

Problems of solid waste management in developing urban cities: a case study of Freetown, Sierra Leone

Foday Pinka Sankoh^{1,2,*}, Xiangbin Yan¹

¹School of Management, Harbin Institute of Technology, China

²Department of Integrated Sciences, Portloko Teachers College, Portloko, Sierra Leone

Email address:

fodaypinka2011@yahoo.com (F. P. Sankoh)

To cite this article:

Foday Pinka Sankoh, Xiangbin Yan. Problems of Solid Waste Management in Developing Urban Cities: A Case Study of Freetown, Sierra Leone. *American Journal of Environmental Protection*. Vol. 2, No. 5, 2013, pp. 113-120. doi: 10.11648/j.ajep.20130205.11

Abstract: This study was designed to determine the existing problems of solid waste management in Freetown. The problems that were assessed were the factors impeding the effectiveness and efficient solid waste management and the wrong attitudes and perceptions of the people about sanitation issues which have contributed to solid waste management problems in Freetown. Structured questionnaires were administered with respect to socioeconomic and solid waste management data. Interviews and personal observations were also used to collect some of the data. Data analysis was carried out using the Statistical Packages for Social Sciences (SPSS) software. The results show that majority of the households did not educate their members on the need to clean their surroundings. Virtually, all the people depend on the Freetown Waste Management Company's facilities for the disposal of their household refuse. The study concludes that solid waste management problems are partly the result of Freetown Waste Management Company's inability to cope with the situation because of lack of equipment, personnel, and inadequate funding. Therefore, the study recommends that the waste management authority's effort in the area of education should be intensified in order to sensitize the people on the need to keep the surroundings clean. The participation of the private sector, government, NGOs' and the international community in offering adaptable solutions towards improving solid waste management situation in Freetown is also needed.

Keywords: Solid Waste Management, Problems, Freetown, Household

1. Introduction

Regardless of the context, solid waste management is one of the biggest challenges of urban areas of all sizes, from mega-cities to small towns and large villages, which are home to the majority of human kind. It is almost always in the top five of the most challenging problems for city managers [1]. The quality of waste management services is a good indicator of a city's governance. The way in which waste is produced and discarded gives us a key insight into how people live. In fact if a city is dirty, the local administration may be considered ineffective or its residents may be accused of littering [1]. Given the rapid rates of urbanization occurring around the world, the importance of an efficient and effective solid waste management system is more critical than ever before. Nowhere is this truer than in urban areas in the developing world, where unprecedented urban growth has resulted in greater amounts of municipal

solid waste being generated. These urban areas are a focal point of environmental problems. Their impacts extend over a wide range of spatial scales-the household, the place of work, the neighborhood, the city, the wider region and ultimately the world [2]. In the rapidly growing cities of the developing countries, urban solid waste management system is currently regarded as one of the most immediate and serious problems faced by the city authorities. In high-income countries, the problems usually centre on the difficulties and high cost of disposing of the large volume of waste generated by households and businesses. In lower-income countries, the main problems are related to collection and disposal, with one-third to half of all solid waste generated in the third world countries remaining uncollected [2]. Therefore, increased solid waste generation creates more environmental problems in developing countries, as many cities are not able to manage it due to institutional, regulatory, financial, technical and public participation shortcomings [3].

2. Materials and Methods

2.1. Background to the Study

Figure 1 is a geographical map of Freetown the study area. Freetown was founded on the 11th March, 1792 and 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 8.48° N and 13.23° W with a total area of 357 square kilometers in the western area of the country. The climate of Sierra Leone is tropical with the raining season lasting from May to December and the dry season from December to April, and rainfall along the coast can reach 495cm a year with Freetown having the highest amount of rainfall, greater than 3500 milliliters. It has a population of 772873[4]. The city is the economic, financial and cultural center of Sierra Leone where the 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 11 Quay. This harbor is capable of receiving ocean going vessels and handles Sierra Leone's main port. Industries, commercial activities, health and educational institutions have duly increased the population of Freetown with a corresponding increase in the quantity of solid waste. The problems of solid waste in Freetown can be traced far back as the 60s when the management has been under variable organizations; both private and public (Table 1). Unfortunately, each change further deteriorated the system, bringing it on the verge of collapse.

Table 1. "Forster care" Record of Solid Waste Management responsibility

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 through Ajibu Jalloh Private Contractor
1987	Environmental Health Division(EDH) Phase 1
1993	Environmental Health Division(EDH) Phase 11
1995	Environmental Health Division(EDH) Phase111
2003	Ministry of Youth and Sports through the National Youth Multipurpose Cooperative Society(NYMCOS)
2005	Freetown City Council(FCC)
2006	Ministry of Local Government
2008	Freetown Waste Management Company(FWMC)

The problem of increased population was further compounded in the mid 1990s when Freetown served as a 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 management facilities as skip trucks, containers were vandalized or completely destroyed. The Freetown Waste Management Company (FWMC), the current authority, is struggling to manage the wastes under tight budgets, limited trained but

inexperienced man power, and little or no legislative authority and experience in solid 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 [5]. Many previous studies have examined problems of solid waste in both developed and developing countries. These studies analyzed the problems of solid waste in different countries, sharing data and allowing for evaluation of the state-of-the-art in terms of waste generation, collection, transportation, disposal, recycling, attitudes and perceptions of the people towards sanitation issues, inadequate funding, insufficient tools and equipment [6-15].

According to Wilson, D. C. et al.,(2010)[16], one-third to one-half of solid waste generated within most cities in low and middle income countries, of which Sierra Leone is no exception are not collected. They usually end up as illegal dumps on streets, open spaces and waste lands.



Figure 1. Map of Freetown Source: maps. Google.com

In Freetown the problem is acute as the disposal facilities have not been able to keep pace with the quantum of solid waste being generated. It is common to find large heaps of garbage lying in a disorganized manner at every nook and corner of the city. In developing countries, there is no formal waste collection system [17]. The predominant system of collection should be through storage communal bins placed at various points along the streets and this sometimes leads to the creation of unauthorized open collection points. Proper management of solid waste is a complex task which depends as much as upon organization and cooperation between households, communities, private sector and government authorities as it does upon the selection and application of appropriate technical solutions for waste collection, transfer, recycling and disposal. In addition, it requires the construction and installation of essential facilities and machinery based on a suitable management plan [18]. Waste disposal is a challenge to solid waste

management in developing cities as the availability of land for disposal is very limited [7], [15]. McDougall, F.R. et al [15] have also shown that the problem of solid waste management in urban cities can be attributed to poor financial status of the management authorities. Solid waste management involves a huge expenditure and thus receives scant attention in many parts of the world. Cities in both developed and developing countries generally do not spend more than 0.5% of their per capita national product (GNP) on urban waste services, which covers only about one-third of overall cost [19]. In Sierra Leone, FWMC was established by an act of parliament to serve as the authorized waste disposal unit in the municipality of Freetown. It was partly funded by World Bank and Freetown City Council (FCC). Due to the inadequacy of this funding, the FWMC is struggling to cope with the present situation as its workers are subjected to poor conditions of work-late or no payment of salaries, no protective gears and medical fee for the workers. Therefore, the objectives of this paper are to examine the problems of solid waste management in Freetown, Sierra Leone and provide an insight to citizens, government officials, the private sector, and Non-governmental Organizations who might want to resolve the solid waste management crisis in Freetown.

2.2. Research Design

This study uses a quantitative approach of data gathering [20] which involved an enquiry into the social problems of waste management in Freetown, measured with numbers and analyzed with statistical procedures.

Hypothesis testing statistics, Chi-square test was employed to establish the significant relationship between (a) identified factors impeding the effectiveness of FWMC and the efficiency of solid waste management system and (b) wrong attitudes and perceptions of the people about sanitation issues contribution to solid waste management problems in Freetown. The choice on the use of questionnaires as a key data gathering instrument in this study was the effectiveness of previous studies' methods demonstrated on problems of solid waste management in [21-24].

The study employed four different questionnaire surveys for household residents, staff of FWMC, staff of Freetown City Council and staff of the Ministry of Health and Sanitation in collecting data on the problems and suggested solutions of solid waste management in Freetown. A pilot study consisting ten respondents was conducted before the main study in order to check the clarity of the questions, to eliminate difficulties or ambiguities, and to estimate the length of time a respondent would take to complete the questionnaires [25]. The results obtained will provide an opportunity for a revision of the questions where necessary before the main study was conducted.

2.3. Sample Size Determination

In this study questionnaires were administered to 901

respondents of the study area which included household residents out of 1203 households in the study area, staff FWMC, staff of Freetown City Council and staff of the Ministry of Health and Sanitation. Of the 901 questionnaires administered 631 were received given 70% response. 70% sample size was the representative population which was easy to manage and came up with good results. The method ensured 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 problems of waste management in Freetown, it is crucial to use stratified-simple random sampling as every member of the study area had an equal probability of being selected to be part of the study.

2.4. Questionnaire Administration

The study was carried out in three stages: stage one (1) involved a desk study in which documents and records relating to the problems of solid waste management were studied to obtain background information as well as data to enable the analysis of the problems of solid waste management in Freetown, Sierra Leone; stage two (2) involved a visit to the Waste Management authority, the Freetown City council and the Ministry of Health and Sanitation to interview few staff members at random. The questions were tailored to derive information on the problems of solid waste management in Freetown and ways to alleviate the problems; stage three (3) involved the administration of structured questionnaires which contained both close and open ended questions to 901 respondents in order to obtain solid information. The first part of the questionnaire sought to obtain data on socioeconomic characteristics such as age, gender, marital status, average family size, occupation, monthly income and education. The second part was to obtain information on the current problems of solid waste management in terms of collection, storage, transportation, attitudes and perceptions of people towards sanitation issues which include people's opinion on responsibilities for ensuring clean surroundings, education of house holds to clean their surroundings, disposal of household waste and children's involvement in solid waste management. The data gathered from various sources were processed and analyzed separately and integration occurred at the data interpretation stage. This strategy was selected as it allows the findings to be confirmed, cross-validated, and corroborated within a single study [26]. The data gathered from the questionnaire was analyzed by using the Statistical Product and Service Solutions (SPSS) soft ware.

3. Results and Discussion

3.1. The Relationship between Socioeconomic Characteristics and Problems of Solid Waste Management

In every human settlement, the microscopic unit of waste generation is the household. Due to societal changes, the

household plays an important role in environmental problems associated with the generation of solid waste. These societal changes influence the characteristics of given households, including age and gender, marital status, occupation, family size and income level (due to societal status and wealth). Majority of the respondents fall within the economically active group (20-50 years) (Table 2). The scenario here is that they have the purchasing power to consume and hence generate wastes. With regards the marital status of the respondents, majority of them are married households (32%) although dominated singles by a narrow margin (Table 2). Married life affects family size which in turn influences consumption patterns and waste generation and management. Married people encourage meals that are African in nature and minimum packaged food with attendant waste like plastic materials. Single people on the other hand consume more of packaged foods which generate plastic materials as wastes. Also respondents indicated that 21.8% of them are in the formal sector employment while 78.2% are in the non-formal sector employment. A majority of the respondents are in the non-formal sector employment-a potential source of waste generation in the city. In addition, respondents indicated that they earn income from both formal and non-formal sectors of employment. The income level of an individual member of any community is a vital factor which determines his/her demands for goods and services.

Table 2. Description of socioeconomic characteristics of respondents

socioeconomic characteristics	Frequency	Percentage
(a) Age		
< 20years	162	25.7
20-50years	301	47.7
Above 50years	168	26.6
Total	631	100
(b) Marital status		
Married	202	32
Single	158	25
Widow/Widower	120	19
Separated	151	24
Total	631	100
(c) Occupation		
Formal employment	138	21.8
Nonformal employment	493	78.2
Total	631	100
(d) Income levels (In Leones)		
< 200000	172	27.3
200000-500000	184	29.1
500000-900000	142	22.5
>900000	133	21.1
Total	631	100
(e) Educational levels		
Higher education	378	60
Senior secondary school	158	25
Junior secondary school	57	9
Primary school	32	5
None	6	1
Total	631	100

In Table 2, majority of the respondents are high income earners. The higher the income, the waste generated which has an implication on waste management.

3.2. Attitudes and Perceptions of Respondents towards the Cleanliness of their Surroundings

Issues of attitudes and perceptions appear to affect both inhabitants and authorities regarding solid waste management in Freetown. In Table 3 the respondents indicated that issues such as people's opinion on responsibilities for ensuring clean surroundings, education of household to clean their surroundings, disposal of household waste and children's involvement in solid waste management contributed to solid waste management problems in Freetown. Further analysis of respondents data shown in figure 2 revealed that since a higher percentage of the respondents (75%) were thinking that the FWMC is solely responsible for ensuring clean surroundings, it is likely that the people may support clean up campaigns meant for making the surroundings clean. This confirms the studies of Sood [27] that with the establishment of the FWMC the public tend to have the view that the FWMC should be sole responsible for managing waste. In order to change this trend it was suggested that the people be educated to see the problem as a shared responsibility of both the individuals in Freetown and the FWMC.

Table 3. Attitudes and perceptions of the people towards solid waste management

Attitudes and perceptions	FWMC	FCC	HHR	MoHS	T	%
(i) education of households to clean their surroundings	35	40	35	40	150	24
(ii) people's opinion on clean surroundings	60	78	16	50	204	32
(iii) disposal of household waste	25	50	55	27	157	25
(iv) children's involvement in solid waste management	23	45	40	12	120	19
Total	143	213	146	129	631	100

FWMC=Freetown Waste Management Company; FCC= Freetown City Council; HHR= Household residents; MoHS= Ministry of Health and Sanitation; T= Total; %= Percentage

Also, 37% of the respondents thought it was appropriate for individuals to share in the responsibility of cleaning their own surrounding while about 63% thought it was not appropriate. The 37% respondents who thought individuals

must be responsible for cleaning their own surroundings gave their reasons as indicated in figure 3. Besides the reasons given by respondents that individuals should take responsibility for the cleanliness of their surroundings, there are other reasons. These reasons include the general impressions of visitors to the city since it is the gate way to the country, destruction of the city's scenic beauty, and the choking of drainages channels that will lead to flooding and environmental pollution.

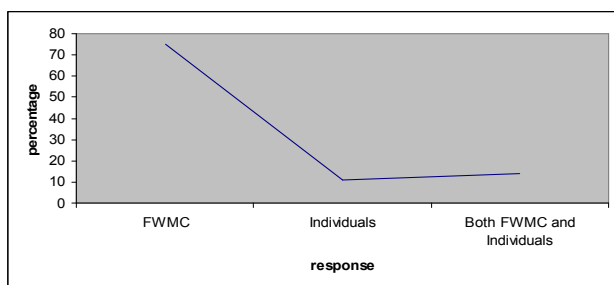


Figure 2. Views on responsibility for ensuring clean surroundings

Individuals should therefore help in the cleaning of their surroundings. The reasons given suggest low level of respondents' knowledge concerning sanitation issues. More seminars and talk shows on sanitation could be organized as a remedy.

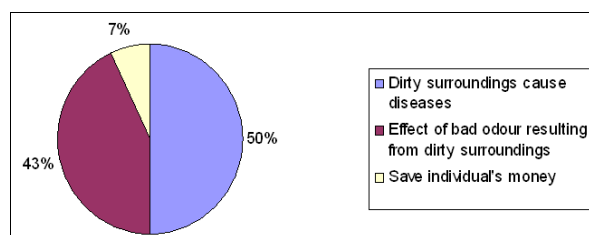


Figure 3. Reasons for individuals to help clean their own surroundings

It was also realized that there was some kind of relationship between the respondents' level of education and their perceptions about cleaning their own surroundings. A higher percentage of those with relatively higher education thought that it was appropriate for individuals to clean their own surroundings (Table 2). The study showed that 74% of the respondents do not educate their households on the need to clean the surroundings while about 26% do. The implications of having more people who do not care to educate their households on making the surroundings clean could mean that society will translate it into acceptable behavior in relation to solid waste management, and especially the children will not develop the right attitudes and perceptions for sanitation at an early stage in life. This is likely to impact negatively on how the present and next generation would handle sanitation in general and solid waste in particular. This is because it was realized that 86% of the respondents involved children below the age ten in the disposal of their household waste. Such children are often asked by their parents and other family members to carry the

household waste to the sanitary site. Thus, according to these respondents carrying the household waste was not the duty of adults. About 14% of the respondents who did not involve such children in solid waste disposal explained that they did not have such children in their households to carry refuse. There is a greater likelihood of indiscriminate disposal of household waste in Freetown with children dominating as carriers of household waste to the designated sanitary sites. This may partly explain why refuse is found all over the city. This problem might be changed for the better if the children (under ten) who carry household waste are given special training about waste handling. The study indicated that respondents used containers like old buckets, plastic containers, baskets, dustbins and polythene bags to store solid waste. With the exception of dustbins, none of the containers had covers. More garbage was stored in old buckets (29.3%) and plastic containers (28.1%) (Figure 4). These waste handling methods are a likely contributory factor for poor sanitation in the respondents' community because much of the solid waste is littered about before reaching the disposal sites. Much of the refuse is kept close to the kitchens and rooms, which may cause diseases like cholera and typhoid fever.

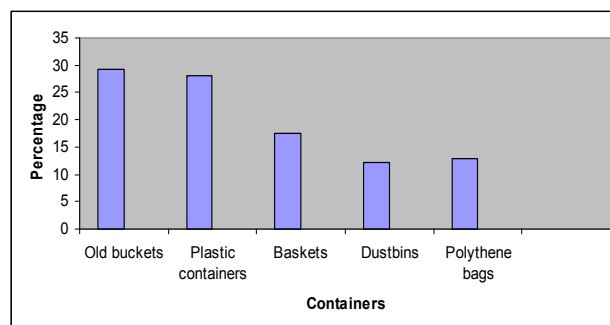


Figure 4. Household solid waste storage containers

From this analysis, the problem of solid waste and the people's perception and attitude in the study area can be linked to the levels of formal education. Improved teaching and learning of issues on sanitation in all levels of education could help improve the general sanitation in the communities. Households' heads should be aware and well informed to educate their household members on basic issues of sanitation in order to curb the problem. Linked to the interest of the households, educating other members is the lesson that should be taught. For those that educate their households on sanitation, some of the lessons taught are summarized in Table 4. Lessons such as the regular organization of communal cleanup exercises, discouraging of people who may be found littering about and respect for sanitary laws did not come up as issues taught. The respondents' inability to point out these lessons could be an indication that general education on sanitation should be further emphasized in the community.

Table 4. Lessons taught to household members on sanitation

Lesson	Frequency	Percentage
1. Dirty surroundings cause diseases	225	36
2. Household members must not litter	40	6
3. People and family must not burn refuse in open pits	50	8
4. Both(1) and(2)	75	12
5. Both(1) and(3)	116	18
6. Both(2) and(3)	125	20
Total	631	100

3.3. Problems of Freetown Waste Management Company (FWMC) in Solid Waste Management

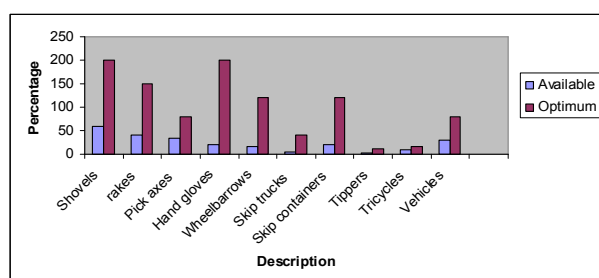
Generally, all solid waste produced in Freetown are collected for final disposal at various designated sites by the FWMC. This is because Freetown is the capital city of Sierra Leone and it is a first class residential area with high income status, poor layout of streets and other infrastructure, and dense population. Therefore, the waste management method adopted must be related to the nature of the community served, its financial capacity and climatic conditions.

However, analysis of respondents' data shown in Table 5 revealed that FWMC cannot effectively cope with the solid waste management problems in Freetown as the amount of solid waste produced far outweigh its capacity to dispose of it. This is because of its inadequate equipment (Figure 5), which is also a result of limited finances and lack of modern equipment and personnel. These problems coupled with the attitudinal and perceptual problems further increase the ineffectiveness of the solid waste management in the city.

Table 5. Problems of solid waste management in Freetown

Problems	FWMC	FCC	HHR	MoHS	T	%
(i)Lack of personell	20	27	25	30	102	16
(ii)Wrong attitudes and perceptions	60	50	40	25	175	28
(iii) Inadequate tools & equip- -pment	40	11	45	23	119	19
(iv)Unavailability of land	25	20	30	16	91	14
(v)Inadequate funds	55	27	50	12	144	23
Total	200	135	190	106	631	100

FWMC=Freetown waste management company; FCC= Freetown City Council; HHR= Household residents; MoHS= Ministry of Health and Sanitation; T= Total; P= Percentage

**Figure 5.** Kind and adequacy of FWMC's equipment

Analysis of the data gathered from the FWMC indicates that there are currently two land fills (Granville brook dumpsite in the East and Kingtom dumpsite in the West) in the city which are woefully inadequate. The major problem arising at this point is that it is even impossible to create new landfills because there is no land available as land owners in the surrounding villages and towns of Freetown are not willing to give up their lands. The number of workers currently on the field was known to be inadequate. More people need to be employed but FWMC was unable to do so because of its financial problems. A summary of the findings on the inadequacy of the labor force is shown in figure 6.

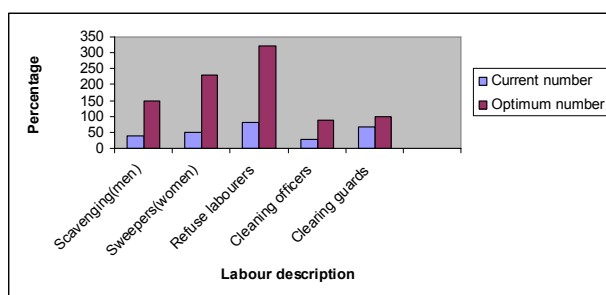


Figure 6. The labor force of FPMC

Because FPMC cannot adequately provide enough vehicles, containers and personnel, the proliferation of garbage dumpsites across the city continue. As one citizen remarked, “every morning when one wakes up, new dumpsites materialize in areas they are not supposed to be”. This problem has encouraged the use of various inappropriate methods for household waste disposal such as solid waste being left in open pits for burning. The help of concerned citizens, government organizations and Non-Governmental Organizations in terms of the provision of funds and equipment may be a remedy to this problem.

3.4. Statistical Analysis

The Chi-square was used to test the following hypotheses:
 (a) the significant relationship between wrong attitudes and perceptions of the people about sanitation issues and effective solid waste management (data from Table 3).
 (b) The significant relationship between waste management authority’s inability to cope with solid waste crisis (due to problems) and its effectiveness in the solid waste management (data from Table 5).

Table 6. A summary of the chi-square test statistics.

Hypothesis	Df	χ^2 Cal.	χ^2 Tab	P-value
(a)	9	59.36	27.88	P<0.001
(b)	12	46.46	32.91	P<0.001

Df= degrees of freedom; χ^2 Cal. = chi-square calculated; χ^2 Tab. = chi-square tabulated

Since the chi-square calculated is greater than the tabulated with 9 degrees of freedom at $P < 0.001$ was significant, therefore the hypothesis was accepted to be true. Hence wrong attitudes and perceptions of the people on sanitation issues contributed significantly to the problems of solid waste management. Also for hypothesis (b), since the chi-square calculated is greater than the tabulated with 12 degrees of freedom at $P < 0.001$ was statistically significant; therefore the hypothesis was accepted to be true. Hence waste management authority’s inability to cope with solid waste crisis is positively related to the problems of solid waste management.

4. Conclusions

The collected data on the problems of solid waste management in Freetown, Sierra Leone were presented and analyzed. The study shows that the people of the study area had poor attitudes and perception towards solid waste handling. They would store their household refuse in containers that have no coverings. The people depended virtually on the Freetown Waste Management Company’s facilities for their household refuse disposal. The waste management authority’s equipment and personnel for handling solid waste in the city were woefully inadequate. The FPMC workers lacked incentives that will motivate them to do perfect jobs. Therefore, the study recommends that the public should be educated by the waste management authority on solid waste and its related issues through the radio, television, newspapers, and even in schools on proper ways of handling solid waste and keeping the surrounding clean. People should develop proper attitudes and perceptions towards waste handling through formal and informal education. The participation of the government, the private sector, citizens, Non-Governmental Organizations and donor agencies to strengthen the financial base of the waste management authority. This will enable it to acquire equipment, effective and efficient personnel.

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