

Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone

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ABSTRACT

Indiscriminate disposal of solid waste in dumpsites located within urban areas has proved to be a problem to nearby residents in most developing cities of the world, Freetown is no exception. Open dumps have environmental safeguards; they can pose major public health threats and environmental effects in urban cities. Therefore, this paper presents the findings of a research carried out in Freetown municipal area in Sierra Leone to determine the environmental and health impacts of solid waste disposal at Granville Brook dumpsite on the surrounding human settlements. Data were collected from three hundred and ninety eight nearby dumpsite household residents (<fifty metres) and two hundred and thirty three far away household residents (>fifty metres) through the use of structured self-administered questionnaires. Interviews and personal observations were also used to collect some of the data. Descriptive statistics involving tables, graphs and figures were used to present and analyze the data. Results show that both nearby residents and far away residents suffered from related diseases such as malaria, chest pains, diarrhea and cholera, due to the location of the dumpsite closer to their settlements. As a result, this study highlights the need for the Freetown City Council to properly manage and relocate the dumpsite to a safe distance from all human settlements, and provide resettlement and environmental education programmes for all persons living less than fifty metres away from the dumpsite as interim measures.

Keywords: Environment; Health; Solid Waste Disposal; Dumpsite; Pollution

1. Introduction

Open dumpsite approach as solid waste disposal method is a primitive stage of solid waste management in many parts of the world. It is one of the most poorly rendered services by municipal authorities in developing countries as the systems applied are unscientific, outdated and inefficient. Solid waste disposal sites are found both within and on the outskirts of developing urban cities. With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal disposal sites and due to poor and ineffective management, the dumpsites turn to sources of environmental and health hazards to people living in the vicinity of such dumps. One of the main aspects of concern is the pollution caused to the earth—be it land, air and water. According to Nguyen [1] many cities in developing countries face serious environmental degradation and health risks

due to the weakly developed municipal solid waste management system. Several studies have been conducted in order to examine the health and environmental effects arising from waste dumps. Such studies showed that a link exists between the two [2-6]. The conclusion from this and other studies has led to an increasing interest of researchers in the study relating to environmental pollution as well as its effects on plants and animals. Few of these studies examined the environmental and health implications of solid waste disposal to people living in close proximity of wastes dumpsites [7-10]. The ever-increasing consumption of resources results in huge amounts of solid wastes from industrial and domestic activities, which pose significant threats to human health [11]. However, the ills of inappropriately disposed municipal solid wastes are quite numerous to be mentioned. Health deterioration, accidents, flood occurrences, and environmental pressures are just a few of the negative effects. In many developing countries, solid waste disposal

sites are found on the outskirts of urban areas. These areas become children's sources of contamination due to the incubation and proliferation of flies, mosquitoes, and rodents. They, in turn, are disease transmitters that affect population's health, which has its organic defenses in a formative and creative state. The said situation produces gastrointestinal, dermatological, respiratory, genetic, and several other kind of infectious diseases [12].

Open dumpsites in developing urban cities involve indiscriminate disposal of waste. They are uncontrolled and therefore pose major health threats which affect the landscape of urban cities [13]. The UNEPA [14] stated that wastes that are not managed properly, especially solid waste from households and the community, are a serious health hazard and lead to the spread of infectious diseases. The report further stated that unattended wastes lying around attract flies, rats, and other creatures that, in turn, spread diseases. Normally, it is the wet waste that decomposes and releases a bad odor. The bad odor affects the people settled next to the dumpsite, which shows that the dumpsites have serious effects to people settled around or next to them. The group at risk from this unscientific disposal of solid waste includes the population in areas where there is no proper waste disposal method, especially the pre-school children, waste workers and workers in facilities producing toxic and infectious materials. Other high-risk group includes population living close to the waste dump [2]. In particular, organic domestic waste poses a serious threat, since they ferment, creating conditions favorable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and rag pickers being the most vulnerable [4]. Studies conducted by Yongsu [6] show that exposure to hazardous waste in dumpsites can affect human health, children being the most vulnerable to these pollutants. Direct exposure can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. Rushton [15] in his studies to establish a connection between health and hazardous waste showed that waste from agriculture and industries can also cause serious health risks. Other than this, co-disposal of industrial waste with municipal waste can expose people to chemical and radioactive hazards. Health care waste and other medical waste disposed in dumpsites, mixed with domestic waste, increasing the risk of infection with Hepatitis B and HIV, and other related diseases [16]. Open dumpsites are a major problem to the environment especially to the air that we inhale. Dumpsites emit obnoxious odors and smoke that cause illness to people living in, around, or closer to them [17]. According to Medina [18], pollution, a major environmental effect of dumpsites, is not directly

transferred from land to people, except in the case of dusts and direct contact with toxic materials. Pollutants deposited on land usually enter the human body through the medium of contaminated crops, animals, food products, or water. Also, the dumpsite has smelly and unsightly conditions. These conditions are worse in the summer because of extreme temperatures, which speed up the rate of bacterial action on biodegradable organic material. Disposal sites can also create health hazards for the neighborhood [7]. Gouveia and Ruscitto [9] highlighted that in a number of health surveys a wide range of health problems, including respiratory systems, irritation of the skin, eyes and nose, gastrointestinal problems, psychological disorders, and allergies, have been discovered. In addition, dumpsites closer to residential areas are always feeding places for dogs and cats. These pets, together with rodents, carry diseases with them to nearby homesteads. This paper therefore sought to present findings of a study carried out in Freetown municipal area in Sierra Leone to determine the environmental and health impact of solid waste disposal at Granville Brook dumpsite on its surrounding human settlements. We suggested new insights concerning the dumpsite in order to reduce the high prevalent rate of malaria and other diseases in the city. The findings presented could be of relevance for many municipal cities in developing countries and waste management researchers.

The Study Area

The research setting was Freetown, founded on the 11th March 1792. It was selected as a case study because it is the capital city of Sierra Leone, a small country in West Africa. It is a major Port city on the Atlantic Ocean located on Coordinates 8.48°N and 13.23°W with a total area of 137.8 square miles (357 square kilometers) in the western area of the country. The climate of Sierra Leone is tropical (hot and humid); with the raining 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 milliliters. It has a population of 772,873 [19]. The city is the economic, financial and cultural centre of Sierra Leone. The city's economy revolves largely around its harbor-occupying a part of the estuary of the Sierra Leone River in one of the world's largest natural harbor-Queen Elizabeth II Quay. This harbor is capable of receiving ocean going vessels and handles Sierra Leone's main export. The city is politically divided into three broad regions-East, Central and West. The Granville Brook dumpsite, one of the oldest, largest and most popular government designated open dumpsite is located in the east of Freetown, Sierra Leone. The dumpsite is located at the neck of the estuary of

Granville Brook, on the line between Greater Freetown and Kissy, on the Bai Bureh road—the busy, main highway from the city to the rest of the country. Freetown was designed to serve as a model to other Sierra Leonean cities in the way solid waste is managed. For many years, large quantities of Freetown's solid wastes is disposed of at the Granville Brook dumpsite which is essentially an open dump. This approach can be classified as a primitive stage of land fill development and is the predominant waste disposal option in Freetown which can pose major public health threats and environmental impact in the city. Down the valley of the estuary, on both sides along the Granville Bay is the Racecourse Culvert residential slum. It is one of the largest and poorest slums in Freetown, located at the mouth of the Freetown River. All wastes disposed of in the dumpsite will end up there causing health risk and environmental disaster like massive flooding during the rains to the inhabitants [20]. In Freetown, the Granville Brook dumpsite is now in the centre of the city, surrounded by many human settlements; thus posing public health hazards to residents who settle next to it. At the same time, the dumpsite is already filled; having been pushed beyond its limits, and due to poor operational system, the dumpsite has almost degraded into potentially hazardous and toxic dump (**Figure 1**). Land is now scarce in the city to relocate the dumpsite; land owners in the surrounding villages and towns of the city are not ready to give up their lands for the creation of a new dumpsite. Therefore, as a best option, the location of the dumpsite should be properly planned and managed to avoid risks to human health and the environment, at large [21]. Corrective and management measures are likely to be expensive, complex and pose serious threats to the environment and its inhabitants.

2. Methodology

2.1. Research Methodology

This study covered Granville Brook dumpsite in Freetown, Sierra Leone. The study is aimed at identifying the environmental and health impact of solid waste disposal on the human settlements around the dumpsite. We collected the data for this study from both primary and secondary sources to present the findings on the environmental and health impacts caused by solid waste disposal at the Granville Brook dumpsite in Freetown, Sierra Leone. Firstly, we involved a desk study of secondary data wherein documents and records relating to appropriate data sources including books, journals, newspapers, and activities both published and unpublished were studied to obtain background information on the environmental and health impacts of solid waste disposal



Figure 1. Granville Brook dumpsite overlapping residential houses at Racecourse Culvert slum.

at Granville Brook dumpsite in Freetown, Sierra Leone; Secondly, we visited the dumpsite where a few people involved in scavenging and agricultural gardening were interviewed at random. Household residents in the surroundings of the dumpsite were also interviewed. The questions we designed were tailored to derive information on environmental and health impacts caused by solid waste disposal at Granville Brook dumpsite in Freetown and ways to alleviate the problem. Information obtained was used to update the data collected during the desk study; thirdly, we administered structured questionnaires (both close and open ended designed questions) to 971 households which enabled us to obtain solid information. The first part of the questionnaire obtained data on socioeconomic characteristics such as educational level and employment status while the second part obtained information on residents' views on the location of the dumpsite and their surroundings, disposal methods used by residents, and the implications of the dumpsite to the health of the residents' community.

2.2. Sample Size

In this study, we administered questionnaires to two categories of respondents: nearby household residents to the dumpsite (<50 metres) and far away household residents from the dumpsite (>50 metres). The study area consists of 971 households. Sample size was determined by using a stratified random sampling method. Out of the 971 households, 631 (65%) consisting of 398 nearby residents and 233 far away residents were selected to be part of the study. 65% sample size was the representative population which was easy to manage and came up with good results. This method enabled us to make sure that there was no biasness in the selection of the population who were part of the sample. This was the case because in order to determine the effects of the dumpsite it is crucial to have two strata (layers) of residents—nearby resi-

dents and far away residents. Also, through stratified-simple random sampling every member of the study area had an equal probability of being selected to be part of the study. The choice on the use of questionnaires as a key data gathering instrument in this study was the authors' desire to obtain data on analysis that could help realize the objectives of the study.

2.3. The Pilot Study

Before the start of the main study, we carried out a pilot study to ensure that respondents felt comfortable with the questions and that they understood them. In addition, it allows the researcher to focus on particular areas that may have been unclear previously and to test procedures, equipment and estimate the length of time a respondent would take to complete the questionnaire. The length of time invested in the pilot study can be valuable and enriching for later phases of the study. We selected a group of ten different people to conduct the pilot study. The ten different people did not participate in the full study but they were comparable to the respondents in the full study. The questionnaire took approximately twenty minutes to be completed. Some revisions to the scales were made to take account of the level of education of the respondents.

We used descriptive statistics which involved charts, graphs and tables to present and analyze the data.

3. Results and Discussion

3.1. The Relationship between Socioeconomic Characteristics of Respondents and Environmental and Health Impact of Solid Waste Disposal

We studied two socioeconomic characteristics of respondents in this paper-employment status and educational level of respondents. This is probably because employment as a source of income may depend on the level of education. **Figure 2** shows data obtained on the employment status of respondents during field work. Majority of the respondents were not employed (48%), making life difficult for them. Therefore, they embark on small scale agricultural gardening on the swampy area by the fringes of the Granville Brook dumpsite as a source of income and livelihood. They also use the stream for washing clothes and bathing their children. These activities expose these residents to solid waste particularly hazardous wastes which can lead to various diseases through chemical exposure.

A majority of nearby residents and far away residents are not educated (**Table 1**).

Equally, a small percentage (16.8%) indicated that they attained higher education. The scenario here is that majority of the respondents became scavengers in order

Table 1. Educational levels of respondents.

Educational level	Frequency		Total	Percentage
	Near by residents	Far away residents		
Primary level	140	110	250	39.6
Higher education	53	53	106	16.8
Not education	205	70	275	43.6
Total	398	233	631	100



Figure 2. Employment status of respondents.

to make a living from the collection of wastes. They collect cans, metallic objects, plastics and other products in order to sell them and make their living. Direct handling of solid waste, especially Health care waste mixed with domestic waste can lead to increasing risk of infection on scavengers.

3.2. Residents' Views on the Location of the Dumpsite and Their Surroundings

Household residents, especially those who are closer to the dumpsite are not happy about the location of the dumpsite in their community. They complained that the dumpsite is too close to their houses causing them a lot of sicknesses. Furthermore, they argued that their surroundings are smelly and filthy (**Figure 3**) and some of the wastes from the dumpsite over lap their houses causing pollution in the environment.

3.3. Disposal Methods Used by Residents

The disposal methods of solid waste used by residents in the study area were very unsatisfactory. The preference of educated people to adopt better methods of waste disposal could be higher than illiterates (**Table 2**). It is obvious from the table that most of the people who throw refuse on open land and drains are uneducated. Those who keep waste in bins or burn it are most likely those with higher education. In general, majority of the respondents either throw their waste on land or drains or streets. Equally, only a small proportion (21%) of the respondents deposits their waste in bins and bags from FWMC where they can be transferred to the designated points for ultimate disposal.

Table 2. Disposal methods used by respondents.

Educational level	Near by residents		Far away residents	
	Frequency	%	Frequency	%
Street bins	35	9	23	10
Dumpsite	128	32	85	36
Bury & burn in pits	62	16	30	13
In bags from FWMC	56	14	25	11
In drains & streets	117	29	70	30
Total	398	100	233	100

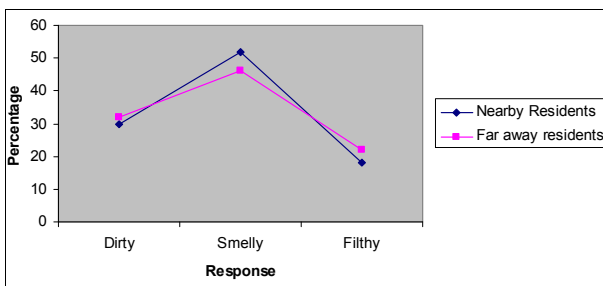


Figure 3. Cleanliness of household residents' surrounding.

3.4. Impact of Having a Dumpsite in a Nearby Community

The dumpsite in a nearby community has many impacts as indicated by the respondents during the study. Majority of both nearby and far away residents indicated that the dumpsite is the breeding place for disease vectors, cause diseases, and makes the place dirty. However, the location of the dumpsite has considerably made the residents to suffer from various diseases with malaria being the most prevalent (Figure 4).

3.5. Measures Employed to Protect Household Residents from the Effects of the Dumpsite

All the respondents indicated that no measures are taken up to make sure that the community, at large, is protected from the dumpsite. Lack of protection from dumpsite related effects was worst because of low knowledge on pollution. Majority of both nearby residents and far away residents indicated that they knew nothing about pollution (Figure 5). A small percentage of them indicated that pollution causes sickness. Therefore, the residents suggested that among many other options, the dumpsite should be relocated as an interim measure (Figure 6). This is because the only source of information on pollution available to them is the media (Figure 7) with its characteristic short comings such as affordability, frequent blackouts to name a few.

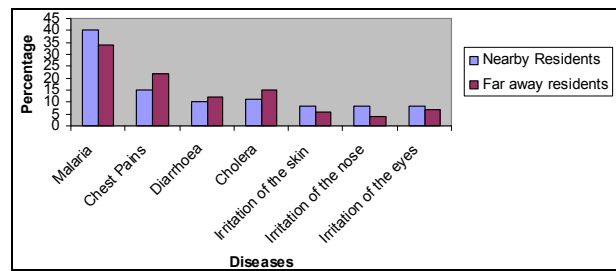


Figure 4. Diseases due to the location of the dumpsite.

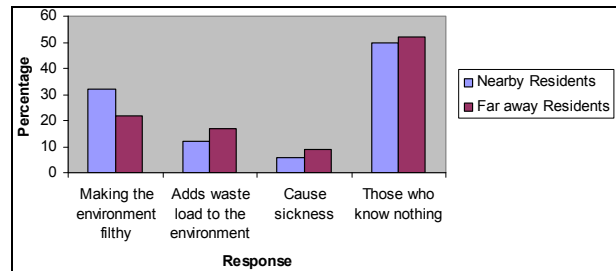


Figure 5. Household residents' knowledge on pollution.

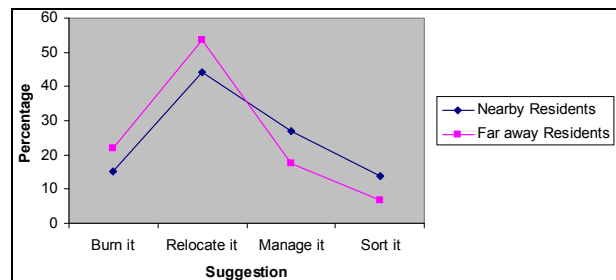


Figure 6. Household suggestions on solid waste.

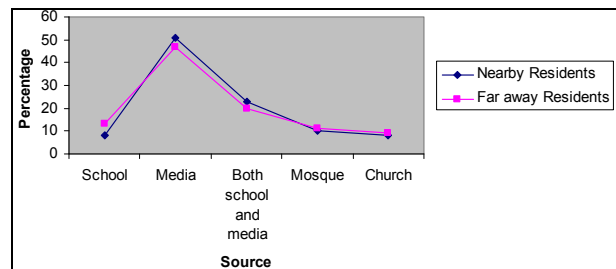


Figure 7. Household residents' sources of information on solid waste management.

4. Conclusion

This study examined the environmental and health impacts of households living around (nearby) and away (far away) from the Granville Brook dumpsite in Freetown, Sierra Leone. Results from the analysis of data revealed that both nearby residents and far away residents suffered from related diseases due to the location of the dumpsite closer to their settlements. It was discovered that residents less than fifty metres from the dumpsite are most affected by the dumpsite. Hence they were victims of

malaria, chest pains, diarrhea, cholera, irritation of the skin, nose and eyes. This state of health of respondents in this study can be linked to pollution from the dumpsite. It was also noted that the extent of air and water pollution is worse in the raining season as a result of offensive and disease-carrying odor, as well as ground water pollution. In the dry season, the smoke from the incineration of the dumpsite is an important source of air pollution for people living far away from the dumpsite. They therefore complained about chest pains. The study therefore concludes that the dumpsite should be properly located and managed to minimize its effects on the environment. For improved health status of the populace living less than fifty metres away from the dumpsite, it is a matter of must for the Freetown City Council to resettle such persons. In the long term, efforts to provide low cost houses situated in a clean environment is a priority that the City Council must pursue vigorously to enable the poor to live in affordable yet clean environment. People need to be educated by health motivators about the effects of dumpsites on their health.

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