

A Situational Analysis of Waste Management in Freetown, Sierra Leone.

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Abstract: Freetown served as safe haven for thousands of people from the provinces during the war and suffered a corresponding increase in the rate of generation of waste with very little waste management facility as such facilities were vandalized or completely destroyed. Solid waste management in Freetown has been under variable organizations, with each change further deteriorating the system, bringing it on the verge of collapse. Freetown Waste Management Company (FWMC) is struggling to manage the wastes, hence, the need for the intervention of potential investors/donors to ameliorate this waste management problem by helping address this problem sustainably for the betterment of the lives of all Freetown residents. Streams of waste are characterized by their sources, the types of waste produced, and the composition and generation rates; therefore, knowledge of these characteristics is required in order to design and operate appropriate waste management systems, hence, the need for the Sierra Leone Government or FWMC to set limits on certain physical characteristics and properties for waste classifications; having significant implications for the collection and disposal of various waste streams, since any material deemed hazardous must be handled with specific protocols. The total quantities and characteristics of waste streams generated are yet unknown, with uncategorized refuse, poorly collected, dumped at the two city's insanitary landfills, hence exposing FWMC workers, scavengers, etc., to the dangers of hazardous waste. This appalling garbage situation needs efficient corrective measures or serious rehabilitation; otherwise it will adversely impact the living conditions of the people, further endangering their environment and health. [Journal of American Science 2010;6(5):124-135]. (ISSN: 1545-1003).

Keywords: Sierra Leone, Hazardous waste, health care waste, landfills, Freetown Waste Management Company.

I. Introduction

Management of waste in Freetown poses costly and annoying problems (including low service coverage – averaging 40%, insufficient budgets, highly inadequate equipment, substantial inefficiencies such as high costs, low quality service, low labour productivity, poor public attitudes, and widespread illegal dumping). With respect to waste management, a direct relationship exists between a city's population size and both the percentage of waste removed and rate of household enjoying regular waste collection. If solid wastes are not managed properly, they can pose many environmental and human health risks for many Freetown's inhabitants; for instance, refuse blocking storm drains can cause malaria and other diseases and fires set at disposal sites can cause major air pollution,

causing illness (mostly respiratory) and reducing visibility, making disposal sites dangerously unstable and possibly spreading contaminants to adjacent property. Unfortunately, Freetown's poor bear an uneven burden of the impact of externalities resulting from poor management of municipal solid (and/or liquid) wastes.

In a study carried out by Sood (2004) for the Government of Sierra Leone, it was estimated that over 745 tons day⁻¹ (averaging 0.45 kg person⁻¹ day⁻¹) of garbage is generated in the Freetown municipality, of which, biodegradable organic waste, mostly from residential areas and vegetable markets, accounts for over 84%. Construction, demolition debris and yard wastes are not included in this estimate as these are highly variable and skew quantity assessments.

However, medical, toxic, and hazardous wastes are included, as these are currently disposed off with regular wastes. Additionally, the few Freetown industries contribute approximately 20 tons day⁻¹ of wastes, mainly, broken bottles and glasses, waste cans, rags and plastics, and small amounts of hazardous wastes.

II. History of Waste Management in Freetown and other parts of Sierra Leone.

Waste management in Freetown has been under variable organizations, both public and private. Unfortunately, each change further deteriorated the system, bringing it on the verge of collapse. The Freetown Waste Management Company (FWMC), the current authority, is struggling to manage the wastes under tight budgets, limited trained but inexperienced manpower, and little or no legislative authority and experience in waste management. Given the lack of education and awareness, and coupled with the very weak penalties (if any) for non-compliance, the public at large is also generally non-cooperative.

The main issues noticeable in the system are highly inadequate and malfunctioning equipment; inefficient collection practices with quite a variable levels of service, poor and unhygienic operating practices; including no environmental control systems; open burning of garbage; indiscriminate illegal dumping and littering; and a public with seemingly little sensitivity to the garbage around them or any awareness of what represents responsible waste management. Coupled with changing waste management authority, the appalling garbage situation, with its present state of management in Freetown, which borders collapse, needs efficient corrective measures. A collapse of the system will adversely impact the living conditions of the city dwellers, further endangering their environment and health. Freetown's solid waste management system needs serious rehabilitation, first on an emergency basis, followed by development and implementation of long-term, sustainable measures. It also needs a change in behavior of individuals and the society. A successful solid waste management depends on an efficient operational system from the outset. It is commonly recognized that four technical pillars of any SWM system are: (i) storage at or near the point of generation, (ii) collection of waste, (iii) street cleansing, and (iv) transport and disposal of wastes. Each of these precepts for sustainable SWM also requires careful planning and implementation by a financially sound, well-footed institute that has executive authorities and appropriate policy and legislative support. In addition, the participation, organization and management of relationship between all key stakeholders must also include consensus building throughout the planning

process, which also requires regular revisions and updating. A sound solid waste management system is also essential for sustained economic growth, which in turn can also help generate better revenues and potentially better waste management resources and services (World Bank, 1999). Unfortunately, a sustainable solid waste management system is beyond the ability of any municipal government alone, as is the case of the Freetown City Council (FCC). To meet this need, SWM authorities in many countries are increasing involving private sector and communities as key participants.

In terms of solid waste management, in Freetown, there is too much to do, and at present, there is too little to do it with. Waste management in Freetown, under shifting authorities, has been treated as a political football. Table 1 shows the Record of our Solid Waste Management Responsibility.

The Sierra Leone Department of Health and Human Services (DoHSS) was assigned the responsibility in the 60s which nominated FCC in 1971, an urban Health Authority to manage Freetown's solid wastes. However, the FCC had difficulty in providing the services, and in late seventies, given the hosting of the 1980 Organization of African Unity (OAU) conference in Freetown, the Health minister, while launching a "Keep the City Clean" campaign, also transferred the waste management to the Ministry of Health, DoHS's (Department of Health and Sanitation) new name. In early 80's sanitation was added, and a new name - the Ministry of Health and Sanitation (MoHS) emerged. In 1987, the MoHS assigned the waste management responsibility to its (then newly created) public health units under its Environmental Health Division (EHD).

The *Kreditanstalt für Wiederaufbau* (KfW) of the Federal Republic of Germany helped the EHD's Public Health Units with technical and financial assistance during the 1980-1990 periods, which assistance included provision of waste management vehicles, equipment and consultancy services. The equipment provided included ten (10) skip trucks, two (2) tippers, two (2) front-end loaders, three (3) monitoring vehicles and one (1) one-track bulldozer. The assistance, however, was abruptly halted in 1994, because of the Sierra Leone's government's political misunderstanding, and declaration of the German Ambassador as *persona nongrata*.

The World Bank, in 1995, under its Freetown Infrastructure Rehabilitation Program (FIRP), provided two (2) skip trucks, two (2) monitoring vehicles and thirty (30) skip containers to the city. Additionally, the project also provided one (1) truck in 1997. Unfortunately, by this time, most of the skip trucks provided earlier by Germany had ceased to operate, creating an acute shortage of skip trucks

needed to cope with the city's growing requirement. Coupled with the domestic insurgency, by this time, most of the equipment was damaged or destroyed. In 1999, based on government's request the British government provided used waste management equipment including four (4) skip trucks, three (3) cesspit emptier, two (2) waste bowzer, and two (2) tipper. Almost all of these vehicles have since been grounded due to lack of maintenance.

Table 1: History of waste management in Freetown, Sierra Leone.

| Date | Name of Authority |
|---------------|--|
| Before 1961 | Department of Health and Human Services (DoHSS) |
| 1971 | Freetown City Council (FCC) |
| 1980 | Ministry of Health (MoH) |
| 1982 | Ministry of Health, German Assistance and Ajibu Jalloh – Private Contractor |
| 1987 | Environmental Health Division (MoH), German Assistance and Ajibu Jalloh-Private Contractor |
| 1993 | Environmental Health Division (MoH) with assistance from Freetown Infrastructure Rehabilitation Project (FIRP) |
| 1995 | Environmental Health Division (MoH) with assistance from Freetown Infrastructure Rehabilitation Project (FIRP) |
| May 2003 | National Youth Multi-purpose Cooperative Society (NYMCOS) under Ministry of Youths and Sports (MoYS) |
| March 2005 | Freetown City Council (FCC) |
| February 2008 | Freetown Waste Management Company (FWMC) |

The waste management situation further deteriorated significantly under the EHD's resumption of Freetown's waste management responsibilities. As before, key contributing factors were essentially the same and included high bureaucratic inefficiency, corruption allegations especially in the procurement of spare parts and existence of "ghost" workers, poor management, lack of accountability, and lack of funds. The continued restructuring also placed junior, inexperienced, and incompetent staff over the qualified and the experienced ones, adversely impacting staff morale and performance.

At this time, EHD's key solid waste personnel included its chief, one Senior Sanitary Engineer (SSE), one Sanitary Engineer (SE) and three Public Health Inspectors. In addition, EHD also had 57 junior staff and 328 labourers. In terms of equipment, the EHD's

main operating equipment (until 1994) included one (1) bulldozer, nine (9) skip trucks (average availability 80%), two (2) dump trucks (90% availability), two (2) loaders, ten (10) other vehicles, and three (3) cesspit emptier and 2295 m³ vehicles. Waste containers were emptied according to the appraised requirements, daily or less frequently.

Following several field missions consisting of the MoHS and UNDP, assessing Environmental Health and Waste Management situations in five major towns and Freetown city in 2005, a project concept on Sustainable Waste Management was designed by the MoHS, in cooperation with the UNDP Governance Unit. At the same time, the World Bank, as a key partner, agreed to fund the provision and preparation of landfill sites. To formally launch the project in the different towns, a 2-day Validation Workshop (called "Write-Shops") was organised in each of the six locations: Koidu, Bonthe, Bo, Kenema, Makeni and Freetown. Detailed implementation plans were put up at these Write-Shops, and the local community; from paramount chiefs to religious leaders, to representatives from schools and local police, was at the forefront of their development.

As an emergency measure, also the IDA Transport Sector Project (TSP) financed a solid waste collection program for Freetown, Bo and Kenema designed mainly to generate employment, through local contracts; and was implemented by the Sierra Leone Roads Authority (SLRA) under the overall supervision of the Coordinating and Monitoring Unit (CMU) of the Ministry of Transport and Communications (MoTC). Makeni, the headquarter town of the Northern Province, was not included at that time due to the problem of inaccessibility caused by the war. Although relatively successful, these service contracts ended in March 2002, and the MoHS continues to be responsible for the management and sustenance of refuse collection and disposal in the country.

The Ministry of Youth and Sports (MoYS) was responsible for managing the city's wastes in May 2003. The transfer of solid waste management to the MoYS also created an ideal enabling environment to partially tackle unemployment, drug abuse, and the homelessness of city's vast numbers of unemployed youth. For collection, the MoYS has assigned the responsibility to one of its (non-professional) branches, called "National Youth Multi-purpose Cooperative Society", (NYMCOS). Earlier, the NYMCOS youths were engaged in mostly voluntary services in the cleaning of strategic public places, streets, drainages, and sidewalks.

However, in March 2005 the responsibility of the management of Freetown's waste was transferred to the FCC, which used to receive between 35 and 40 million Leones per year from government for garbage

collection by paying staff monthly salaries, hiring and fuelling vehicles and machines, providing protective gears and medical care for the workers. To compound the problems, there were very few official garbage dumping sites, so the overcrowded-city residents use gutters and other unofficial sites resulting in choked waterways/streams that flow down to the sea, depositing waste into the waters that only wash up again on the beaches, destroying the environment and beautiful tourism sceneries. The reality on the ground was that there was an inadequate number of trucks to clear garbage as they were generated. The vehicles and few trucks the council was using were donated by the Libyan President and some trucks were out of service by then. This waste disposal situation would have brought about many health hazards in the city. For instance, residents of Fort Street and Lucas Street among others trapped in heaps of filth and unbearable stench have complained about dirt-related sicknesses. One of the residents remarked that, mosquitoes and flies continue to increase, respectively, malarial- and diarrhoeal-related deaths in the communities and that the transit points are now garbage fortresses sometimes blocking human and vehicular traffic (Concord Times-Freetown, 2008a).

Based on the recommendations of a study by Sood (2004), a World Bank project aimed to help Freetown manage its waste in an effective and sustainable manner, will fund equipment for much-needed emergency and the short-term, two to four year cleanups, as well as helping establish an independent organization, Freetown Solid Waste Management Company (FSWMC, named proposed by Sood 2004 report), capable of implementing these activities. Equally important, for Freetown, the outputs can provide long-term sustainable solid waste management (SWM) services.

To implement the recommendations of the report by Sood, the Sierra Leone Government, in 2008, decided to take garbage collection from the authority of FCC, and called for its privatization to ensure Freetown from continuing been filthy and to avert huge capital investment spent in solving the traditional structural problems in waste management. The council no longer had the logistical capacity to dispose of the city's mounting garbage as all the vehicles used by FCC were not able to collect the volume of garbage at dumpsites and it was not pleased with government's decision as garbage collection has traditionally been the responsibility of the local council. The FWMC (a name almost the same as that proposed by Sood) was given that mandate backed by a three (3) million US dollar World Bank loan and it started operations on February 1, 2008. This company inherited 520 cleaners from the GTZ/Klin Salone (GTZ – Germany's agency for overseas development/German technical cooperation in

collaboration with Klin Salone - a youth-based enterprise) programme; whereas the real running cost they inherited was one hundred and twenty one (121) million Leones a month from the government and GTZ, together with its, providing the balance money needed for the cost of providing safety gears and salaries of 520 cleaners and the running and maintenance of 11 trucks and other equipment, 2 tippers and 9 compactors which had to be fueled on a daily basis and repaired and other administrative costs. The Project Manager of GTZ in Sierra Leone said they came up with the Klin Salone project to promote health, a cleaner environment, and create jobs for some hundreds of marginalized youths (the most vulnerable in the country) through the private sector after years of war and political instability. For the past one year and half, GTZ worked with 42 youth groups in Freetown who have been actively involved in both the public and door-to-door collection of wastes.

III. Study Area

Freetown is the capital and largest city of Sierra Leone. A major port city on the Atlantic Ocean located in the western region of the West African country. The climate of Sierra Leone is tropical (hot, humid); with the Rainy Season lasting from May to December and the Dry Season from December to April, and rainfall along the coast can reach 495 cm a year with Freetown having the highest amount of rainfall, greater than 3500 mm, hence one of the wettest places along coastal western Africa. The other main towns in Sierra Leone include Bo, Kenema, Makeni and Koidu.

The ten-year (1991-2001) old rebel war severely impacted Freetown's economic and infrastructural developments, including the vandalization or complete destruction of waste management equipment such as skip trucks, skips/large containers, etc, coupled with swelling its population from 1.2 million in 1994 to an estimated high of 1.4 million in 2006 (Rosenberg 2006). Recent UN and World Bank estimates indicate a projected annual population increase of 4.0 for Freetown (World Factbook 2008), which would proportionately increase the amount of solid waste generated with resultant inadequate sanitation, etc. The result of serious population migration has been squalor, poor housing, inadequate sanitation, congestion, pollution, poor public services, and chronic unemployment, particularly among the youth, most of who are without any employable skills. The ubiquitous pile-up of garbage, can be seen everywhere in Freetown. Also, most city drains are clogged with garbage and even a number of manhole covers have been removed to dump garbage. Many existing skips/containers that also act as transfer stations for the solid waste are broken. Often, garbage is strewn around, where scavengers (mostly

children and wandering dogs, birds, pigs, and other stray animals) forage amongst the rubbish, spreading it around. City's coastal area residents dump their wastes into the sea, whilst, in poor neighborhoods, collected waste is often set on fire. The situation is a major contributor to the city's significant rise of the incidence of vector-propagated diseases.

Besides increasing population, in general, problems with solid waste management particularly in Freetown and Sierra Leone in general, are a lack of continuity in implementation of government policies (which are sometimes inadequately formulated), financial and operational constraints, and unfortunate attitude of citizens towards waste management. Poorly collected waste is subjected to much quicker putrefaction, stronger stinks, and more flies (vectors of diseases) and during the long rainy season of Freetown the waste, being uncovered, becomes soggy, smelly and difficult to handle (collect and transport).

IV. Analysis of the Existing Situation

As indicated earlier, the ten-year rebel war severely impacted the infrastructure, the agriculture, and the economy of Sierra Leone. During and by the end of the war, thousands of refugees, mostly rural poor migrated to Freetown, swelling its population.

The ubiquitous pile-up of garbage is a significant contributor to the city's significant rise of the incidence of vector-propagated diseases. Currently, most of the city's drains are choked with rubbish. A number of manhole covers have been removed so that garbage can be dumped there. Where special dumps or public "dustbins" or containers (skips included) are provided, garbage is often dumped outside due to lack of capacity, poor collection, and/or public insensitivity. Open Dumps allow free access to waste pickers or scavengers, animals, and flies; and often produce unpleasant and hazardous smoke from slow-burning fires. Garbage can be seen strewn everywhere, scattered, or in small or large piles, many of which are regularly set on fire, used as a waste disposal option. Waste generation in Freetown far outstrips its collection and transport.

From media reports, it seems as if the company presently in charge of waste management in the city, FWMC, is struggling to cope with the present situation (Concord Times-Freetown, 2008a, 2008b and 2009) as it suffered so many strike action threats from workers in 2008 and 2009 because of reasons of poor conditions of service and unfair treatments, including but not limited to, late or none payments of salaries, non-provision of workers protective gears, no medical care for the workers, the attitude (molestations) of some bosses to their workers; inadequate funding; lack of heavy equipment and other working tools to do the job; lack of trained and experienced workers to

efficiently do the job; insufficient availability of official garbage dumpsites; etc.

Kroo Bay, one of the largest and poorest slums in Freetown, is located at the mouth of one of the rivers which crosses Freetown, so all waste dumped in the streets and in the drainage systems all over the city will all end up there causing a health risk and a serious environmental disaster (for instance, massive flooding during the rains) to the inhabitants. And also drains along the streets of Freetown, meant to collect rainwater in the rainy season, become clogged with waste and during heavy rainstorms entire areas of the city are flooded as a result of bad management of the waste.

At the two dumpsites (i.e., Granville Brooke Landfill in the East and Kingtom Landfill in the West of the city) in Freetown, thousands of scavengers make their living from the collection of waste. They collect cans and other metallic objects, plastics, and other products in order to sell them for few Leones (the local currency). Healthcare waste is also dumped at the dumpsites, mixed with domestic waste, increasing the risk of infection with Hepatitis B and HIV and other diseases (World Bank, 2000).

Silvia Garcia, a researcher, Caledonian Environmental Centre/PhD student and 2009 Gordon Masterton/Magnusson Award winner, went on a successful working visit to Freetown in April 2009 as a part of twelve (12) professionals working in the waste management sector in the United Kingdom (UK); on which visit, this group was able to review the city's waste problem from top to bottom and held meetings with a number of key stakeholders including the FCC Mayor, FWMC, GTZ, the British Council, Klin Salone, MoH, the World Bank, hospitals and universities. These experts delivered training in relevant waste management approaches to a mix of waste practitioners and universities and organized environmental awareness sessions with a large group of very enthusiastic school children; and also delivered a session with the aim of launching an ecoschools programme in few schools selected by the British Council. This opportunity was used by them to raise awareness of waste and environmental issues and assist in setting up environmental clubs. They gave to the School of Environmental Sciences (Njala University, NU) some waste management books donated by Dr. Gholam Jamnejad of the Built and Natural Environment Department at Glasgow University; and are currently working on potential partnerships between Sierra Leone and UK universities. Before their departure, the group also undertook a waste and environmental audit for the Freetown's British Council offices; and later presented the main findings of their visit to the group of stakeholders.

Upon their arrival to the UK, Silvia, on behalf of the group, expressed her appreciation, “Thanks to the Magnus Magnusson Award and my employer, Caledonian Environment Centre, I am part of this project. It has had a great impact on me, both professionally and personally. After being in direct contact with the severe poverty my perception of life has changed; my “problems” are not problems anymore and I have realized how well we live in the UK. Professionally, waste in developing countries is a new area to develop which is much more challenging than my everyday job in the UK. I believe that nobody can remain indifferent after such an experience. We are therefore very keen to continue our project, in order to work towards a sustainable transformation of waste management in Freetown. We are currently working in a document that summarizes our findings, intended activities and future actions, which will be presented to potential investors/donors in order to address the waste management issue in Freetown”.

In a recent media report (Sierra Express Media, 2009), contrary to Concord Times-Freetown (2008a, 2008b and 2009), the General Manager and Operations Manager of FWMC claimed that, the company was embarked on recruiting more manpower to help clean the city and that they were engaged constantly in efforts to sensitize the residents of Freetown about the need for respect for sanity and cleanliness; there’s an ongoing construction of garbage disposal points all over the city; and the company has procured more vehicles, motor cycles and push carts to make sure that the city is clean on a twenty-four hour basis.

In August 2009, the Government of the Republic of Sierra Leone (through the Ministry of Finance and Economic Planning), on behalf of the FWMC, released an “Invitation for Bids” notice for the construction of Transit Points (including perimeter fence walls) in Eastern and Western Freetown and Access Roads within the Kissy Grandville Brooke Landfill and the Kingtom Landfill, Freetown, and Rehabilitation of Offices and Garages at Works Yard, Blackhall Road, Freetown. The government recently received this financing from the International Development Association (IDA) toward the cost of the Sierra Leone Water and Power Project (Water and Sanitation Component), of which funds IDA intended applying a portion, through the FWMC, to eligible payments under the contract for IFB No: FWMC/NCB/08/01.

V. Waste Collection Practices, Categorization and Disposal Methods

5.1 Collection Practices

The snags to an efficient or rather house-to-house waste collection in Freetown include, the

unwillingness and/or inability of the residents to pay for such services; coupled with large areas of the city been highly congested, making up more than two-thirds of all city neighbourhoods, mostly inhabited by low-income communities. Additionally, waste storage practices at homes are rather poor, adding to the insurmountable collection difficulties. Unsorted waste is often stored in old leaky buckets, and used paper/plastic bags instead of a bin lined with plastic bags. Given the small-scale house-to-house collection, pre-collection from homes to the public or communal skips placed at strategic spots in the city, has to be organized by households or some informal private groups; thus, household waste is thrown by a family member, usually either a child or a family servant and since 2005 this has been done on a very limited basis by an arm of National Youth Multi-purpose Cooperative Society (NYMCOS), doing the service for a negotiated payment from the households concerned. To add to the waste collection problem, there has never been any transfer station, a common situation to most Africa countries. Rubbish picked up by collection workers (not provided with safety gears, including gloves, etc.) from communal skips is moved straight for the city’s two disposal sites.

Table 2: Garbage Skips Distribution and their Average Monthly Collection Rates (Adopted from Sood, 2004)

| Zone # | Zone Range | # of Skips | Collection Frequency | Estimated Population |
|--------|---|------------|----------------------|----------------------|
| 1 | Calaba Town to Ferry Junction | 11 | 30 | 185,000–200,000 |
| 2 | Ferry Junction to East End Police Station | 9 | 20 | 185,000–210,000 |
| 3 | East End Police Station to St. John | 8 | 25 | 250,000–285,000 |
| 4 | St. John to Juba Bridge (7 th Battalion) | 26 | 50 | 275,000–410,000 |
| | Total No. of Operational Skips | 54 | 31.2 (Avg.) | |

The then Ministry of Youth and Sports (MoYS) in early 2000 divided the city into four zones for waste collection (as shown in Table 2); each zonal team consisted of ten members who had access to tipper trucks, 5-7 ton capacity wheelbarrows, and related equipment including shovels, long and short brooms, rakes, shovels, etc.

Household waste in Freetown is collected using 6 m³ skips, which are strategically located along various streets and given their (skips) highly inadequate number, wastes are often illegally deposited in small dumps along city streets, and market and business districts, making collection inefficient and expensive. Furthermore, often immobilization rate of waste collection vehicle reaches about 70% in Freetown, thereby seriously impacting the rate of collection. The volume of waste to be collected in areas, where manual collection is performed, often far exceeds the capacity of the collection system. To salvage the situation, a few community groups collect their own waste; which, however, often end up as garbage mounts elsewhere. In economically better neighborhoods, such as Signal Hill, and Wilkinson Road, etc., waste collection is performed at least three times a week, on the average, considered a desirable collection frequency, but poor neighborhoods, like Calaba Town, Wellington, etc., are serviced less frequently, once a week, on the average; the reasons cited for the variation been better roads, little or no congestion, etc., in economically better neighborhoods making vehicular waste collection easy.

Streams of waste, broadly categorized into “controlled” and “non-controlled”, are characterized by their sources, the types of waste produced, and the composition and generation rates; therefore, knowledge of these characteristics is required in order to design and operate appropriate waste management systems. The single most important part of waste classification is accuracy because all other waste management requirements (including monitoring and controlling the existing waste management systems, and making regulatory, financial, and institutional decisions) hinge on this one assessment. It’s also proper to determine the volume, density and weight of solid waste produced to estimate the storage requirements and collection frequencies and devise suitable collection methods.

5.2 Waste Categorization

Streams of waste, broadly categorized into “controlled” and “non-controlled”, are characterized by their sources, the types of waste produced, and the composition and generation rates; therefore, knowledge of these characteristics is required in order to design and operate appropriate waste management systems. The single most important part of waste classification

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Table 3: The eight major categories of Solid Wastes (modified from Sood, 2004)

| Source | Typical waste generators | Types of solid wastes |
|----------------------|--------------------------------------|---|
| # Residential | Single and multifamily dwellings | Food wastes, paper, cardboard, plastics, Textiles, leather, wood, glass, bulky items, and household hazardous wastes |
| # Industrial | Light and heavy manufacturing | Housekeeping wastes, e-waste, packaging, food wastes, demolition materials, wastes from mining industries (mine tailings), etc. |
| # Commercial | Stores, hotels, restaurants, markets | Paper, cardboard, plastics, wood, food wastes, hazardous wastes, e-waste, etc |
| # Institutional | Schools, hospitals, prisons | Same as commercial, government centers, new construction sites, road repair, Wood, steel, concrete wastes, e-waste, etc. |
| # Municipal Services | Street cleaning, etc. | Street sweepings; landscape and tree Trimmings, general wastes from parks, sludge water, e-waste, etc |
| # Process wastes | Heavy and light manufacturing | Slag, mineral tailings, etc |
| Agriculture | Crops, orchards, vineyards, dairies | Spoiled food wastes, agricultural wastes, etc. |

All should be included as “municipal solid waste”

Principally, the three main classifications of urban solid wastes are municipal, industrial and hazardous. But, the designation of a material as ‘municipal waste’ depends upon the individual city’s definition of

municipal solid waste. Nonetheless, the current waste authority, the Freetown Waste Management Company (FWMC) handles solid waste, known as “controlled waste”, from households, markets and institutions, street and public open spaces, dead animals; “uncontrolled waste” from agriculture, mines and quarries; and non-hazardous waste from processing and industries. The eight major categorizations of solid waste generators are as shown in Table 3.

5.3 Disposal Technologies

Freetown’s wastes are disposed of at the city’s two landfills, which are essentially open dumps; which approach can be classified as the primitive stage of landfill development and is the predominant waste disposal option in Freetown. These uncontrolled or insanitary open dumps have no environmental safeguards, hence, can pose major public health threats, and affect the landscape of Freetown.

5.3.1 Municipal Wastes

The two landfills, Kingtom and Granville Brooke, located at the western and eastern ends of the city, respectively, were initially designed as controlled dumps. In addition to the disposal at these landfills, there is also significant illegal dumping of wastes at vacant lots, street corners, roadside, the city’s drains (mostly clogged with garbage), and the few streams from the mountainside that empty into the sea.

Bulk of the refuse deposited at these landfills is mainly domestic refuse and market-refuse, mainly from the public markets; with organic, biodegradable waste accounting for the largest component with lesser amounts of industrial and street-refuse, in addition to the city’s medical, hazardous, and toxic wastes. Uncategorized refuse are dumped at these landfills as all refuse is mixed and piled at available or accessible areas at each dumpsite. Some commercial and other institutions, which pay little or no fee to the waste management authorities, do their own dumping using their own refuse carts or vehicles. Waste is tipped in heaps at each of the landfills, and leveling of these occurs in a several-day rhythm depending on the availability of a bulldozer [given the high daily hire costs of \$600 day⁻¹ in late nineties and early 2000 (Bartone, 2001)], which works diagonal to slope. With infrequent bulldozing, smaller fraction of all collected medical waste disposed with regular waste, come up to the surface of the dumpsite. Uncertain bulldozer availability often results in garbage heaps that are intermittently burnt to decrease volume, and to make space for incoming garbage, thereby polluting the environment and posing some health risks to the residents. There exists the potential for open as well as controlled dumps to significantly pollute an area’s groundwater; as water percolates through the solid

waste in landfills, it absorbs chemicals and microorganisms present in the rotting materials. The uncontrolled discharge of liquid formed in solid waste dumps or landfills, known as leachate, contaminates ground and surface waters, and thus, pose environmental and public health risks to the local area. Additionally, the emission of harmful gases such as methane (highly flammable gas having the risk of explosion and affects global warming), given its high calorific value, need to be controlled and economically utilized. Each of the two landfills has at least one (1) rudimentary office and no weigh station or formal tipping area. The staff at each landfill is skeletal and it’s composed of five laborers, two supervisors, one clerk, at least one health inspector and two security guards.

The 2-3 skip trucks, used to transport skips to the city’s wastes to the nearest dump, are supported by two front-end loaders dump trucks to haul garbage. When in good conditions, these trucks work right around the clock, sometimes, driving over scattered waste dumps; as use of bulldozer for waste leveling is highly irregular, given the high daily hire costs, when available for renting from a private company. Because the city’s environment is congested, a huge number of skips are hauled at night usually by a crew of four, including a driver and during the day, pushcarts, both small and large, transport wastes from neighborhood to the nearest skip/container or illegal dump, many of which seem to have never been cleared. In many of these containers, garbage is regularly set on fire to dispose of wastes. Sood (2004) estimated that over 40-50 percent of the total garbage in Freetown is disposed of illegally, including large quantities been dumped in open drains, sewers, street corners and so on. Furthermore, each of the landfills, particularly the Kingtom’s, is also reaching its designed capacity, which situation is exacerbated by the lack of appropriate equipment, in particular to level the refuse, preventing “refuse hills.” The two landfills have already failed, having been pushed beyond their engineered limits; and due to poor operational practices, each landfill has almost degraded into potentially hazardous and toxic dump. At the fringes of each of the landfills, some vegetable gardening is done by squatters living in makeshift huts and they are also engaged in various small-scale industrial activities. The leachates from these open dumps entering the adjacent surface and ground waters will expose downstream residents to disease organisms in their bathing, irrigation, and drinking water supplies, and through eating contaminated fish and other foods. Consequently, proper management of the two landfills can effectively remedy this situation.

5.3.2 Industrial Wastes

Commercial and industrial wastes are privately collected and transported to nearest dump site. For instance, the Sierra Leone Brewery Limited (SLBL) collects and deposits its waste at the nearest dumpsite, at no cost. Forms of wastes from Freetown's industries, including the SLBL, Freetown Cold Storage Company Limited (FCSC), range from solid (broken bottles, plastics, spent grains and yeast), liquid (including detergents used for cleaning bottles and other equipments) to gas (basically CO₂ which is a product of fermentation). The non-biodegradable ones include bottles and plastics and the spent yeast extracts from Brewery are believed to be biodegradable, thus, releasing dangerous gases. The SLBL's liquid waste, mostly of unknown composition, is discharged untreated into a nearby Rogers Stream as the SLBL has no wastewater treatment plant. However, it must also be noted, that an effort is being made in the factory to minimize the amount of CO₂ going into the atmosphere as some percentage is trapped and used in the gasification or carbonation of the final products. Also used in the manufacturing process is caustic soda and its wasted excess, being a base, will cause alkalinity (increase in pH) of the surrounding streams to which it is released, hence aquatic life will be threatened.

Surface mining methods to extract ore are employed by most of the mining industries in most rural areas of Sierra Leone. By its very nature, surface mining causes disturbance to the surface of the earth and its associated activities is certainly detrimental to humans, animals and plant lives in the short term. The mining industry, however, differs from the other production industries in generating an extremely large quantity of waste materials in the form of overburden tailings heaps, slags, sludge and mineralized deleterious wastes; hence, causing adverse environmental effects on the landscape in its broadest sense and on the community depending very much on the particular mining company. Some 700,000 tonnes of slimy, red (mainly ≤ 2.5 mm tailings consisting mainly of alumina, silica, kaoline and iron oxide) wastes from the Sierra Leone Ore and Metal Company (SIEROMCO) process plant are disposed of into impoundment areas in valley adjacent to the plant, ending up into the Jong River. Sierra Rutile Limited (SRL), mining and processing mineral sands (including rutile, TiO₂; ilmenite, FeO.TiO₂ or FeTiO₃; and zircon, ZrSiO₄ or ZrO₂.SiO₂), generates tailings and high concentrates of acidic pyrites (FeS₂) and marcasites (FeS₂) that are pumped back into the pond and sand tailings pumped to the back of the dredge; ending into Nitti harbour and the other bodies in this mining area. The other mining industries including, Gold Mining, Marampa Iron Ore Mining Company, and lot of diamond mining industries, also deposit their wastes into their immediate surrounding adjacent water bodies.

The main resultant effects from such operations are traffic, noise, visibility, dust, water pollution, vibration, displacement of residents in the affected areas, the destruction of current land use, and so on.

5.3.3 Hazardous, Toxic and Medical Wastes

Hazardous wastes, which can be in the form of solid, liquid, sludge or even gas, contain highly persistent inorganic or organic chemicals and compounds with acute and chronic (immediate, short-term, as well as long-term) impacts on human/public health and on environment; with direct contact (such as during handling of waste) been the most common exposure route. They also vary in the degree of hazard posed.

5.3.3.1 Industrial and Hazardous Wastes

Key industries in Freetown are plastics, soap manufacturing, tanneries, Freetown Cold Storage Company Limited (FCSC), National Confectionary Company Limited (NATCO), Aureol Tobacco Company (ATC, non-functional at present), Sierra Leone Brewery Limited (SLBL), R. K. Distilleries, G. Shankerdas and Sons Limited (GSS), and others; none of which has any effluent controls. Waste lubricating oil, motor and gearbox oils, and some cutting oil; small amounts of organic solvents; flesh and hide cuttings contaminated with sulfide and chromium salts; waste batteries; and textile dyeing wastes which contain toxic metals like cyanide, are the main hazardous and toxic wastes arising from these facilities. Additionally, there is rubbish from production processes, including, floor sweepings, rags, discarded cardboard and wooden packaging materials, broken glass, metal offcuts, and swarf, whilst the office waste is mainly paper and cardboard. In Freetown, there is no heavy industry, large production or processing of chemicals, oil refining or other similar industrial operations that can generate significant quantities of hazardous wastes. Moreover, inhalation of dust from waste storage or dumpsites may also constitute a hazard at the facilities.

Generally, however, the industrial units are small, with the exceptions of SLBL and FCSC; and all dispose of their wastes, mostly by private arrangements at the nearest landfill. SLBL also gives waste malt to area farmers who use it as cattle or pig feed at no cost. Smoke from burning tires, often used to provide heat to small manufacturing operations, can be seen in a number of places around the city.

5.3.3.2 Health Care/Medical Wastes

Another category of waste that requires special care in handling and disposal is HCW, defined as the total waste stream from a healthcare establishment, research facilities, laboratories, and emergency relief donations. HCW is broadly classified

into communal and special wastes; with communal waste usually having the characteristics of regular municipal waste, such as food waste, packaging materials, waste plastic, cardboards, and office supplies. It can be safely disposed of with regular municipal waste. The remaining HCWs, called special waste, require special attention.

Medical waste is generated by Freetown's health care facilities, including veterinary hospitals. The government medical hospitals in Freetown include Connaught Hospital, PCM Hospital, Under Fives Hospital, Kingharman Road Hospital, Rokupa Hospital, Macauley Street Hospital, and Children's Hospital. The Ministry of Health and Sanitation's (MoHS) 2004 estimates of the total number of beds, including those at the city's major private clinics and health centers (including The Good Shepherd Clinic, Yearima Memorial Clinic and Lumley Health Center, Curney Barnes Hospital, etc.) is 1,455. It is unfortunate that, the overall health care delivery has significantly deteriorated in terms of quality and patient care, coupled with an inefficient waste handling and disposal system in the city's limited number of hospitals; hence, no current estimates of total quantity of medical wastes generated in Freetown are available. Average rates have been projected at $0.55 \text{ kg bed}^{-1} \text{ day}^{-1}$ (Sood 2004), to an estimated total of 727 kg day^{-1} depending upon the number of beds occupied and based on similar city data. The numerous ways used for safe handling and disposal of medical waste (of which the infectious waste can vary from 3%-30% of the total medical wastes) include incineration, non-burn technologies such as use of microwave (radiation) systems, shredding and sterilizing, shredding and chlorination, autoclave, electric arc systems and mechanical systems.

5.3.4 Sludge/Sewage Disposal

With Freetown having no central sewage treatment plant, and at household level, about 60 percent of the city's total population uses pit latrines, and over 30% have septic tanks coupled with the given improper maintenance and servicing, each of these systems represents serious health and environmental hazards to the public. The emptying of cesspits at household and industrial levels has been the duty of the MoHS and now FWMC's and other cesspit emptying private companies. Slurry trucks or "cesspit bowzers" are used to collect and transport faeces to one of the city's two landfills, the Kingtom landfill, where the faeces are spread in a polder with alternating pits (each currently overflowing) for dewatering and drying up. Upon drying, a polder's contents are covered with soil and after few months the product, "night soil", is used as fertilizer. There must be some risk concerns as inappropriate treatment and disposal methods are used;

the existing polder/slurry pond has run out of capacity and its overflowing sewage is led, in its vicinity, through a 6-8 feet-connecting pipe to an unlined pit, which is further connected to a source of tidal water which takes the untreated sewage out to the sea. Inadvertently, a number of families have set up homes close to the tidal pipe and often, these families use waste plastic to prevent the sewage pass their front doors. There is no water supply in the area, and the situation presents an environmental and health nightmare.

VI. Discussions

Freetown waste management has been under various authorities, both public and private, with each change associated with further deterioration, and bringing the system on the verge of collapse. The current authority, FWMC, is struggling to manage the wastes under the aforementioned prevailing conditions and given the illiteracy rate and awareness, coupled with the very weak penalties (if any) for non-compliance, the society at large is also generally uncooperative with seemingly little sensitivity to the garbage around them or any awareness of what represents responsible waste management.

There are no reliable estimates of the quantities of hazardous wastes produced by Freetown's approximately more than 30 manufacturing companies but a German study gives an estimate of 7,500 tons year⁻¹ (GOPA 1995). Also a study carried out by Sood (2004) estimated that an average of $0.45 \text{ kg person}^{-1} \text{ day}^{-1}$ of garbage is generated in the Freetown municipality, of which, biodegradable organic waste accounts for over 84%, excluding construction, demolition debris and yard wastes; but including medical, toxic, and hazardous wastes, as these are currently disposed off with regular wastes. The few Freetown industries account for over 20 tons day⁻¹ of solid wastes, and small amounts of hazardous wastes and the key industries that have the potential to generate hazardous wastes include, soap, paint manufacturing, the large Germany's Heineken-owned brewery (SLBL), chemical, kernel oil and other products. It is likely that given poor economic growth, past domestic insurgency and other factors, these quantities may not have changed. There is also no separation or pretreatment of wastes or polluted effluents at any of these facilities and no existing environmental monitoring, either voluntarily or by authorities of industrial wastes in Sierra Leone. Most industrial wastes are disposed off at the city's landfills by private arrangements. In a few cases, such as, during the operations of ATC, wastes such as tobacco dust and cigarette wrappings were disposed at the facility. In some cases, the effluents are illegally discharged into city drains. Unfortunately, this is also

the case at the SLBL. A used oil recycling facility (recycling used oil from the Sierra Leone Ports Authority and National Power Authority) located at Rokel in the eastern outskirts of Freetown also engages in illegal waste disposal, disposing the potentially dangerous residues in an unlined earthen pit at the facility. Sierra Leone also lacks industry-specific environmental regulations and has an overall weak institutional capacity, which aspect needs to be reviewed through establishment and strengthening of institutional framework.

Generally, frequency of waste collection in Freetown is very low as its estimates range between 35 and 55 percent of the total waste generated and given such low collection rates, the uncollected waste is sometimes burnt, buried, or illegally deposited in open spaces, water bodies, and storm-drainage channels, along the streets or roadsides; with particular days set up for removal of bulky items such as furniture, tree stumps and tree cuttings. The key issues apparent in the system are highly inadequate equipment; poor, unhygienic operating and inefficient collection practices with quite variable levels of service; littering, widespread illegitimate dumping and open burning of garbage; inefficient or no environmental control systems; and a public with apparently little or no sensitivity to the garbage around them or any awareness of what characterizes reliable waste management.

VII. Conclusion

As per above discussions, a sound institution is essential to sustainable solid waste management (SWM) operation. Experience in developing countries indicates that an efficient waste management institute should be autonomous, and has executive authority to design, monitor and implement sustainable SWM strategies; and given the needs for its multi-sectoral role, such an institution must also possess authority, visibility, adequate budgets, legislative and policy support, administrative capacity, and a strong constituency to advocate its plans and their potential implementation.

The FWMC, the current authority, seems to have many shortcomings, particularly, on the areas of management and implementation. Additionally, coupled with equipment shortage, inadequate budgets, lack of authority, the company is struggling with very weak staff capacities at all levels. Lack of adequate records and information related to the SWM costs; lack of internal controls; lack of institutional and regulatory frameworks for procurement, and legislative enforcement; etc.; are some of the snags on the operational side of FWMC. Minimum standards will have to be set and implemented for all World Bank projects with FWMC.

One of the major weaknesses of SWM in Freetown is administration, though tight or limited budgets, inability to raise revenues through user fees, municipal bonds, or other means, as well as poor organizational set up are also serious limitations to effectively implement and run the solid waste management projects. The service ultimately depends on effective administrative and organizational systems and hence, they are very crucial to a sustainable SWM system. It's proper to make provisions for both public feedback and input from related public organizations in planning, evaluation and upgrading of the system. As a role of a private sector, cost-recovery contributes to sustainability. After the setting up of sound institutional structures, it's possible to adopt sustained improvements through labour-intensive, low-capital alternatives, and enabling administrative changes, when necessary.

And on this note, one can really tell the severity of waste management problems in Freetown, despite the invaluable joint efforts of the new company, the government and its partners (World Bank, IDA, GTZ/Klin Salone, etc.) to clean the city of its heaps of waste. There is the need for the intervention of potential investors/donors to ameliorate or lay to rest this waste management problem by helping address this problem sustainably, once and for all for the betterment of the lives of all Freetown inhabitants.

Thus, in the context of Freetown, there is a dire need of a sound institute, if a sound and proper waste management is to be realized.

VIII. Recommendations

Based on this study, this report is proposing that this appalling garbage situation needs efficient corrective measures/serious rehabilitation, first on an emergency basis, followed by development and implementation of long-term sustainable measures; otherwise it will adversely impact the living conditions of the city dwellers, further endangering their environment and health. It also needs a change in behavior of individuals and the society. In addition, the participation, organization and management of relationship between or/and among all key stakeholders must also include consensus building throughout the planning process, which also requires regular revisions and updating. A sound solid waste management system is also essential for sustained economic growth, which in turn can also help generate better revenues and potentially better waste management resources and services. Unfortunately, a sustainable solid waste management system is beyond the ability of any municipal government alone, as it's the case of the FWMC. To meet this need, waste management authorities in many countries are increasingly

involving private sector and communities as key participants.

Regulatory requirements making it easier to classify waste in Freetown has either not commenced or are dormant. To assist the waste industry in meeting the changed requirements for waste classification, the FWMC needs to replace its environmental guidelines (if any), which will outline a clear and easy-to-follow step-by-step process for classifying waste. There should be regulations on special waste, which will provide effective system of control for wastes that are difficult to handle. The regulations will ensure that dangerous wastes are soundly managed from their production to their final destination or recovery. Any would-be transfrontier shipment of hazardous wastes is to be controlled by a national legislation as they can pose threat to both human health and the environment. For instance, the UK legislation on this is governed by the EC Directive, which is based on international multilateral and environmental agreements.

There should be proper management of HCW, both within and outside healthcare facilities, to lessen risks, the first priority been the segregation of wastes, preferably, at the point of generation, into reusable and non-reusable, hazardous and non-hazardous components; and the other important steps been the instituting of a sharps (i.e., sharp instruments) management system, waste reduction, avoidance of hazardous substances such as the PVC-containing products, mercury thermometers and others, wherever possible, ensuring workers' safety, providing secure methods of waste collection and transportation, and installing safe waste treatment and disposal mechanisms.

It is envisioned that successful implementation of the measures recommended in the study can help establish a long-term, 10-year and beyond, self-sustainable waste management system in Freetown.

Acknowledgement

This work was supported in parts by grants from National Outstanding Youth Research Foundation of China (40925010), International Joint Key Project from National Natural Science Foundation of China (40920134003), National Natural Science Foundation of China (40873060, 40673065), and International Joint Key Project from Chinese Ministry of Science and Technology, and the 111 Project (B08030).

Submission Date: October 19th, 2009

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