



ASSESSING THE MANAGEMENT OF DOMESTIC WASTE COLLECTION AND DISPOSAL METHODS IN SIERRA LEONE. CASE STUDY: CENTRAL BO CITY

ABSTRACT BY:

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This research work examines the problem involved in domestic waste collection and disposal methods in central Bo City. The study itself is divided into five main chapters excluding the preliminary section which is composed of items such as certification, dedication, acknowledgements, abstract and table of contents. Chapter one is the introduction to the piece of work. It comprises of the background to the study, statement of problem, objectives of the study, significance of the study, limitation and delimitation of the study and definition of terms.

The second chapter deals with the review of literature. In this chapter, the author consulted the work of renowned authors on the subject matter, critically analyzing the various viewpoints put forward by this author agreeing or disagreeing with them, where necessary. Chapter three deals with the methodology involved in carrying out the research, whilst chapter four forms the bulk of the study and has to do with the result and the discussion carried out in the studies. This focuses mainly on the improper disposal of waste, causing a negative effect on the inhabitants of the community as a whole. The final

chapter makes a summary of the findings, conclusion and several recommendations made for government, the community and other bodies concerned.

INTRODUCTION

Background to the Study:

Bo City in Southern Sierra Leone like many other municipalities has witnessed a massive increase in domestic wastes as in other developing cities while the use for amenities are on the increase. The effort of industry owners and importers to keep pace with demand has led to a massive flooding of the market with different kinds of commodities and appropriate handling packages. The end product has resulted in huge quantities of wastes which the community must handle in an economical manner; thus polluting the human environment. The appealing conditions that underline past and present waste collection methods now requires urgent investigation.

The collection and disposal of domestic waste is known to have been practiced in Bo City even before the Second World War. These wastes include those from slaughter houses, organic wastes such as discarded food items from kitchens, solid house hold wastes including papers, metal cans, wrappers, plastics, broken glasses, bottles and sawmill wood waste. Some wastes are quickly decomposed (such as organic plant parts) because they are biodegradable (Tolmon et a 1980). The public health act (1960) assigned to the department of health and social service (DOHSS) was responsible for providing sanitary waste services. This mandate was fully exercised by the DOHSS until 1991 when it delegated to Bo Town Council (BTC) the responsibility for providing sanitary waste services.

In 2004, when the Local Council Act was implemented, the Mayor of Bo City Council wrote a project proposal on waste management which outlined the strategies and budget line, a document which helped the collection of wastes in the city of Bo. The DOHSS again set up another division known as the Environmental Health Division (EHD) in 1993.

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This organization is responsible for solid waste management including street sweeping and dumping of unwanted materials at the respective sites. However, it is sad to note that these efforts to improve and expand waste disposal facilities are yet to keep pace with the increased volume of domestic wastes generated.

Statement of the Problem:

The disposal of wastes from public areas in Bo City has for long been the concern of the department of health and social services. However, waste collection and disposal methods are still a problem in Bo City. Although metal containers have been provided in various bin collecting sites, many people have persisted in throwing wastes on the street and in gutter, making some parts of the city stinky and unpleasant out look to visitors. This practice of unregulated dumping of wastes caused blockage and worsen in the rainy season when the gutters become blocked, causing the overflow and spread of garbage and water puddles. This creates suitable places for mosquitoes to breed and the consequences are the spread of malaria, yellow fever, cholera, dysentery and other water borne diseases in the communities. On many occasions the aged, children lunatics and domestics animals such as dogs, fowls and pigs usually fidget the contents. The government hospital is a case in point where there are garbage sites where pigs from the surroundings usually feed on these wastes.

AIM/OBJECTIVES

AIM:

The aim of this research is to assess the management of Waste and the Disposal methods in Bo City.

Objectives of the Study are:

- i. Identify the main waste disposal stations in central Bo City.
- ii. Determine how many homes and families are serviced by each waste disposal station.

- iii. Determine the main components or form of waste matter frequently deposited in the container located at the waste disposal stations.
- iv. Identify the main instruments or materials used in the waste collection and disposal exercise.
- v. Suggesting possible alternative ways by which waste collection and disposal methods can be made more efficient and more economical.

Significance of Study:

The significance of study lies in the potential risks of domestic wastes on the environment and human health. The main risk to health arises from the breeding of disease vectors, primarily flies, cockroaches and rats. Also the most obvious environmental damage caused by waste accumulation is health hazards and because of its undesirable effect. There is need for a study of this nature to be undertaken to provide adequate information on the status of wastes disposal methods in Bo City.

Definition of Terms:

In order to properly appreciate the study, the following terms need to be clarified as follows:

- i. **Refuse:** This is a dry waste (rubbish) of all sorts such as kitchen waste, dirt from floors, park and market wastes, old shoes, bags, shirts, wrapping paper; plastic which are unwanted and are discarded from our environment.
- ii. **Refuse Collection:** This is the process of transferring domestic waste from the storage receptacle (dust bin in the homes) to the place of disposal (container station). Essentially, this involves emptying the waste into a container, located at the waste disposal site.

- iii. **Refuse Disposal:** This term describes the process of transferring domestic and solid wastes from containers at the waste disposal sites to land fill sites. This involves removing the refuse container by a vehicle to the land fill site.
 - iv. **Solid Waste:** These are non-liquid waste arising from domestic, trade, industrial, commercial, agricultural and mining activities.
 - v. **Waste:** is a mixture or discarded refuse that may contain harmful and hazardous substances capable or detrimental to the health or well being.
 - vi. **Department of Health and Social Services (DOHSS) -** Responsible to collect and dispose of waste in Bo City.
 - vii. **Environmental Health Division (EHD):** An Organization responsible for solid waste management and dumping of unwanted materials at the respective sites.
 - viii. **Biodegradable:** These are waste materials that are quickly decomposed by biological activity, especially by micro organisms.
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REVIEW OF LITERATURE

Introduction:

In this chapter, a review of some outstanding contributions to wastes management is made. These contributions viewed mostly from the perspectives of the authors attest to the fact that efforts to improve and expand waste disposal facilities are yet to keep pace with growing population trends.

Population Growth and Waste Generation:

Over the last decades, considerable population increases has occurred; accompanied by a sharp increase in urbanization, industrial and agricultural land use. This has resulted in a massive increase in the discharge of wastes and other pollutants causing undesirable effects on the surroundings. Frank, Flintaff management of solid wastes in developing countries South-East Asia Series No.1

Wtto 2006 observed that as population expands, we are faced with increasing problems of waste disposal, sewage and garbage. While sharing this view, Daince, Bruce Petal (2004) explains that two main issues in flowing resources and out flowing wastes are a function of the size of the settlement. Hence the larger the size of the settlement, the larger are its demand for resources on its surrounding. Thus as more and more waste are generated due to the parasitic relationship which human settlement caused on the surrounding, the need for proper waste disposal systems become increasingly important. In a World Health Organization (WHO) publication, improving environmental health condition income settlements offset No. 100 (2007). Claims that in developing countries the population density of large areas of the mayor cities is much higher than in the industrialized countries. In these cities, external sites for home shortage of wastes are usually lacking. Unless there is collection frequency preferably on daily basis, there will always be a massive waste build up in such cities.

Disposal Collection and Management of Wastes:

For over two decades the disposal of urban wastes has become a very difficult problem. According to Frank (WHO, 2007), land fill has always been the most common disposal method and is likely to remain so, there is therefore an urgent need to discover methods of treatment which will cut down on the volumes of wastes that will eventually be accommodated on scarce land fill sites. Davies Somerset and Carter (2009) believe that if proper care is not taken, wastes could find their entrances directly into water supply system of the food chain. This would therefore cause undesirable effect on the life. In line with this view the Blair Research Institute in a publication on developing countries (CWS/92.5) maintains that inadequate and in sanitary disposal of infected human wastes leads to the contamination of the ground and source of drinking wastes. He further emphasized that poor solid waste management often present a major problem in most low income communities in both urban and rural areas.

The low income communities in urban areas are often characterized by high densities and lack of adequate basic facilities. While sharing this view, the WHO (2007) states that the main health hazards that may arise from improper refuse disposal are due to increase in rat and fly population. In order to maintain good health, there is need to have a good environment. This calls for urgent need to set up a proper and effective domestic wastes management system. Frankwood (WHO, 2007)

states that management at all levels should be vigilant in providing the maximum protection to workers against risks of accidents and ill health . In the same vein, he maintains that high level of mechanization should be adopted for solid wastes. Management systems relates directly to the cost of labour, as compared to that of plant and energy. In his view, evaluations to these problems have to be sought within the limitations of the country. In developing countries, the most important single factor is whether the community can afford to pay for a good standard of service. World Health organization WHO (2003) explains that the management of solid wastes in urban areas becomes more difficult as population increases and living standards rise. The same publication holds the view that cities in developing countries often lack technical and financial means for the adequate collection, handling and disposal of solid wastes and the management of hazardous wastes is a problem in almost every country. While not dismissing this fact, the Ministry of Health report XI (2001), state that an essential prerequisite for organized waste storage is a suitable storing technique. This depends on the type and volume of wastes to be stored at topographical and meteorological conditions and on existing requirement by authorities.

In his contribution, Frank Wood (WHO, 2007) express that every country must create an indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates equipments manufacturing capacity, energy cost and the availability of foreign exchange for the purpose of imported plants. In view of the above, the World Health Organization WHO (2007) publication states that public education on waste reduction, handling and storage is therefore needed to minimize the risks of disease. In furtherance of this, the Blair Research Institute emphasizes that great importance should be placed on behavioural change within communities with message targeted at specific groups. However, in terms of both cost and environmental protection, Frank Wood (WHO, 2007) believes that sanitary land fill and composting emerge as the most suitable methods of solid wastes disposal for developing countries like Sierra Leone.

METHODOLOGY

Introduction:

Considering the present rate of urbanization, the volume of collection and disposal of domestic wastes in central Bo City represents a daunting challenge to both the central and municipal governments. The need to maintain a healthy environment and to forestall any further decline in the

quality of human life requires a thorough investigation into the problems associated with the current waste disposal practices. The chapter gives an account of the methodologies pursued in unraveling such problems. This include the reasons for the choice of the study area, the method used in arriving at a suitable sample size, the sampling techniques employed and the ways in which the wastes were determined. Details on the data sources and the main research instrument used in this study are also derived

Study Area:

Bo town is the second capital city of the Republic of Sierra Leone. It is found in the Southern Province and is the provincial head quarter town. Bo town now city grew from early settlers. Some of whom immigrated from nearby countries. Today Bo City continues to be the second administrative nerve center of Sierra Leone. While at the same time serving as the center for commercial and educational activities in the country. Central Bo City which stretches from Clock Tower, Dambala Road, Fenton Road, Bonjon Street and part of Mahei Boima Road, Kissy Town Road unto the Shenge Market area. The section forms one of the three sectional settlement into which Bo City is divided. Eastern and Western Bo City forms the remaining two, extends respectively from the Eastern Police, Torkpoi Town Section, Yemo Town axis to New Site and from Paramedical, New London, New York unto Kebbie Town.

The significance for the selection of central Bo City as the study area are as follows:

- i. This area is characterized by the city central business district. In this section, various commercial activities carried out produces tremendous amount of wastes from both street vendors, petty traders and other commercial houses. Hence the site should be the main focus in terms of waste collection problems.
- ii. Most important offices, streets and diplomatic houses are located in this area. Hence priority must be given to this area, in terms of an effective methods of waste collection and disposal. There is also a residential population of over 20,000 inhabitants, therefore one finds the contribution of household refuse of the overall waste that is generated.

- iii. This site offers the opportunity to examine waste generated from both commercial activities as well as domestic sources. The examination of this area will provide a realistic picture of how wastes from domestic and commercial sources are managed in this city.

- iv. **Sample Frame Size and Sampling:**

In selecting the sampling frame and size, a preliminary survey and count of the existing container stations in various areas in Central Bo was first undertaken. The number obtained was cross checked with the sanitary office of the Ministry of Health and Sanitation. In all eight (8) container stations were identified.

- a. **Container Station Selection:**

In order to make an adequate representative of the container stations, Central Bo City (the study area) was stratified into two divisions in accordance with existing demarcated constituency boundaries used for local government elections. These divisions are:-

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- i. Bo Central I which extends from the Clock Tower, Dambala Road, part of Fenton Road and central police station.
- ii. Bo Central II stretches from part of Fenton road, Mahei Boima road, Bonjon Street, Kissy town road and Shenge market area. From these divisional arrangements, it was discovered that a total of three (3) container stations exist in Bo Central I while central II has five stations. The container stations were labeled and given code numbers. A 40% representation of container stations in each of these two divisions was drawn by lottery to be the sample size. The 40% sample was considered manageable in the circumstance of the ward and offers a good statistical index. Hence three (3) container stations were randomly selected in Bo Central I while two (2) were selected in Bo Central II. To avoid difficulties

during calculations, containers station which covers a 40% sample. In all, a total of fifteen (15) streets/roads were covered in this survey.

b. Street Selection:

Each of the containers is located at a strategic point (mostly road junctions) to service a number of houses on streets within a given area. The expected number of streets/roads served per container was obtained from the sanitary guards attached to the various stations selected for this study. It was learnt that each station serviced four (4) streets on the average. Two (2) of these streets were randomly selected by lottery at each container station which covers a 40% sample. In all, a total of fifteen (15) streets/roads were covered in this survey.

c. Household Selection:

On each street, the dwelling chosen to the container station was selected for this study. This is because this dwelling experience all the drawbacks associated with waste collection and disposal. One household head in each dwelling was interviewed. For dwellings with more than one household head, a list of all household heads in the dwelling was prepared. From these lists, a random selection by lottery of one household head was selected to form the sample.

d. Commercial House Selection:

Of the fifteen (15) streets selected for this study, only ten (10) were discovered to be having commercial houses. At each of these streets, lists of all the commercial houses were prepared from which a random selection by lottery of one commercial household was drawn for houses with more than one commercial operation only one was selected from a list using a simple lottery procedure.

e. Selection of Sanitary Officers:

The Ministry of Health and Sanitation, for purpose of an effective collection and disposal strategy, divides Bo City into four (4) sanitary zones. Out of these zones (the study area), there is a sanitary manager, a bike supervisor and two foot supervisors. All of these officials in this sanitary zone in central Bo City with the hope that the functional differences of these officials will be represented in their responses to the question posed in the research instruments.

f. Selection of Sanitary Guards:

There are at most two (2) guards to a container in each of the sanitary stations in central Bo. This study examines eight (8) such stations.

In each of these container stations, a list of all the guards was prepared. One guard was selected for detailed interview using a random selection procedure.

g. Determination of Weight Density and Component of Wastes:

In determining the weight, density and component of wastes frequently generated in the field, the container stations were randomly selected from each of the divisions of central BO. This represented 10% and 7% respectively of the number of containers stationed in Bo Central I and II. At each of the stations, two bucket loads of wastes from the containers were sorted by hand on a sieve – like structure so that only materials with a size of about 15 mm will fall through it. These were sorted into the required constituents depending on their rate of decay measurement of the total weight of wastes at each of these selected waste sites was done using a scale from which a box already weighed (with its weight measured) was hang. The first five loads of wastes brought at each of these stations in the morning were selected to determine the average waste generated per household at any given time.

Sources of Data:

Data were obtained from both Primary and Secondary sources. Primary information were obtained by administering a structured questionnaire to a selected population of household heads, commercial house workers and sanitary workers. A reconnaissance survey was also undertaken using a checklist to take stock of information not covered in the questionnaire. This procedure was closely followed with a direct personal observation of people's attitude towards domestic waste collection and disposal methods. Information were obtained from interviews obtained from different classes of people on issues centered on the objectives of the study. Secondary sources of information included publications such as text books, journals and other useful documentation on wastes health and sanitation.

Data Collection:

Data was collected for this study through the use of structured questionnaires administered to thirty (30) respondents between January 2018 – April 2018 before embarking on a full scale data collection, a feasibility study of the research area was done. This enabled the researcher to examine the waste disposal sites for container with some of the guards attached to the container stations selected for this study. The researcher introduced himself to the senior Ministry of Health and Sanitation staff attached to the study area and informed them on the purpose of the research. Most of the questionnaires were administered by the researcher. Some were however self administered by respondents who were guided on how to fill in the details. Creole and Mende languages were the medium of communication used in the interview but all relevant information were written in English Language.

Research Instrument:

This research involved the use of two sets of structured questionnaires administered to two categories of respondents. This first set of questionnaire was administered to fifteen (15) household heads and twenty (20) Ministry of Health and Sanitation workers of different houses engaged in commercial activities. This questionnaire was divided thus:

- Section ‘A’ - Identification of Respondents
- Section ‘B’ - Waste Accumulation
- Section ‘C’ - Container Station Distribution
- Section ‘D’ - Ways of Improving Methods of Waste Management

Section ‘A’ of both sets of questionnaire was meant to solicit information on the general and demographic profile of each of the respondents interviewed.

Section ‘B’ of the first set of questionnaire focused essentially on information on the rate of waste generation, including the types of waste most frequently generated.

Section ‘C’ of the questionnaire solicited information on the distribution of containers among the various container sites. It also investigated the causes of the gradual reduction of container sites and the ways in which waste from the homes and offices finally enters into the containers.

Section 'D' was centered on finding out about the attitude of people towards the use wastes and waste sites. Alternative methods of waste treatment by the people were also identified in this section. In the second set of questionnaire section 'B' asked questions covering the main activities adopted by Ministry of Health and Sanitation and Bo City Council in the collection and disposal of wastes. It also focused on the materials used in the waste collection exercise, their allocation and degree of availability for use. Section 'C' and 'D' were primarily entered on identifying the main impediments to the current methods used in waste collection and how to overcome such problems. This section provided for possible suggestions on alternative waste collection methods, assuming the problems associated with the present waste collection method are not overcome.

Data Analysis:

The analysis of the responses entailed in the questionnaire was both descriptive and mathematical. The information were tabulated accordingly from which the frequencies were determined and converted to percentages. These percentages were then interpreted into the results and findings

RESULTS AND DISCUSSION

Introduction:

The main thrust of this chapter is an analysis of information obtained on the current waste collection and disposal methods in central Bo City. Most of the data including the characteristics of the respondents are tabulated. Frequencies and percentages are also used to represent the findings which form the hub of the ensuing discussions. It no doubt forms the basis of the results reached at the end of this work.

Waste Site Distribution and Characteristics of respondents:

The collection and disposal of public wastes in central Bo City is co-ordinate by the Ministry of Health and Sanitation and the Bo City Council through the establishment of various waste sites. These wastes which are mostly domestic in nature are often collected in containers which are unevenly distributed in the Bo central area. The container stations distributed in 2017 were 60% in

central I and 40% in central II respectively. This indicates a higher stationing of the existing containers in Bo central I.

The users of these containers were categorized into household heads who are mostly downtown office workers and commercial house workers amongst whom are petty traders, business house workers and middle – level workers like craftsmen as explained in chapter 3.3 like the other categories of container users, the sanitary workers were classified into field workers and office workers as shown in table 4.1 This table shows a greater proportion of sanitary.

TABLE 1: Classification of Sanitary Workers According to Job Type:

Job Type	Frequency (F)	Percentage (%)
	Sanitary Workers	
Field	13	90
Office	2	10
Total	15	100

According to table 1 above, (90%) of the workers directly engaged in the Field Work either as Supervisor or Guards. It is only the Zonal Managers are retained in the office.

TABLE 2: Marital Status of Respondents:

Marital Status	Sanitary Workers	Frequency (F)	Commercial House Worker	Percentage (%)
		House Hold Heads		
Married	12	10	9	83
Single	2	4	1	13.2
Divorced	1	-	-	1.9
Widowed	-	1	-	1.9
Total	15	15	10	100

SOURCE: (City Council, 2017 Survey)

In table 2, 83% of the respondents are married while 13.2% are single of whom 1.9% are either divorced or widowed. This preponderance of marriage among the various categories of container users. (83%) are indicative of a higher tendency to generate waste.

TABLE 3: Distribution of the Respondents:

Age Group	Sanitary Workers	Frequency (F)		Commercial House Worker	Percentage (%)
		House Heads	Hold		
0 -19 yrs	-	-	-	-	-
20- 29yrs	4	6	4	4	32
40-59yrs	7	6	6	6	49
60-79yrs	4	3	-	-	19
Total	15	15	10	10	100

SOURCE: (City Council, 2012)

Age Distribution of Respondents:

Some respondents in the active age bracket (20-60 years) of the population, however a total of 7.54% of the sanitary workers who are mostly container guards fall above the working age group of the country. This number, though not very significant, contributes to the inadequacies in the waste disposal drive of the Ministry of health and sanitation (MOHS).

In terms of educational achievement, table 4a shows a high level of educational attainment among the commercial house workers with 56% having gone through tertiary institutions and another 44% having secondary education. This figure contrast sharply with the sanitary staff (table 4a), with just 10% of their workers having tertiary education, another 30% having attained a secondary school education while the bulk of the staff have either primary education (20%) or non-formal education (40%). This present level of education attainment among the sanitary staff may not be unconnected with.

TABLE 4a: Educational Attainment Among Household Heads:

Educational Level	Frequency (F)	
	Sanitary Workers	Percentage (%)
Tertiary	2	10
Secondary	3	30
Primary	4	20
Non-formal	6	40
Total	15	100

TABLE 4b:

Educational Level	Frequency (F)	
	Household Heads	Percentage (%)
Tertiary	6	38
Secondary	5	33
Primary	-	-
Non-formal	4	29
Total	15	100

TABLE 4c:

Educational Level	Frequency (F)	
	Commercial House Workers	Percentage (%)
Tertiary	6	60

Secondary	4	40
Primary	-	-
Non-formal	-	-
Total	15	100

Educational Attainment Among Commercial House Workers in Table 4c:

The inadequate funding of the Ministry of Health and Sanitation (MOHS) to enhance workers education and training and hence the drawbacks of the current waste disposal method. The household heads as shown in table 4b are mostly educated with a total of 38% and 33% having obtained tertiary and secondary education respectively. A much smaller percentage of 29 attested to have acquired a non-formal type of education. With regards to length of services only sanitary workers and commercial house workers were interviewed as shown in table 4.5(i). Both categories of workers had worked for 1-29 years.

TABLE 5a: Length of Service of Sanitary and Commercial House Workers:

Length of Services	Sanitary Workers	Commercial House Workers	Percentage (%)
0-9 yrs	8	8	66
10-19yrs	6	2	31
20-29yrs	1	-	3
30-39yrs	-	-	-
40-49yrs	-	-	-
Total	15	10	100

There appeared to be a greater concentration of workers within the first nine (9) years which reduces as the length of service increases. Amongst the sanitary staff for example, a total of 60%, 30% and 31% were registered respectively for the age group 0-9yrs, 10-19yrs and 20-29yrs. The trend may indicate that more people have entered the job recently even-though the possibility equally exist that

some people over the years have left. Like the length of service, there was a gradual decrease in the length of residence among the households with a higher number registered for a period 0-9 years. This trend, as shown in table 5b is consistent with the residential pattern of most urban centres in less developed countries where tenancy is highly practiced.

TABLE 5b: Length of Service of Sanitary Workers:

Length of Services	Sanitary Workers	Percentage (%)
0-9 yrs	8	60
10-19yrs	6	35
20-29yrs	1	5
30-39yrs	-	-
40-49yrs	-	-
Total	15	100

It could be seen in table 5c, where as the respondents from amongst the household and commercial houses included both sexes that for the sanitary worker consisted of only males. A greater percentage of this staff were 40 years and above, a good number of whom were field workers directly attached to the containers. It was therefore apparent that most of these workers were aged and these were often assigned to collecting and disposing of the wastes.

TABLE 5c: Length of Residence of Household Heads:

Length of Services	Sanitary Workers	Percentage (%)
0-9 yrs	6	38
10-19yrs	4	24
20-29yrs	3	25

30-39yrs	1	4
40-49yrs	1	4
Total	15	100

TABLE 5d: Sex Composition of Respondents:

Sex	Sanitary Workers	Frequency (F)	Commercial	Percentage (%)
		Household Heads	House Worker	
Male	15	6	8	69.8
Female	-	9	2	30.2
Total	15	15	10	100

Waste Matter and Method of Collection

TABLE 6: Container Stations Distribution in 2015 Compared with Figures for 2012:

Area	No. of Stations in 2012	No. Of Stations in 2015	Difference	Percentages (%)
Central 1	12	6	6	25
Central 2	8	4	4	25
Central Bo City	20	10	10	25

SOURCE: EHD, 2012 AND Author's 2015 Survey Data

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In table 4.6 the total number of container stations in the entire central Freetown area in 2012 compared with that for 2015 shows a reduction of 25%. It seems very likely that given the

bad practices of accumulating huge quantities of wastes at waste sites which have created a climate of opinion that have led land owners to oppose the location of any kind of waste disposal site in their vicinity, more stations will close down. This development coincides with a seemingly luke worm attitude of the Ministry of Health and Sanitation (MOHS) in replacing worn out container possibly due to lack of adequate funds. In terms of machinery, table 4.7 shows the variety of equipment’s used by the Ministry of health and Sanitation (MOHS) in the disposal of wastes.

TABLE 7: Quantity of Machines Used by Ministry of Health and Sanitation (MOHS) in the Disposal of Wastes in 2011/12 Compared with Figures for 2015:

Type of Machine	Quantity in 2011/12	Quantity in 2015	Difference	Percentage (%)
Skip trucks	9	3	6	66.60
Dump trucks	2	1	1	50.00
Loaders	2	-	2	100.00
Bull dozers	1	-	1	100.00
Other vehicle (light Vans)	10	2	8	80.00

SOURCE: MOHS, 2012 and Author’s Survey Data

As shown in table 7, there has been a drastic decline in the available machines for work since 2011/12. Loaders and bull dozers for example, are no longer available, while other vehicles, skip trucks and dump trucks respectively showed a decline of 80%, 66.6% and 50% in terms of availability.

Considering that these are the only machines serving the entire Bo City, it may not be uncommon for waste disposal sites to be prioritized in the use of these machines. In addition to the machine, a

variety of tools, equipments and materials were used especially by the container and guards and sweepers in the course of collecting and disposing of wastes. It is worth noting however that these implements were mostly crude and grossly inadequate. The main wastes generated are classified according to their rate of decay of shown in table 8.

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TABLE 8: Classification of Wastes According to Rate of Decay:

ORGANIC WASTES	INORGANIC WASTES
Papers	Broken bottles/glass
Vegetables	Plastics
Dust	Empty tins/cans
Fruit peels	Guages
Empty boxes/cartons	Needles
Kitchen wastes	Syringes
Leaves and flowers	Rubbers
Clothing materials	Oil wastes
Timber/wood/ stick	Rod (Iron)
Saw dust	Metal (Scrapped)
Coal wastes and ashes	Hair (human and animal)
Fish entrails	Chemical wastes
Meat bones	Nylons
Plasters	Worn out zincs
Worn out shoe and heels leather	
Bags of worn – out paper or leather	
Soap wastes	
Food wastes	
Dead animals	

Total Organic wastes x = 20	Total Inorganic waste x = 15
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SOURCE: Author’s Survey, 2015

As could be seen the wastes are mostly vegetative and food matter which often generate very offensive odor. Much of the factories and enterprises in this area operate on a small scale and their wastes are normally caught in the net of the overall municipal wastes.

30.

The predominance of vegetative and food wastes among the main wastes constituents signifies the importance of households in generating waste.

TABLE 9: Type of Wastes in Relation to Main Waste Source:

Source of Waste	Type of Waste	Percentage (%)
Households	Organic	16
	Inorganic	5
Market Centers	Organic	14
	Inorganic	8
Offices and Institutions (Public and Private)	Organic	6
	Inorganic	14
Street Side Wastes or Gutter Wastes	Inorganic	14
	Inorganic	12
Shop and Business Houses	Organic	9
	Inorganic	12
Total Wastes	Organic	57
	Inorganic	43

SOURCE: Author’s 2015 Field Survey

Table 8 shows the contribution to the total wastes by the main waste source in central Bo. Although the wastes are not separated into types at the time of disposal into the containers, it is evident from this table that a greater quantity of wastes from households, market centers and street sides can easily decay when compared with wastes from offices and institutions as well as wastes from shop and business houses.

31.

The contribution by these latter sources of wastes which were highly inorganic results in the rising need to flood the market with different kinds of commodities to meet the demands of the growing population. This rise in the proportion of inorganic wastes might continue for a long time to come and hence further intensifying the pressures on the current waste disposal facilities. There is therefore an urgent need for the adoption of treatment methods that could reduce the volumes of wastes that can be accommodated in the scarce containers. When asked about the forms of waste treatment adopted besides the disposal of wastes into containers, over 70% of the respondents admitted using none. However, a significant number totaling 15% admitted using the biodegradable waste constituent as manure while another 10% claimed to either burn the wastes or throw them into streams. A significant amount of recycling was also observed among households in keeping rice bags, bottles, etc separate and selling them to collectors. Containers and land fill sites are also searched by scavengers and the process is continued by refuse collectors and disposal site scavengers.

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SUMMARY, CONCLUSION AND RECOMMENDATION

Summary of Findings:

Domestic waste collection and disposal in Bo City began at the end of First World War. In 1960, the public health act empowered the Department of Health and Social Services (DOHSS) the responsibility to collect and dispose of waste in Bo City. This mandate was fully exercised by the Department of Health and Social Service (DOHSS) until 1991 when it delegated to the Bo Town Council (BTC) the responsibility for providing sanitary wastes services.

Another sector dealing with waste collection and disposal is the Environmental Health Division (EHD) of the Ministry of Health and Sanitation. This waste disposal drive in Bo City has been faced with a series of set backs which has led to the accumulation of large quantities of wastes which must be safety and adequately collected. This study is an investigation into the adequacy of present method of collecting and disposing wastes in Bo City. The research was carried out in central Bo City which forms one of the sectoral divisions of Bo in which can be found the city's main central business district, administrative offices and diplomatic missions. In the course of this work both primary and secondary data were used.

The study population comprised of household heads, commercial house workers and sanitary officers of the Environmental Health Division (EHD) attached to the central Bo area. A 40% sample of containers stations in both Bo central I and central II were randomly selected and this was considered to be manageable for the purpose of this work. In determining the population sample a

40% sample of the number of streets served by each container station was selected from which two dwellings close to the container were examined.

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Seven (7) of the streets selected for this study were found to have commercial houses. One of such houses was selected at random from each street to form the sample. Eight (8) senior sanitary officials attached by the Environmental Health Division (EHD) central Bo including one guard at each of the eight container stations were also randomly selected to form the sample population.

This work was intended to identify the problems of the present method of collecting and disposing wastes and to suggest alternative methods which will enhance a sustained and a more efficient waste handling mechanism. In pursuance of this intention, two sets of questionnaires were administered to fifteen (15) household heads and ten (10) commercial house workers to determine the main waste components frequency of waste generation. The waste sites dwellers were not happy with the disposing waste site and comment on the present method of collecting and disposing wastes. The second set was administered to fifteen (15) sanitary officials to identify waste sites, main wastes generated, number of times the containers are emptied, instruments and materials used in waste collection and to suggest possible alternatives that could solve the problems associated with the current waste collection and disposal drives of the Environmental Health Division.

An over age of twenty-five (25) minutes was spent in administering each questionnaire. Apart from the relevance of a house hold heads to respond to interviews, the overall exercise was very successful with very little interference. The relevant information obtained were tabulated and the frequencies of respondents determined. In most of the tables, the frequencies of the interviewees were converted to percentages. The analysis was both descriptive and mathematical. The study

revealed that while the population of central Bo City is on the increase and hence the rates of waste generation, the number of container stations have

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seen a dramatic decrease over the years. In addition, it was found that capital equipment (Vehicles and Machines) used in the collection of waste have declined drastically both in number and availability for work. It is not surprising therefore to find a large accumulation of wastes at the container stations for most of the time. There was a popular rejection of the container land fill method of collecting wastes. A few people admitted using alternative methods of waste management. These included burning of wastes, throwing wastes into streams and streets. Composting and recycling etc these were therefore the most wide spread methods. These practices suggests the desire of the public for instituting a more efficient and reliable method of waste collection and disposal.

Conclusion:

This research aimed at examining the method(s) used by both the Bo Town Council and the Environmental Health Division (EHD) of the Ministry of Health and Sanitation in Collecting and disposing domestic wastes in central Bo City. The following are the conclusions drawn from the findings of the study.

- ✓ There is a rapid increase in the population of central Bo City with an average annual growth rate of 40% over the next twenty (20) years. The result is that there has been an increase in the number of households with a corresponding expansion in the rate of waste generation.

- ✓ There is a decline of about 25% in the number of containers sites in central Bo City between the periods 2009 to 2012. The closure of these sites can partly be attributed to the growing demand by land owners for their land areas which were used as container sites. Also, the seeming lack of maintenance of the containers by the Environmental Health Division (EHD) of the Ministry of health and Sanitation (MOHS) has led to a reduction of containers available to cover all the previous sites.

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- ✓ The same materials which were provided by the German Cooperation unto 1994 (when the German Embassy closed down in Sierra Leone). Continues to serve as the main items or instruments used by the Bo City Council in the collection and disposal of wastes. This study reported that large quantities of these machines and vehicles now show a considerable decline in terms of availability for work.
- ✓ There is a narrow level of educational attainment particularly among the sanitary staff attached to the container stations. Also, a total of 7.54% of the sanitary guards fall far above the retirement age (60 years). Owing to the absence of worker – incentive and poor salary conditions due to inadequate funding of the Environmental Health Division (EHD), it is apparent that the efficiency of workers has declined over the years.
- ✓ The volume of wastes generated at any given waste site exceeds the existing facility (containers) and materials for collecting and disposing of wastes. As a result, there is nearly always an excess accumulation of waste of different degrees of decay which poses a threat to both the environment and human health.
- ✓ Household heads and sanitary workers are aware of the inadequacies of the container land fill method of collecting and disposing wastes. Regrettably, there is yet no decisive method to be adopted on a broader scale for replacement.

- ✓ A small number of container users have adopted alternative methods of treating wastes such methods like burning and the act of throwing wastes into streams and streets degrades both the quality of the environment and human life.

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5.3 Recommendations:

In view of the conclusions, the following recommendations are made:

- ❖ Households, shopkeepers and office workers should be encouraged to provide and maintain storage containers. These are particularly important in very busy areas where certain streets are too narrow to admit sanitary vehicles. Containers should be made available for emptying by Environmental Health Division employees at prescribed times as such a practice helps to reduce the pressure on the public waste collection sites.
- ❖ Government should make substantial allocation of staff or mobilize other agencies, organizations to provide efficient support to Environmental Health Division for an efficient collection and disposal of wastes from the city.
- ❖ There is need to establish institutions for training with the objective of increasing the efficiency of the workers. This should include vocational or professional training for middle and top management.
- ❖ There is need to establish a skilled and efficient management structure with a specialized background in waste management. This should include civil and mechanical engineers, chemical engineers transport organizers and economists.

- ❖ Environmental Health Division (EHD) should employ motor vehicles for the achieve high productivity.
- ❖ Environmental Health Division (ED) together with the councils should design container sizes that can adequately collect large quantities of wastes over a long period.
- ❖ Environmental Health Division (EHD) should ensure the enclosure of waste at all stages of storage and collection to produce health risks to residents and workers management should improve productivity by motivating workers by providing some measures of creative satisfaction.

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There should be regular consultations and outer change of views at all levels in order to accommodate complaints, suggestions and also to inform workers and users on management problems and policies.

- ❖ Management should work relentlessly towards providing maximum protective gears for workers against the risk of accidents contracting and the spread of diseases.
- ❖ Effort should be made by management to educate the public on the more responsible use of the containers provided and to solicit their co-operation for a sustained and efficient method of collecting and disposing wastes.
- ❖ Management should ensure that container sites are cleared daily or preferably three (3) times daily.

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