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Solid Waste Management: The Case of Komenda-Edina-Eguafo-Abirem (KEEA) Municipal in the Central Region of Ghana

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Abstract
The increase in quantity and complexity of solid waste has been such that there is an adverse effect on our environment. The study sought to determine the solid **w**aste management in Komenda-Edina-Eguafo- Abirem (KEEA) Municipal in the Republic of Ghana.
A sample of 192 respondents including community residents, Assembly workers, ZoomLion workers (waste collection company) and market traders were used in the study. Purposive and simple random sampling techniques were used to select the respondent for the study. Questionnaires, structured interview schedule and observation were used to gather information.
Results of the study revealed that plastic, paper and food items are the common types of solid waste generated in the Komenda-Edina-Eguafo-Abirem Municipality. It was recommended that the government should consider engaging some organisations or individuals with expertise in recycling, since solid waste can be recycled to bring about many benefits. Also more sanitation workers should also be employed to support the present work force to clean the municipality.
Keywords: Solid waste, Waste generation, Waste collection

Introduction and Background

Sanitation is one of the most important determinants of the quality of life but it is often times neglected. Human survival depends on the quality of the environment. The term environment refers to the air, water and the land around us. These elements provide a variety of important services such as habitat in which to live and resources to produce goods and services (Sharp et al, 2002). This implies that one cannot do away with the environment and therefore, there is the need to protect the environment.
The environment, which enables us to live by interacting with other things within it, is gradually deteriorating and this is as a result of human activities, thereby contributing to environmental problems. Among the environmental problems are the three main types of pollutions. These are water pollution, air pollution and land pollution. Pollution according to Sharp et al (2002) is loading of the environment with waste that are not completely recycled, are not recycled fast enough, or are not recycled at all. These primarily arise from the use of the environment by producers and consumers as a place to dispose of the waste of production and consumption. Baerwald et al (1992) attested that "the amount of waste and problem involved in disposing of waste have increased as many countries of the world have grown wealthier". It shows that, the problem of disposing of waste is becoming complex. As population and industrial production increase, waste generation has also increased.
The management of solid waste in our urban communities has become a significant policy issue in the world over. Today, solid waste management have become particularly difficult basically due to rapid growth of the populations across the world. This has made it very difficult for sanitation to keep pace with the rapid growth of the population growth. Furthermore, the rapid accumulation of the solid waste presently could also be as a result of increasing levels of wealth. For example, Smith and Enger (2000) observed that the solid waste problem facing the world today is the results of the economic boom that followed World War II. Countries such as the United Kingdom, France and the United States of America generated a lot of solid waste in the form of pollution in their respective countries.
However, some of the greatest challenges to its management are felt most keenly in the developing countries. This irony is based on the gap between the patterns of growth and modernization in the developing world on the one hand, and the capacity to pay for, plan for and effectively manage solid waste as part of an integrated national system on the other (Thomas - Hope, 1998).
Third world countries therefore face particular challenges in the management of solid waste, as in other aspects of environmental management of waste. Thus it is important that greater attention is focused on solid waste

management within the wider context of environmental management.

According to Thomas-Hope (1998), thirty to fifty percent of the population of developing countries is urban and produces a disproportionately high volume of waste. Thousands of tons of solid waste are generated daily in Africa. Most of it ends up in open dumps and wetlands, contaminating surface and ground water and posing major health hazards. Generation rates, available only for selected cities and regions, are approximately 0.5 kilograms per person per day-in some cases reaching as high as 0.8 kilograms per person per day. While this may seem modest compared to the 1-2 kg per person per day generated in developed countries, most waste in Africa is not collected by municipal collection systems because of poor management, fiscal irresponsibility or malfeasance, equipment failure, or inadequate waste management and budgets. Throughout most of Sub-Saharan Africa solid waste generation exceeds collection capacity. This is in part due to rapid urban population growth. But the problem of growing demand is compounded by broken-down collection trucks and poor programme management and design.

In Ghana the situation is not different in the various Districts Assemblies such as Komanda, Edina, Eguafo, Aberim; Twifo Praso, Heman Lower Denkyira; Ahanta West; and Shama Districts. Disposal of wastes constitute a serious problem in the towns and the cities. The UNDP Human Development Report (1996) ranks Ghana, 129th out of 174 developing countries, where 9.5 million of her estimated 18 million population were without access to good sanitation. The implication of this is that waste are left to piled up uncollected thereby bringing on board sanitation problems as a result of the lack of access to waste management services by significant proportion of the population of which KEEA District is no exception.

A survey carried out in low income high density population areas in 365,550 households in Accra revealed only 41 per cent of these households have solid waste disposal facilities provided in or around their houses (Statistical Service, 2002). Residents at Chorkor for instance, with a population of over 45,379 have only two collection points where each of these points has two old containers. These are filled to the brim in the early hours of the morning. In the absence of attendants, garbage is left there and accumulates on the ground (Statistical Service, 2002). Similar situation exists in Komenda - Edina - Eguafo-Abirem Municipal.

The emergence of plastics, polyethylene and styrofoam products in domestic and commercial waste has given a new dimension to the waste management problem. The rising standard of living in Ghana for example has moved people from the use of environmentally friendly and biodegradable materials such as straw mattresses, paper carrier bags, 'leave wrappers', cane settees and stools to more sophisticated substitutes. Form mattresses, plastic chairs, polyethylene materials are now widely in use. The extent of their usage and the indiscriminate hazard and irresponsible disposal of these non-degradable materials has contributed immensely to the environmental hazards. According to *Clarke and March (2010),* access to sanitation can be as low as 42 percent in urban areas and 11 percent in rural areas in Ghana.

The importance of the Komenda-Edina-Equafo-Abirem to the development of the nation cannot be overemphasised because of its attractiveness as one of the main tourist destinations in the Central Region of Ghana. However, the district is prone to all kinds of sickness such as cholera, skin rashes, etc., due to the problem of poor sanitation. Many towns in the district such as Komenda, Elmina, and Eguafo suffer from uncollected refuse.

According to Ministry of Local Government only 42% of waste generated daily in Elmina is collected (www.ghanadistricts.com). The Elmina town in the municipal is divided into eight areas for the purpose of refuse collection. However, due to the inadequate number of refuse trailers, only three areas enjoy organised refuse collection. There are no household collection points. Instead, individuals, mostly children, carry the waste to the disposal points, which in certain areas are as far as about 200 metres away from their houses. The required maximum distance is 100 metres. In communities where they do not have "controlled" refuse collection, few dustbins are placed along vantage points on the street for pedestrians to use.

Though, the District Assembly in 1994 through the Urban III Project provided ten trailers, two dumpers and two tractors for waste collection and transport to the final disposal site, three of these trailers have broken down and have not been replaced. This is because no trailers were reserved for any emergencies such as breakdowns. These seven trailers are located at few locations including Dutch Cemetery, SSNIT Flats, Marine, Nyanta, Sarmu, Estate and the New Market all at Elmina. Though, the KEEA has acquired five other trailers with support from Cordaid/Memisa (a Dutch NGO) in supporting a general clean-up and hygiene campaign, the nagging question is still the adequacy as more of such equipments are needed if we are to make significant improvement in the solid waste management in the municipal.

The capacity of each of these trailers is 7.28 cubic metres and they are removed daily by the two tractors to the final disposal site at Ataabadze, 8 kilometres away from the Elmina Town. In areas where there are no trailers for waste collection as in Teterkesem, Akotobinsin, Bantuma, Ayisa, Zongo etc. suburbs of Elmina and the rest of the towns or communities within the district, solid waste is either incinerated or buried. Some people prefer dumping them indiscriminately in their backyards or any available space, or into the lagoons.

Refuse collection in the district capital is done free of charge on household basis, except hotels which are supposed to pay for services rendered. This study is therefore meant to assess solid waste management in Komenda - Edina - Eguafo - Abirem Municipal Area. The research was guided by this research question-How does solid waste generated, collected and transported in the municipality?

2. Literature Review on Solid Waste Management

According to Robinson (1986), solid waste requires that the discarded material be useless, unwanted and have no market or other value at the place where it is located. The term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material (Strander and Theodore, 2008). According Schubler et al (1996), solid waste is defined to include refuse from household, non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals), market waste, yard waste and street sweepings. Solid waste includes disposal of normal solid or semisolid materials, resulting from human and animal activities, that are useless, unwanted, or hazardous and which seek to minimise the health, environmental and aesthetic impacts of the environment. Many people feel that solid waste management is a simple affair - simply putting waste into a vehicle and unloading it at a dump. If this were true, then why do so many towns suffer from uncollected refuse blocking streets and drains, harbouring flies and rats, and degrading urban environments? Successful solid waste management is rarely achieved without thought, effort and much learning from mistakes.

According to a United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face after unemployment is unsatisfactory solid waste disposal (UNDP, 1997). Solid waste management could not be limited to dealing only with refuse material that has been produced. The approach must incorporate a proactive dimension in order to reduce not only the amount of waste generated or discarded, but also to redirect the minds and behaviours of populations towards a new level of positive participation in maintaining the environment in a healthy and aesthetically satisfactory conditions (Thomas-Hope, 1998).

In the past, solid waste management consisted of gathering the wastes in the open dumps with no protection. According to Dhanuja (2006), the final disposal of waste is the most neglected aspect of municipal solid waste. He observed that the most common method of disposal in developing countries is open dumping which contravenes all accepted landfill principles. Solid waste management includes all activities that seek to minimize the health, environmental and aesthetic impacts of solid waste (Zhu et al, 2008). The current problems associated with solid waste management lie not only in the increased quantities and greater urban concentrations of the waste generated but also in the varieties of the waste which have to be managed, and in transitional potential for contamination (Thomas - Hope, 1998).

To Zhu et al (2008), a typical waste management system in a low or middle - income country includes the following elements:

- Waste generation and storage;
- Segregation, re-use and recycling at the household level;
- Primary waste collection and transport to a transfer station or community bin;
- Street sweeping and cleansing of public places;
- Management of the transfer station of public places;
- Management of transfer station or community bin;
- Secondary collection and transport to the waste disposal site;
- Waste disposal in landfills; and
- Collection, transport, and treatment of recyclables at all points on the solid waste pathway (collection, storage, transport and disposal).

For Schubler et al (1996), the scope of Solid waste management system encompasses the following functions and concerns:

- Planning and management (strategic planning, legal and regulatory framework, public participation, financial management (cost recovery, budgeting, accounting, etc), Institutional arrangements (including private sector participation), and disposal facility sitting;
- Waste generations (waste characterisation, source, rates, composition, etc.), waste minimisation and source separation; and
- Waste handling (waste collection, waste transfer treatment and disposal etc.)

Schubler et al (1996), observe that, waste management system must be absorbed and carried by the society and its local communities. The system must, in other word, be appropriate to the circumstances and problems of the particular city and locality, employing and developing the capacities of all stakeholders, including the households, and communities requiring service private sector enterprises and workers (both formal and informal),

and government agencies at the local, regional and national levels. This statement applies not to methods of disposal but also to the collection of waste and even to the devices for storing them.

The management of solid wastes in today's society are complex because of the quantity and diverse nature of wastes, the development of sprawling urban areas, the funding limitations for public services in large cities, the impacts or technology, and the emergency limitations in both energy and raw materials (Tchobanoglous et al, 1993). According to the World Development Report (1992), many cities generate more solid wastes than they can collect or dispose off and the volume increases with income. This means that as the cities keep on expanding with associated changing lifestyle in relation to income of the people, the wastes continue to pile up. The 1992 World Development Report states that in low and middle-income countries, municipal waste services often swallow between fifty and a half of a city budgets.

In many developing countries, domestic waste contains a large proportion of inert materials such as sand, ash, dust, and stones, and has high moisture levels because of the high usage of fresh and vegetables. The importance of organic, biodegradable component of municipal solid waste cannot be overemphasized. Not only because it constitutes a sizable fraction of the solid waste generated in developing country but also because of its potential adverse impacts on public health and the consequences on the environment (Schübeler, 1996). One major adverse impact is its attraction of rodents and vector insects, for which it provides food and shelter. These impacts are not confined merely to the disposal site; they pervade the surrounding and anywhere that waste are generated, spread, or accumulated. Unless organic waste is managed appropriately, its adverse impact continues until it has fully decomposed (Zhu et al, 2008). Waste that contains high proportion of moisture or is mostly inert material is not suitable for incineration, ruling out one treatment option. According to Zhu et al (2008), domestic waste from industrial countries has a high content of packaging made of paper, glass and metal, so the waste has low density.

Collection of waste is a complex and dynamic service which requires continuous iterative and integrated planning. Each city is a unique case. Its refuse differs in quantity and character from that of other cities. Furthermore, the physical setting of its dwellings and streets and the socio-cultural attitudes of residents dictate the extent to which it can move from labour - intensive systems to those that are more mechanized (Holmes 1984). According to Tchobanoglous et al (1993), the functional elements of collection, as used includes not only the gathering of solid waste and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle, or a landfill disposal site. Full waste collection coverage is a key to a hygienic environment, uncollected waste remains in the neighbourhood attracts pathogens and pollutes waterways. This situation leads not only to risks but also constitutes a public eyesore and negatively affects the economic development.

According to Ohwande (1984), transportation of refuse to disposal sites is very important aspect of refuse collection activities. Refuse transportation may be very difficult, unless it is properly programmed, it will adversely affect the sanitary disposal of refuse. This problem normally occurs when there is no access route or the roads are so congested that conventional collected method of waste are nearly impossible. Many factors make efficient refuse transportation difficult in many developing countries. Some of these factors are; the nature of the refuse; the traffic situation; shortage of funds; and haulage distance. Motor vehicles, railroads, and ocean-going vessels are the principal means now used to transport solid wastes.

According to Schübeler et al (1996), municipal solid waste management is a major responsibility of local governments, typically consuming between 20% and 50% of municipal budgets in developing countries. In recent times solid waste management has attracted increasing attention from bilateral and multilateral development agencies, due to the mounting urgency of urban environmental problems. The safe and reliable long term disposal of residues is an important component of integrated waste management. Solid waste residues are waste components that are not recycled, that remain after processing at a materials recovery facility, or that remain after recovery conversion products and / or energy (Tchobanoglous et al, 1993). The methods for solid waste disposal or management depend on many factors such as the nature of the waste, availability of land space, technology, labour, the local condition and the environment. Among the various means of disposal of solid waste are land filling, incineration and composting.

3. Methodology

In order to achieve the intended purpose for this project, the researchers used a descriptive survey design aimed at determining solid waste management in Komenda - Edina - Eguafo - Abirem Municipal Area. The population for the study was the sanitation workers, the market women and the residents within the KEEA Municipality. The sanitation workers have the sole responsibility of taking care of sanitation issues in the community. They are therefore in a position to tell what problems they face. Residents in households and market women within the community are part of the target population because they produce waste.

The researchers selected all the six electoral areas in the KEEA Municipality which are referred in this study

(Elmina, Ntranoa, Ayensudo, Eguafo, Komenda and Kisi). Two communities were selected at random from each of the electoral zones. From each community, 10 respondents in a household were randomly selected. These are also largely homogeneous communities with respect to culture and economic activities (mainly fishing and farming). Ten market traders were also randomly sampled from the major markets for the study. Although 120 community residents were targeted for the study, only 112 (representing 93.3%) households completed the questionnaire. Details of the communities and the number of respondents selected are shown in Table 1.

Table 1 Population and Sample Selected

Electoral zone	Community	Community residents sampled	Market traders sampled	Assembly workers sampled	Zoomlion workers sampled
Komenda	Komenda	10	10	2	2
	Abrobiano	10			
Ayensudu	Ayensudu	10	10	2	2
	Brenu Akyinim	10			
Kissi	Kissi	10	10	1	1
	Antadu	10			
Eguafo	Abreshia	10	10	2	2
	Braso	10			
Elmina	Teterim	10	10	2	2
	Neizer Gardens	10			
Ntranoa	Ntranoa	10	10	1	1
	Ankaful	10			
Total		120	60	10	10

Source: Field work, 2012

Purposive sampling was used to select the assembly workers and Zoom Lion workers. The structure of the study demands a carefully targeted sample of residents in the municipal area. To get accurate and reliable information, the researchers used questionnaires, interviews and observation as instruments for acquiring information. The questionnaires were administered to both sanitation workers and selected individuals who can read and write. Some sanitation workers and the selected individuals were also interviewed to assess how solid waste is managed in the communities. The sanitation workers were observed while they engage in their duties. The questionnaire had close-ended and open-ended items. The closed-ended items have responses from which the respondents were asked to choose the one that applied to them. Space was provided for additional comments. The interview provided information such as how wastes generated in the communities are disposed off. With regard to the observation, the researchers visited some of the wastes disposal sites for first-hand experience. Simple percentages and averages were used to analyse the data. It was grouped into frequencies, and percentages. The emerging relationships between the variables, and conclusions were based on frequencies and percentage. In an attempt to give meaning to the research findings, the outcome of the interviews and the observations were triangulated with the outcome of the questionnaires administered.

4. Results and Discussion

The objective of the study sought to assess solid waste generation, collection and transportation. The main issues addressed in this section were; types of solid waste generated, collection of solid waste and transportation of solid waste.

4.1 Types of solid waste generated

With respect to types of solid waste generated, respondents were asked to indicate the main types of solid waste generated in the municipality. Table 2 shows the distribution of respondents by types of solid waste generated in the district. It can be seen from Table 2 that, most respondents (57.8%) revealed that plastic is the main type of solid waste generated in the district, followed by food items and paper in that other. Observation and interviews conducted revealed that wastes generated are not segregated into plastic, metal, food, papers etc. The mixed up will even make recycling difficult. The implication of the many plastic waste generated is that when these end up in the refuse dump and find their way into the soil they stay there for a longer time before decaying, and therefore reduce the soil's fertility and/or impede plant growth. Another serious treat these plastic materials posse to the environment is that farm animals and even fish choke to death when they mistake plastic for food. Small plastic containers such as empty margarine and pomade containers collect rainwater that serves as breeding sites for mosquitoes.

Table 2: Distribution of Respondents and Types of Solid Waste Generated

Waste	Community Residents		Assembly Workers		Zoom Lion Workers		Traders		Total	
Type	N	%	N	%	N	%	N	%	N	%
Plastic	63	32.8	6	3.0	7	3.6	35	18.3	111	57.8
Paper	15	8.0	1	.50	2	1.0	8	4.0	26	13.5
Food*	34	18.0	3	2.0	1	.50	17	9.0	55	28.7
Total	112	58.8	10	5.5	10	5.5	60	31.3*	192	100.0

*Rounding of error
*Food items
Source: Field work, 2012

4.2 Collection of Solid Waste and Disposal of Waste

This section presents findings on the collection and disposal of solid waste in the municipal. Table 3 presents findings on where solid wastes are disposed in the municipal. Table 3 reveals that majority, 118 (61.4%) of the respondents indicated that refuse was sent to open dump sites after collection. Others were of the opinion that refuse was burnt, whilst the rest mentioned Zoomlion bins as final place of disposing their waste after collection. It can be seen from Table 3 that open dump of refuse is the main method of disposing off refuse in the municipal. The majority (118 or 61.4%) of respondents mentioning of open dump method of disposing of solid waste is supported by Dhanuja's (2006) view that the most common method of waste disposal in developing countries is open dumping. This implies that solid wastes in the district were mainly burnt than re-used.

Table 3: Where refuse is sent to after collection

Response	Frequency	Percentage
Zoomlion bins	12	6.3
Final disposal sites	12	6.3
Open dump	118	61.4
Burnt	50	26.0
Total	**192**	**100.0**

Source: Field work, 2012

4.4 Frequency of Collection of Waste

It can also be seen in Table 4 below that 142 (74%) of the 192 respondents indicated that they emptied their refuse every morning. This is normally done to avoid its potential adverse impacts on public health and the consequences on the environment. According to Zhu et al (2008), one major impact is its attraction of rodents and vector insects, for which it provides food and shelter. This shows that there is the need to avoid health related diseases by emptying our dustbins every morning or when it is full.

Table 4: Frequency of Collection of Waste

	Households		Assembly Workers		ZoomLion Workers		Traders		Total	
Frequency	N	%	N	%	N	%	N	%	N	%
Every morning	102	53.1	6	3.1	2	1.0	32	17.0	142	74.0
Twice a day	0	0.0	4	2.0	3	1.5	7	3.6	14	7.3
When the waste bin is full	10	5.0	0	0.0	5	2.6	21	10.9	36	18.8
Total	112	58.8	10	5.2	10	5.1	60	31.5	192	100.0

Source: Field work, 2012

4.5 Mode of Refuse Collection

With respect to the mode of refuse collection, it is clear from Table 5, that the majority (82.3%) respondents revealed that human powered equipment was used to collect refuse in the municipality. This means that more human beings are used in the collection of solid waste in the municipality. According to Schübeler et al (1996), human-powered collection equipment includes paddle tricycles, wheel barrows, and two wheeled dollies with baskets. Holmes (1984) believes that human powered equipment is useful in neighbourhoods with limited access to main roads. This means that for solid waste collection to be effective in the municipality there is the need to incorporate proper laid out settlement so that motorised collection vehicles such as tractors with wheeled containers or trailers that hydraulically lift containers, with cranes onto their flat bed for transports to disposal areas could be used.

Table 5: Category of Respondents and Mode of Refuse Collection
Source: Field work, 2012

Mode of refuse collection	Community residents		Assembly workers		Zoom-Lion		Traders		Total	
	N	%	N	%	N	%	N	%	N	%
Human powered	100	52.1	8	4.1	9	4.6	41	21.3	158	82.3
Motorised collection	12	6.2	2	1.0	1	0.5	19	10.0	34	17.7
Total	112	100.0	10	100.0	10	100.0	60	100.0	192	100.0

4.6 Persons Responsible for Collection of Waste to Final Disposal Sites

It can also be seen from Table 6 below that the largest group of respondents, 66 (34.4%) indicated that assembly workers were those who collected waste to final disposal sites. The remaining respondents disclosed that community members and Zoomlion workers collected waste to the final disposal sites. For some respondents to mention ZoomLion workers as the persons responsible are a clear indication of the popularity of the waste collection company in the municipality. The findings supports Schübeler et al (1996) that municipal solid waste management is a major responsibility of local governments, typically consuming between 20% and 50% of municipal budgets in developing countries.

Table 6: Category of Respondents and Persons Responsible for Collection of Waste to Final Disposal Sites

Person responsible	Community residents		Assembly workers		Zoom-Lion		Traders		Total	
	N	%	N	%	N	%	N	%	N	%
Community	37	19.2	1	0.5	1	0.5	24	12.5	63	32.8
Assembly	34	17.7	1	0.5	1	0.5	30	15.6	66	34.4
ZoomLion	41	21.3	8	4.1	8	4.1	6	3.5	63	32.8
Total	112	58.2	10	5.1	10	5.1	60	31.6	192	100.0

Source: Field work, 2012

4.7 Transportation of Solid Waste

The frequency of transporting solid waste and how efficient it is done in the municipality was also investigated. As can be observed from Table 7, the frequencies of transporting refuse in the municipality as at the time of the study included every morning or twice a day or when the refuse container was full.

Of the 192 respondents, 148 (77.1%) of them disagreed that transportation of refuse to the final disposal site was not efficient. This implies that many people were not satisfied with the transportation of refuse in the municipality. With refuse transportation, Ohwande (1984) states that it may be very difficult unless it is properly programmed, else it will adversely affect the sanitary disposal of refuse. To him, this problem normally occurs when there is no access route or the roads are so congested that conventional collected method of waste are nearly impossible. This suggests that many factors make efficient refuse transportation difficult in many developing countries and which some may be the nature of the refuse; the traffic situation; shortage of funds; and haulage distance.

Table 7: Frequency and Efficiency of Transporting Refuse to Final Destination Site

	Frequency							
	Every morning		Twice a day		When full		Total	
	N	%	N	%	N	%	N	%
Efficiency								
Yes	17	8.8	8	4.1	19	9.8	44	22.9
No	59	30.7	28	14.5	61	31.7	148	77.1
Total	76	39.5	36	18.6	80	41.5	192	100.0

Source: Field work, 2012

4.8 Type of Vehicle Used for Transportation of Solid Waste to Final Destination Site and their Ownership

Table 8 below displays the type of vehicle used for transporting solid waste to the final disposal sites and their ownership. For the purpose of this study the type of vehicle use was designated as big and small while the Municipal Assembly and the Zoomlion Ghana limited are the owners of the vehicles. The small vehicles are made up of fifty tri-cycles, whilst the big vehicles are made up of three Skip trucks and two Roll-off. From Table 8, Zoomlion has a total of 53 (96.4%) vehicles. These are made up of fifty small vehicles (tri-cycles) and three big vehicles (two Skip trucks and one Roll-off). The municipal assembly has two (3.6%) big vehicles which are made up of one skip truck and one roll-off.

Table 8: Types of Vehicle Used and Ownership

	Zoomlion		Municipal Assembly		
Vehicle	N	%	N	%	Total %
Small Size	50	100	0	.0	50 100
Big Size	3	60.0	2	40.0	5100
Total	53	96.4	2	3.6	55 (100)

4.9 Problems Associated With the Transportation of Solid Waste

Table 9 below displays the problems associated with the transportation of solid waste. It is clear from Table 9 that 96 (50%) respondents thought that shortage of funds was reported as the problem. This suggests that solid waste piles up for days or even weeks before being transported to the final disposal sites. The health implications of this practice are not far fetched.

For the rest of the respondents, 61 (31.8%) said the nature of refuse transported to final disposal sites was the problem. As regard to the problem haulage distance, 35 (18.2%) respondents agreed to that. Problems associated with transportation of refuse to final disposal sites, the results in Table 8 show that it does not really matter whether a big or small vehicle was used as over 30 per cent of respondents in each case reported nature of refuse and over 18 per cent indicated haulage distance as the problems. The nature of refuse and haulage distance can also be seen as funding related problems. Hence it can be said that funding is the main problem militating against smooth transportation of refuse to the final disposal sites. The problems associated with the smooth transportation of refuse to the final disposal sites suggest the need for Municipal Authorities and/or Government and communities to invest in the transportation of refuse to final destination sites.

With the nature of refuse transportation, Schübeler, (1996) said that in many developing countries, domestic waste contains a large proportion of inert materials such as sand, ash, dust, and stones, and has high moisture levels because of the high usage of fresh vegetables. The importance of organic, biodegradable component of Municipal solid waste cannot be overemphasized. This shows that transportation of refuse to the final disposal site has potential adverse impacts on public health and the consequences on the environment.

Table 9: Problems Associated with Transportation of Refuse to Final Destination

Problems	N	%
Shortage of funds	96	50.0
Nature of refuse	61	31.8
Haulage distance	35	18.2
Total	192	100.0

Source: Field work, 2012

4.10 Disposal of Solid Waste

With regard to the disposal of solid waste in the municipality, Figure 1 emphasised that most respondents (62%) reported that solid waste in the municipality were transported to the final destination sites. The rest, (38%) of the respondents reported that solid waste were disposed off by means of transportation to the transfer stations, buried and burnt, with burning being the next common method. The disposals of solid waste in the municipality as perceived by the respondents suggest that all waste materials be transported far away from where they were generated so as to minimise any unforeseen health risks.

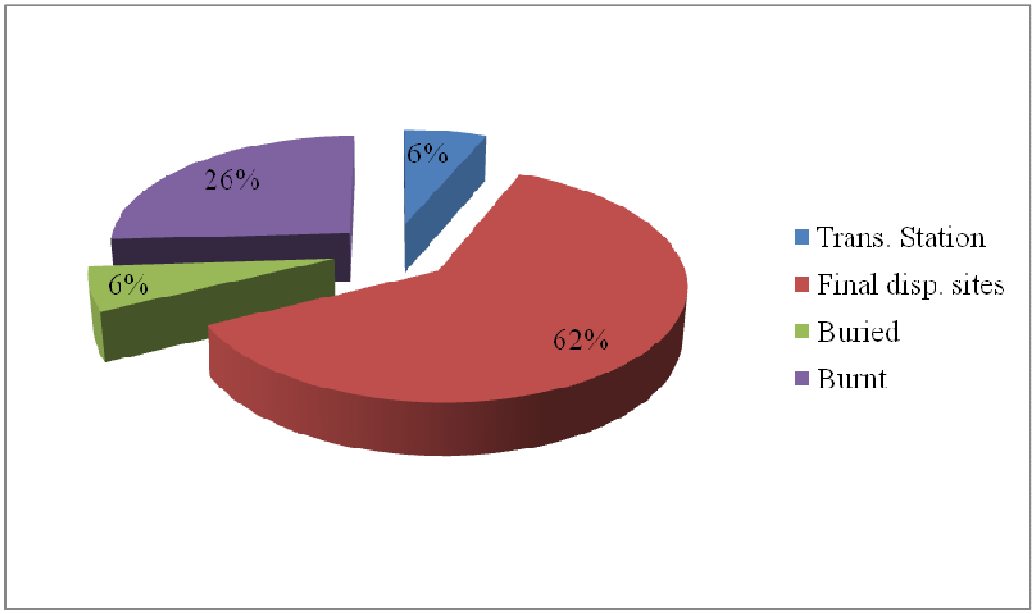

Figure 1: Mode of Refuse Disposal after Collection
Note Total respondents = 192
Key: trans.-transfer
Source: Field work, 2012

4.11 Methods of Refuse Disposal and Satisfaction

The methods of refuse disposal and satisfaction with the methods in the municipality were also investigated. Table 10 below shows that the methods of refuse disposal in the municipality included open-dumping, composting, incineration, landfill and recycling. Respondents were to indicate whether they were satisfied or dissatisfied with the methods.

Of the 192 respondents, 128 (66.7%) were dissatisfied with the methods of refuse disposal in the municipality. With particular reference to open dumping 88 (45.8%) respondents were dissatisfied with the method, whilst 20 (10.4%) respondents were not in favour of composting. Forty-four (22.9%) of the respondents claimed they were satisfied with composting as a method of refuse disposal. Apart from that, 10 (5.2%) respondents were satisfied open dumping. This suggests that the recommended method of refuse disposal in the municipality is composting followed by open dumping.

To Botkin and Keller (1998), composting is a process of rapid and partial decomposition of moist solid and organic waste, by aerobic organism. As a waste management option, composting is done on a large scale and is generally carried out in a controlled environment of mechanical digesters. To them, the finished product, which looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants. This implies that communities throughout the world should be encouraged to compost biodegradable refuse as humus in their gardens since compost allows the soil to retain more plant nutrients over a longer period. To support this Botkin and Keller (1998), suggested that apart from composting being clean, cheap, and safe, it can significantly reduce the amount of disposable garbage. The organic fertilizer can be used instead of chemical fertilizers and is better specially when used for vegetables. It increases the soil's ability to hold water, makes the soil easier to cultivate and helps the soil to retain more of the plant nutrients.

Table 10: Methods of Refuse Disposal and Satisfaction

Satisfaction	Open dumping		Composting		Incineration		Landfill		Recycle		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Satisfied	10	5.2	44	22.9	1	0.5	5	2.6	5	2.6	64	33.3
Dissatisfied	88	45.8	20	10.4	1	0.5	9	4.7	9	4.7	128	66.7
Total	98	51.0	64	33.3	2	1.0	14	7.3	14	7.3	192	100.00

5. Conclusions

With respect to the generation, collection, transportation of solid waste in the municipality, it was concluded that:

- Apart from plastic which is non-biodegradable, domestic (food) waste were indicated as the next solid waste found in the district. Solid wastes generated were not segregated into plastic, metal, food, etc.
- Most of the people in the municipality empty their refuse by themselves every morning.

- The main mode of refuse collection was through human powered equipment in the municipality.
- Transportation of refuse to the final disposal site was not efficient. Factors that make efficient refuse transportation difficult include the nature of the refuse, shortage of funds, and haulage distance. People were not satisfied with the transportation of refuse in the municipality.
- Most of the people were dissatisfied with the methods of refuse disposal in the municipality, with particular reference to open dumping. Open dumping is the main method of refuse disposal; solid wastes in the district were mainly burnt than re-used.

6. Recommendations

The government should consider engaging some organisations or individuals with expertise in recycling, since solid waste can be segregated into plastic, paper, food, and metals. This can be recycled to bring about many benefits. More sanitation workers should also be employed to support the present work force to clean the municipality.

Residents and market traders in the municipality should adopt compositing as a way of solid waste disposal since compost reduces the emission of greenhouse gases in the environment. It is also eco-friendly, increases soil fertility which can replace fertilizers, and free from chemicals. Residents should desist from open dumping of refuse.

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