local stakeholders in waste management to bring about broader engagement, representation and overall effectiveness of the solid waste management system in Freetown.

## Acknowledgements

We would like to express our special thanks and appreciation to our professor Ms. Adriana Allen who was there for us patiently whenever we needed help in our journey of learning through this project, and we would also like to deeply thank to Mr. Alhaji Brima Gogra, Ms. Pascale Hoffman, Mr. Emmanuel Osuyete, Ms. Diana Salazar, Mr. Don Brown, and Ms. Rita Lambert, who have contributed to our policy research with their valuable comments during classes. Special thanks to Dr. Joseph M. Macarthy and Mr. Braima Koroma, co-chairs of SLURC for sharing their knowledge and expertise with us during their visit to UCL.

## References

- Abarca, L. & Vreede, V. (2013) Waste Management Situational Analysis in Urban WASH Consortium Areas in Freetown. WASTE.
- Compost to combat disaster. (2017, November 28). Retrieved from <http://www.sl.undp.org/content/sierraleone/en/home/presscenter/articles/2017/11/28/compost-to-combat-disaster-.html>
- Dodman, D. et al. (2012) Understanding the nature and scale of urban risk in low- and middle-income countries and its implications for humanitarian preparedness, planning and response. International Institute for the Environment and Development (IIED)
- Gogra, A. et al. (2010) A Situational Analysis of Waste Management in Freetown, Sierra Leone. *Journal of American Science* 6(5): 124-135.
- Lilliana, A. & Verele, D. V. (2012) Waste Management Situational Analysis in Urban WASH Consortium Areas in Freetown WASTE. Retrieved from <http://www.washlearningsl.org/wp-content/uploads/2015/04/Waste-Management-in-Freetown-Final-report-2013.pdf>
- Sierra Leone. (2017). Compost to combat disaster. [online] Available at: <http://www.sl.undp.org/content/sierraleone/en/home/presscenter/articles/2017/11/28/compost-to-combat-disaster-.html> [Accessed 9 Jan. 2018].
- Mugagga, F. (2006) The Public –Private Sector Approach to Municipal Solid Waste Management. How does it Work in Makindye Division, Kampala District, Uganda? Department of Geography, Norwegian University of Science and Technology (NTNU).
- Sankoh, F., Yan, X., Tran, Q. (2014) Assessment of Solid Waste Management in Freetown, Sierra Leone towards Sustainable Development. *Journal of Applied Sciences* 14(22): 2909-2924.
- Sankoh, F., Yan, X., Tran, Q. (2013) Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone. *Journal of Environmental Protection*, 2013(4): 665-670
- Sankoh, F. & Yan, X. (2013) Problems of solid waste management in developing urban cities: a case study of Freetown, Sierra Leone. *American Journal of Environmental Protection* 2(5): 113-120.
- Sankoh, F., Yan, X., Conteh, A. (2012) A Situational Assessment of Socioeconomic Factors Affecting Solid Waste Generation and Composition in Freetown, Sierra Leone. *Journal of Environmental Protection* 2012(3): 563-568.
- Sierra Leone. (2017). Compost to combat disaster. [online] Available at: <http://www.sl.undp.org/content/sierraleone/en/home/presscenter/articles/2017/11/28/compost-to-combat-disaster-.html> [Accessed 9 Jan. 2018].
- Sood, D. (2004) Solid Waste Management Study for Freetown, Sierra Leone. World Bank Project No. P078389 submitted to The Government of Sierra Leone.
- The staff of Ministry of Health and Sanitation, Republic of Sierra Leone. (2011) Integrated National Waste Management Strategic Plan 2012-2016. "Keep Sierra Leone Clean, Play your Role for Change"
- Vanguard, T. (2017). Operation Clean Freetown. [online] The Patriotic Vanguard. Available at: <http://www.thepatrioticvanguard.com/operation-clean-freetown> [Accessed 9 Jan. 2018].
- Washlearningsl.org. (2015). Organic waste in Sierra Leone – turning waste to wealth – Sierra Leone WASH Sector Learning. [online] Available at: <http://www.washlearningsl.org/organic-waste-in-sierra-leone-turning-waste-to-wealth/> [Accessed 9 Jan. 2018].
- McElwee, R. (2017) Is climate change to blame in Freetown? Aljazeera News on 18 Aug 2017. <http://www.aljazeera.com/news/2017/08/climate-change-blame-freetown-170817133120465.html> [Accessed 9 Jan. 2018]
- Weiss, R.A. & McMichael, A.J. (2004) Social and environmental risk factors in the emergence of infectious diseases. *Nature Medicine* 10(12), S70–S76: 431-440.
- Johnson, M. A. O. (2009) 'An Assessment of the Urban Conditions and Systemic Issues Contributing to Slum Development in Freetown, Sierra Leone'. Retrieved from: [http://www.slurc.org/uploads/1/0/9/7/109761391/an\\_assessment\\_of\\_the\\_urban\\_conditions\\_and\\_systemic\\_issues.pdf](http://www.slurc.org/uploads/1/0/9/7/109761391/an_assessment_of_the_urban_conditions_and_systemic_issues.pdf).