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Assessment of Waste Management Systems in Second Cycle Institutions of the Bolgatanga Municipality, Upper East, Ghana

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ABSTRACT

Waste management is a discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of waste in a manner that is in accordance with the best principles of public health. The aim of the research was to assess waste management systems in second cycle institutions in the Bolgatanga Municipality and suggest possible measures to tackling the problem. The study adopted both open and close-ended questionnaires to collect data alongside focused group discussions, key informant interviews and observation using a sample size of one hundred and sixty (160). Kilometric reading was taken from the waste collection sites to the dumping sites to determine the distance of each school to the dumping site.Majority (45%) of the respondents, who were household heads, were in the 32-50 year group.95% of the respondents generated 1-5 tons of waste with plastic waste constituting about 57.5 per cent of all the components of waste generated in the institutions. Dustbins were the main equipment used for storing waste though the study found them to be inadequate. In terms of waste collection and transportation in the schools, 'Oboafo' tricycle motorist, skip loaders, roll on/roll off and compaction trucks were mainly used. The study revealed that 20% covered less than 5 km, 40% travelled between 6 and 10 Km, 30% covered a distance between 11-15 km and 10% between 16-20 Km, respectively, to the waste dumping site. The 'pay as you throw principle 'should be introduced to mobilize funds for effective waste management in the municipality. The research will serve as a reference point to the Bolgatanga municipality and all stakeholders as far as waste management is concerned.

Keywords: Dump site, dustbins, Haulage, Incineration,Institutions,Waste,Sanitary.

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INTRODUCTION

According to Palmer (2005), there is no definite definition for waste. Gilpin (1996) stated that the concept 'waste' embraces all unwanted and economically unusable by-products or residuals at any given place and time. McLaren (1993) defines waste as unwanted materials arising entirely from human activities which are discarded into the environment. Jessen (2002) noted that waste is human creation and there is no such things as waste in nature where cut-offs of one species become food for another. Gourlay, cited in Freduah (2004) stated that something can become waste when it is no longer useful to the owner or it is used and fails to fulfill its purpose. Waste is any materials that arises from human and animal activities that are normally discarded as useless or unwanted[11]. Zerbock (2003) stated solid waste is non-hazardous

industrial, commercial and domestic waste including, household's organic trash, street sweepings, industrial garbage and construction waste. So he defined solid waste as any material which has no value to people who possess it and is discarded as useless. Solid waste is an unavoidable by-product of human activities and may be regarded as any rejected material which has no economic demand and must be disposed. Waste is any material which comes from domestic, commercial, and industrial sources arising from human activities and increase as population and urbanization increases over the years[9].

Despite the fact that developing countries do spend about 20 to 40 per cent of metropolitan revenues on waste management, they are unable to keep pace with the scope of the problem[14]. In fact, when the governments of African countries were required by the World Health Organization (WHO) to prioritize their environmental health concerns, the results revealed that solid waste was identified as the second most important problem after water quality (Senkoro, 2003 cited by Zerbock[14] and Ghana is not an exception.

From the foregoing definitions and for the purpose of this research work, "waste" has been defined as when something is no longer of value and fails to perform its functions (Palmer, 1993). Waste is either hazardous or non-hazardous (Palmer, 1998) and comes from different sources. An example of the source classification was provided by the World Bank (1999) in a study in Asia which identified the source of waste as residential, commercial, industrial, construction and demolition, municipal services, processing and agricultural sources (World Bank/IBRD, 1999). The UK Environment Council (2000) identify the major sources of waste as municipal, commercial and industrial, agricultural, demolition and construction activities, dredged spoils, sewage sludge and mining and quarrying operation. Classifying waste by their sources is a useful way of determining the relative constructions of the different areas of society and how to plan for collection and disposal.

Kumah[4] defines waste management as the administration of activities that provide the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of waste. Tchobanoglous*et al*. (1993) provides a more comprehensive definition of waste management. According to them, waste management is that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of waste in the manner that is in accordance with the best principle of public health, economics, engineering, conservation, aesthetics and other environmental consideration and also responsive to public attitudes. Therefore if waste management is to be accomplished in an efficient and orderly manner, the fundamental aspects and relationships involved must be identified and understood clearly (Tchobanoglous*et al*,1993). On the basis of this, waste management incorporates the following: source separation, storage, collection, transportation and treatment and disposal of waste in an environmentally sustainable manner.

Waste generation comprises those activities in which materials are identified as useless and are either thrown away or gathered for disposal (Oladebeye). According to UNEP (2009), in 2006, the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tonesand was projectedto be 37.3 per cent in 2011, an equivalent of 8 per cent increase per year (UNEP, 2009). It is accepted that waste generation is increasing at a faster rate globally, as indicated by UNEP and was confirmed by Mensah and Larbi[6] concerning waste generation in Ghana.Tchobanoglous*et al* (1977) explain storage to mean where waste is stored before it is collected. According to them, storage is of primary importance because of aesthetic considerations. The element of collection includes not only the gathering of solid waste, but also the hauling of waste after collection to the location where the collection vehicles is emptied[5]. In the city, Thimphuin Bhutan, the collection of waste from households, commercial setups were done in concrete receptacles placed at strategic positions and conveyed by trucks/tractors to prevent people from dumping waste indiscriminately (USPS, 2000). The building of these concrete bins and containers may be expensive to do in Ghana and for that matter Bolga Municipality.

If waste management is not done effectively and efficiently, the objective of Integrated Solid Waste Management (ISWM) would not be achieved (Teka, 1997). While garbage is the most potential valuable element or component of waste, it is the most difficult to handle in a sanitary manner and is responsible

for the majority of nuisances and health hazards associated with diseases (Cointreau, 1982).On the basis of this, the study intends to examine the problems enumerated above in second cycle institutions in Bolgatanga Municipality of the Upper East Region of Ghana.

Therefore, the research seeks to establish the causes of this problem by answering the following questions: what types of solid waste are generated in the Second cycle institutions? How do people dispose of their domestic waste?, how frequent is the waste collected and onward disposal?, what resources are available in collecting the wastes generated?, what is the way forward?

Specifically, the research aims at achieving the following objectives: to assess the types and components of wastes generated in the second cycle institutions, to examine means of waste disposal by households (place of disposal), to analyze the mode and frequency of solid waste collection, to assess the capacity of the waste management institutions in managing solid waste in the area and to make recommendations for effective management of waste in the Municipality.

MATERIALS AND METHODS

Study site

Geographically, the study area covered all second cycles' institutions in the Bolgatanga municipal Assembly (B M A) in the upper East Region of Ghana. Bolgatanga municipality was chosen because it has a larger number of second cycle institutions than any other district in the region, and also because it faces major problems of efficient waste management. Apart from that, the study also focused on domestic waste management; this is because most solid wastes generated in these schools come from domestic sources. Despite the seriousness of these problems in these schools, very little research on solid and liquid waste management had been carried out in these schools.

Description of the Study Area

The study was conducted in Bolgatanga, the Upper East regional capital of Ghana. It is bounded to the north by Kassena Nankana district, on the west by Sisala district and on the south by West Mamprusi district and on the east by the Nabdam district. The Bolgatanga municipality covers an average land mass of 4.220 km^2 and constitute 35.1% of total land area of the Upper East region.It has a total population of about seventy four thousand, five hundred and seventy six (74.576) of which 48.2% are male and 51.8% are female (PHC, 2001).

The climate of the Bolgatanga municipality is classified as Sudanese and characterized by pronounced wet and dry season (Asus, 1967). However the municipality has mean north temperature ranging between 21.9^{o}Cand 34.1^{o}C. The highest temperature (45 ^{0}C) is recorded in March and the lowest (10 ^{o}C) temperature is normally recoded in January (BolgaAgric station report, 2006).

The municipality experiences one rainy season starting from April to September and then decline sharply coming to a complete half in mid-October when dry season sets in. It experiences a mean annual rainfall of 840mm and 1150mm with irregular dry spells occurring in June or July (Bolga Agric station report, 2006). The vegetation of the Bolga municipal is characterized by savannah woodland and consists of deciduous widely fire and drought resistant trees of varying density with dispensed cover of perennial grasses and associated herbs. Through the activities of man, the woodland savannah has been reduced to an open pack land where only trees of economic value such as kapok, baobab, acacia,shea nut and 'dawadawa' have been retained with time. These trees satisfy domestic requirement such as fuel wood. Timber for local housing construction. Cattle kraal, vegetable garden fence and material for handcart, in the dry season. Annual bushfires decimate the grasses and shrubs and as a result pasture for the livestock is largely destroyed. These bushfires also ravage the forest reserve in the district and render them distinguishable from the surrounding vegetation (Department of forestry, 2001). However, the soils of the municipality are developed from five different geological formations namely granite, Birimian rock, and voltaic shale's.Recent and old alluvium of mixed origin and very old river terraces, out of these dominant soil groups in the district are of granite origin and the over 70% (Approximately 153.300ha) of the district (Adus,1969).

Research Design and Methodology

Descriptive survey design[3] was adopted in this study applying both qualitative and quantitative research methodologies. The study used structured close-ended questionnaires as the main instrument to collect data alongside with focused group discussions, key informant interviews and observation. These methods sought to provide an opportunity to have an in-depth knowledge of the research which hitherto was not clear. Empirical verification was done via observation on attitudes and behaviors of respondents (Anderson, 1971) to test the truth or otherwise of empirical statements. In all, three (3) focus group discussions were held with the various groups. It involved opinion leaders within the schools, households, students from the study areas etc. Others included in this interview were the Bolgatanga Municipal Assembly staff, Zoomlion Ltd, NGOs into Waste Management, staff from environmental protection agency etc. This method sought to help these groups to freely express themselves concerning the subject. The researcher conducted a series of in-depth interviews with each of the household heads and students during the data collection.The interview with the participants focused on ten structured questions designed by the researcher. This was to ascertain and verify the other sources already employed to collect the information. Interpretation of the questionnaires to those who could not understand was done by the researcher and the appropriate responses ticked. A total of three thousand and twenty five (3,025) male and female students and teachers aged 15 and above was obtained as the sample frame of the assessment survey. The sample size for the study was One hundred and sixty (160). To find out the haulage of waste to the dumpsite, the time of loading the waste and the time of discharge at the dumping site was determined. The kilometric reading was taken from the waste vehicles to determine the distance of each school to the dumping site.

Data Analysis

Data obtained was analyzed using Statistical Package for Social Scientist (SPSS) 16.0 and Microsoft Excel.

RESULTS AND DISCUSSION

Age of respondents

The age groups of the respondents were in the range of15 to 65 (Table 1), most of them within 32-50 years bracket (45%).

Table 1: Age group of respondents

| Age group	Percentage
15-31	27
32-50	45
51-60	21
Above 60	7

Source:(Field Survey, 2013)

Majority of the respondents were in the 32- 50 year group because most of the respondents were household heads within the schools involved in the study. In African societies, age plays important role in the decision making process and the study area is not an exception. Majority of those who were contacted were members of staff of the schools who take part in decision making. These age categories are energetic and undertook most of the activities within the area of the study. The household sizes of respondents were (1-5) 31%, (6-10) 47%, (11-15) 14%, (16-20) 7% and (21-25) 1%.

Second Cycle Institutions Involved in the Study

The study also classified all the institutions involved in the survey on four main indicators. As a result of this category, Senior High Schools involved in the study constituted 45%, followed by the Secretarial schools with 35%, Technical schools recorded 10% and SHS/Technical 10%.

The indicators studied are categorized below;

Fig: 3 Second Cycle Institutions Involved in the Study
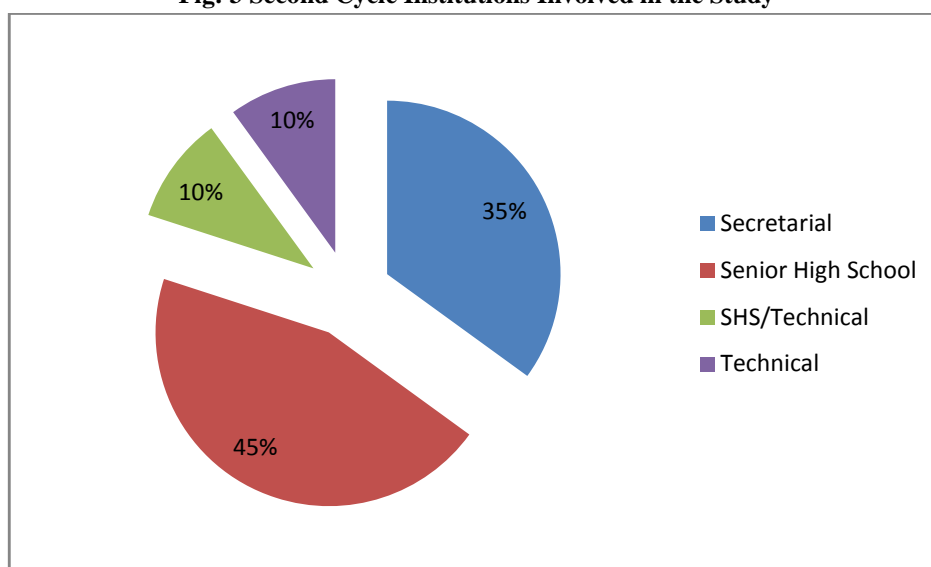
Source :(Field Survey, 2013)

The Quantity Daily Waste Generation by Schools

The study sought the views of the respondents to ascertain the quantities of daily waste generation by the schools in the Bolgatanga Municipality. The results showed that 5% of the respondents generated less than 1 ton of the waste generated in the institutions. The remaining 95% of the respondents generates 1-5 tons of the waste in the institutions.

Types and Components of Solid Waste Generated

Knowledge of the types and the components of solid waste generated will inform management to use the appropriate methods to effectively deal with the various components of solid waste. Methods such as source separation recycling, composting can be used depending on the composition of solid waste in the waste stream. The Waste Management Department (WMD) and Zoomlion GhanaLtd .estimated that 0.45kg daily per capita of waste was generated in the Municipality. This amounted to 810 tons day (Zoomlion Ghana Ltd, 2013).According to the Zoomlion and WMD, the commonest types of waste generated in the area were food waste, rubbish, and ashes and agreed with the findings of Tehobanoglous*et al*(1993) that waste comes from different sources. These components are shown in table 2 below.

Table2:MajorComponentsofWaste Generated

Component	Percentage Generated(%)
Plastic	57.5
Foodwaste	20
Metals	10
Paper	5
Wood	2.5
Glass	5
Total	**100**

Source:WMDandZoomlionGhanaLtd.,2013.

The table shows that, plastic waste constituted about 57.5 per cent of all the components of waste generated in the schools. This is an indication that a lot of polythene bags were used probably for packaging, especially food items in the schools. This further explains why a lot of polythene bags were

seen littered in most of the study areas such as Bolgatanga technical and Bolgatanga Senior High Schools. Wood was the least component of waste generated because most of the respondents depended on gas for energy.

Capacity of Waste Management Institutions

An understanding of the capacities of WMD and the Zoomlion Ghana Ltd .will enable conclusions to be drawn regarding their effectiveness. This section assesses the capacities of the WMD and Zoomlion Ghana Ltd. in terms of tools and equipment.

An interview with the WMD and Zoomlion Ghana Ltd. revealed the equipment base of the two waste management institutions in the Municipality (Table 3).

Table3: Equipment Base of Waste Management Institutions (WMD and Zoomlion)

Equipment	WMD (number available)	Number required	Zoomlion (number available)	Number required	Total available	Total required
Dustbins	550	1000	1047	3000	1,200	3000
Skips	118	200	40	30	186	230
Oboafotricycle	-	-	100	200	100	200
Motorist	-	-	8	50	8	50
Graders	1	2	-	2	1	4
SkipLoaders	3	4	3	3	6	7
Compactiontrucks	1	2	1	2	2	4
Roll on/Roll off Trucks	3	4	2	4	5	8

Source: (Zoomlion, 2013)

Analyses of the equipment base from table 3 are grouped into the irrespective uses, namely, storage, collection and transportation. In terms of waste storage, two-hundred and thirty (230) skips were required by Zoomlion GhanaLtd.and WMD to be supplied in both the middle and low class residential areas. However, one hundred and eighty-six (186) were available and supplied for storing waste in the Municipality. In effect, if this extra skips were not supplied, this could result in people dumping waste at unapproved sites .Also, about four-thousand (4000) dustbins were needed for storing waste in the high class residential areas and schools for effective service in the Municipality. This is because dustbins are the main equipment for storing waste in order to prevent dumping of waste at unapproved sites. In terms of waste collection and transportation in the schools,' Oboafo' tricycle motorist skip loaders, roll-on/roll off and compaction trucks were mainly used. The 'Oboafo 'tricycle and motorist were used for primary collection and transferring of waste collected into a compaction truck for final disposal at the landfill. However, these were not enough to ensure regular collection and transportation of waste to the landfill. For instance about two-hundred (200)'Oboafo 'tricycles were needed by the waste management institutions for the door-to-door collection. Also, the compaction trucks which were used for the door-to-door collection were only two (2) for the entire Municipality. In effect, if the few existing core waste equipment for collection and transportation like skip loaders, compaction trucks and roll on/rolloff trucks are broken down for just a day or two, it would result in heaping of waste. This can lead to outbreak of communicable diseases such as cholera, typhoid and chicken pox.

**Haulage of Waste Generated in Schools to Dumping Sites**

In a study to find out the distance covered from the various schools to dumping sites. It was revealed that 20% covered less than 5 km, 40% travelled between 6-10Km,30% covered a distance between 11-15 km and 10% between 16-20Km to the waste dumping site. This is an indication that, most of the schools in the Municipality are scattered, and by this nature would have disparities in distance coverage to their final waste dumping sites. For instance, a school like Bolgatanga Senior High School is located at the outskirts

of the Municipality and is closer to the dumping site than Bolgatanga Gils Senior High School which is situated in town. An interview with the Heads of Schools in the twelve (12) selected areas revealed that lack of skips and dustbins was a major problem in the Schools. Zoomlion Ghana Ltd. Which was the main company in charge of waste collection had been unable to supply skips and dustbins to areas they served.

Methods of Disposal of Household Solid Waste

The disposal of household solid waste is one of the functional elements in the management of waste.

Fig.2: illustrates the methods of solid waste disposal in the study area

Bar Graph of Disposal of Household Waste
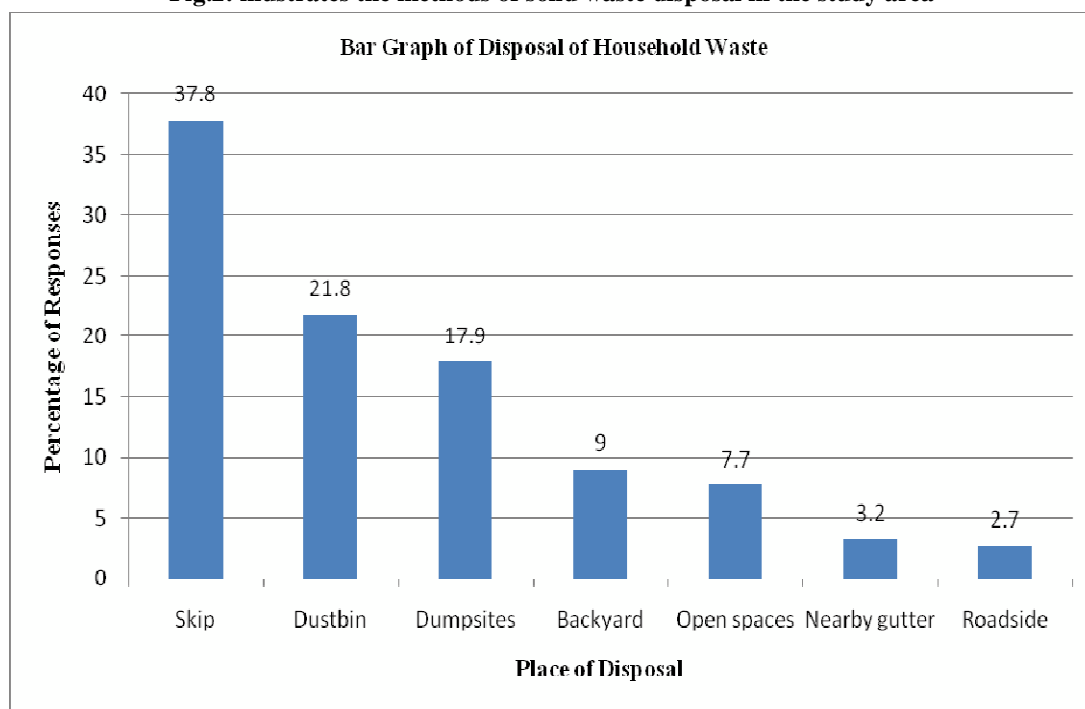
Source:(Field Survey, 2013)

From the graph, the commonest place of waste disposal was the skip (37.8 per cent). This method was used in the residential areas in the schools. These areas include: Bolgatanga Technical School, Bolgatanga Senior High and Zuarungu Senior High. This is followed by storing waste in dustbins (21.8 per cent) mostly in vantage areas and some middle class residential areas in the institutions these areas were: Headmasters Bungalows, Assistant headmasters and the Senior House masters residences. The rest of the respondents (40.5 per cent) resorted to dumping waste along roadsides, open spaces, nearby gutters or backyards. These methods of waste disposal also happened in the low class residential areas who happened to be the majority in the society. This resulted in littering and heaping of waste thereby making the environment filthy. Therefore, the possibility of outbreak of cholera and other environmentally related diseases is high with such practices.

Regularity of Waste Collection

Regular collection is an important exercise in solid waste management. Respondents (30.4 %) indicated that waste was collected twice or once week. The rest (69.6%) was in the low class residential areas where it takes about two to four weeks before the waste is collected. In some areas like Royal Secretarial and Rock foundation SHS collection did not take place at all. This brought about heaping of waste in dump sites and skips overflowing with waste.

CONCLUSION

Inadequate skip supply was a major factor affecting waste disposal in Bolgatanga Municipality especially among the low class residential areas. The survey established that about 66 per cent of respondents have no access to skips for disposing their waste mainly in the low class residential area. This implies that respondents resorted to dumping waste in nearby gutters, by roadside, opened spaces and other

unapproved ways of managing their domestic waste. Additionally, the skip ratio to population was very high (1: 9378) in the high populated areas. This goes to reaffirm the inadequacy of skip supply in the Municipality. Also, the time spent by residents and students to dispose of waste at the few existing skip sites was a factor influencing dumping of waste at unapproved sites. Indeed there was irregular or lack of routine collection of waste by ZoomLion Ghana Ltd. especially in the lower class schools in the Municipality. This resulted in students and households within schools dumping their waste in opened spaces and in most cases burning was the alternative to final disposal at the landfill. Unlike the door-to-door collection which attracted a monthly charge of GH¢ 7.00 in the high class residential areas, the communal collection was carried out at no cost to the residents in all the low class residential areas. This is because respondents in these areas were not requested to pay for waste collection though their monthly average monthly income (GH¢ 260) earned could support the payment.

The landfill did not meet the requirement of a sanitary landfill as in the case of Kumasi Metropolitan Area (KMA) and therefore could be described as an open dump. Though the landfill had a weighbridge, gas recovery system and leachate collection system, they were not functioning. The landfill too had no internal access and sited near a settlement. Additionally, waste was not usually separated into their various components before final disposal. This led to burying of some toxic or valuable resources in the landfill which could have been otherwise re-used. More so, burning of waste occurred in the landfill releasing poisonous gases such as carbon monoxide. The waste management institutions were unable to deliver efficient services as they were under resourced. Skips for storing waste generated were woefully inadequate. In the whole Municipality eighty five (85) skips were supplied particularly in the low class residential areas. However, about 130 extra skips were required by WMD and ZoomLion Ghana Ltd. to be supplied to the low class residential areas and the schools. Also, about four thousand (4000) dustbins extra were required to be supplied in the middle and high class residential areas in the Municipality as against one thousand, five-hundred and ninety- seven (1,597) dustbins distributed. Equipment for waste transportation was also inadequate. These include: oboafo tricycle, compaction trucks, roll on/roll off trucks and skip loaders. For instance two hundred (200) oboafo tricycles were needed by the waste management institutions for the door-to-door collection. However, about one hundred (100) tricycles were available. Furthermore, the compaction trucks which were used for the door-to-door collection were only two (2) for the entire Municipality instead of four (4).

Recommendation

Based on the findings of the study, the following measures are recommended for efficient and effective management of waste systems in the second cycle institutions within the Municipality.

Adequate dustbins and skips should be provided by ZoomLion Ghana Ltd. in collaboration with the WMD and Municipal Assembly for residents and the various schools in the Municipality for waste storage. Approximately six hundred (600) skips should be supplied. This should be provided particularly for the low class residential, highly populated schools and middle class residential areas to avoid dumping of waste in open spaces, gutters and roadside. Skips should be placed at least within 30 metres radius and at most 50 metres radius in the low class residential areas. With this, residents in the low class residential areas will spend less time to dispose off their domestic waste at the skip site. Also, the backlog of five thousand and forty (5040) dustbins should be supplied by ZoomLion Ghana Ltd. particularly for the high class populated schools.

There should be regularity of waste collection by ZoomLion Ghana Ltd. particularly in highly populated schools to avoid heaping of waste and over flowing of skips with solid waste. At least, waste should be collected once or two times a week in low class areas and thrice in the Middle and high class residential areas. There should be regular monitoring of waste collection by the Municipal Assembly. This will keep the place constantly clean and prevent any possible outbreak of communicable diseases such as cholera and typhoid.

The Integrated Solid Waste Management (ISWM) should be adopted to ensure effective solid waste management in the area. Residents and schools should be encouraged by WMD and ZoomLion Ghana

Ltd. to separate the waste generated into their various components before final disposal. Waste can be disaggregated into plastic, metals, wood, cans, bottles and food waste. In this case rubber cans, bottles, metals can be reused; plastics like polythene bags and empty water sachets can also be recycled. The rest like food waste can be composted for manure, incinerate those that are combustible and landfill those that cannot be subjected to any of the above mentioned methods.

The landfill site should be properly managed to avoid heaping of waste and burning. The following should be revived for the landfill to work effectively. These include the weighbridge, gas recovery system and leachate collection system. With the weighbridge the quantity of waste that goes into the landfill can be determined easily. With proper leachate system put in place the possibility of waste polluting groundwater in the area will be prevented. Also, waste dumped in the landfill should be spread, compacted and covered with soil. This will prevent heaping of waste in the landfill. Furthermore, the landfill management should ensure that waste that is carried to the landfill does not contain fire. Any container that contains fire should be isolated and fire quenched before dumping is done. Waste collection sources should be checked to ensure that waste does not contain any drop of fire. This will go a long way to prevent the burning of waste in the landfill. The Environmental Protection Agency (EPA) which is the regulatory authority on sanitation should ensure routine monitoring of management of the landfill site.The landfill site should also be relocated because of its negative environmental impact on the lives of people in the nearby communities. The relocation will prevent the communities from being constantly engulfed by smoke from the landfill. This will also prevent possibility of the waste in landfill especially hazardous waste from polluting water sources of the community through percolation.

The waste management institutions should be adequately resourced by the Municipal Assembly to ensure efficient and effective waste management in the area. The Municipal Assembly should liaise with other corporate bodies like the United Nations Development Program (UNDP) as well as the sister city in the United States (US) to pull financial resources to support the institutions in charge of managing waste especially the ZoomLion Ghana Ltd. With their support, adequate dustbin, skips and core waste management equipment such as compaction trucks, roll on/roll off trucks, skip loaders would be purchased to ensure effective waste collection and disposal. Residents in the low class residential areas should be made to pay for disposing their waste. This is because they are the very people who generate the waste. That is the 'pay as you throw principle' should be introduced. All these should be done through education by letting residents and schools know the importance of environmental cleanliness and how they can contribute to it. This will go to support the financial base of the waste management institutions.

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