



Research Paper

Assessment of Impediments and Factors Affecting Waste Management: A Case of Accra Metropolis

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ABSTRACT

Municipal solid waste management in Accra Metropolitan Assembly is at present delivered in an unsustainable manner. Due to uncontrolled urbanization, large quantities of waste are generated daily in Accra and this exerts much pressure on an over strained solid waste management system. Coupled with weak institutional capacity and lack of resources, both human and capital, the city authorities face difficulties in ensuring that all the waste generated in the city is collected for disposal. Home collection of waste is limited to high and some middle income areas while the low income and unplanned settlements are not given good attention. This leads to indiscriminate disposal of waste in open drains, canals and streams and unauthorized places, creating unsanitary and unsightly environments in many parts of the city. The study showed that about 60% of household waste is organic materials which has the potential to be converted to compost for agricultural purpose. Meanwhile, plastics and rubbers which litters the environment as well as blocking major storm drains and gutters, hence, creating huge environmental hazard is made of 11% of the total component of most household waste generated daily. The study also revealed that the among the methods of disposing waste, dumping waste in skip containers located at authorized places was the preferred means of disposing waste by household though others also dispose waste by other means such as burying and burning. Inadequate skip containers per population of household in an area coupled with irregularity of tracks picking these containers makes skip containers dumping site ugly scene, hence, creating health issues. Among the constraints that impact negatively on sustainable waste management in Accra Metropolis, economic constraints was perceived as the main challenge which affect efficient waste management, as currently the country is going through serious economic challenges as a result, the government does not release money timely to fund projects of which waste management is the key. Most donor partners that use to support the government with funds have either reduced or redrawn their services as they have no confidence in the state of Ghana economy. Aside the constrains, the study also indicated that factors such as poor public attitude towards waste management, poor enforcement of sanitation by-laws, inadequate and untimely release of government funds were also seen as the main factors affecting waste management.

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INTRODUCTION

As urbanization continues to take place, the management of solid waste is becoming a major public health and

environmental concern in urban areas of many developing countries. The concern is serious, particularly in the capital

Table 1: Communities in Accra Metropolis.

Communities	Estimated population
Darkuman	89245
Mpoase	66987
Mamprobi	96788
Chorkor	64945
Kaneshie	75615
Accra Central	63432
Kotobabi	54789
Osu	52654
Achimota	67986
Shiashie	59642
Adabraka	81964
Ridge	48462
Kwashieman	83792
Mallam	68,267
Nima	84586
Awoshie	68583
North Dzorwulu	75893
Korle Gonno	64621

Source: Ghana Statistical Service.

cities, which are often gateways to the countries for foreign diplomats, businessmen and tourists. Poor visual appearance of these cities will have negative impacts on official and tourist visits and foreign investment. Recognizing its importance, a number of developing countries have requested collaboration of external support agencies, both bilateral and multilateral, in improving solid waste management in their cities in the last 20 years or so. Although, some projects succeeded in providing lasting positive impacts on the management of solid waste in the recipient countries and cities, many failed to continue activities after the external support agencies ceased their support as a result of challenges that underpin the project.

Governments in most developing countries have resorted to using their own money to fund waste management projects as external support for waste management is now unsustainable. Unsustainability waste management projects is due to various technical, financial, institutional, economic and social constraints faced by both the recipient countries/cities and external support agencies. Therefore, in order to ensure the sustainability of collaborative projects, the various constraints of both developing countries and external support agencies should be carefully examined so as to get suitable solutions aiming at addressing waste management challenges.

Accra is the capital city of Ghana (Table 1). Its population of 2,291,352 generates about 2,000 tons per day (TPD) of municipal solid waste (MSW), of which over 75% is collected and transported to the Tema dump site at a cost of US\$ 4.45 million per year (GHS 7.7 million). The non-collected waste is openly burnt or dumped in storm water and sewage water drains by residents. Open burning of waste is common even in high income communities due to distance to skip sites or authorized dumping sites.

In 2014, the Accra Metropolitan Authority (AMA) spent

82% of its internally generated funds (IGF) on solid waste management. Most of this funding was spent on collection and transportation. Waste is collected using different types of vehicles such as tricycle, small trucks and large trucks with or without compactors. The major reasons for poor waste collection coverage are due to inadequate or late payment of operational funds and ineffective monitoring of performance of private contractors. Among other attempts to increase collection coverage, currently there is AMA and Zoom lion collaboration project to provide plastic waste containers to individual households for free. However, this project may not achieve its main objective as some households have turned their new dustbins for storage facility.

Over the last ten years, AMA has used at least seven temporary dumping grounds within the city perimeter to dispose the city's solid waste, thus, creating dangers to public health and the environment. This led to public outrage, hence, compelling AMA and Environmental Protection Agency (EPA) to close the last in-city landfill site at Achimota a suburb of Accra. All dump sites which were located inside the city severely impacted public health, the environment and quality of life. Accra city has a history of public confronting authorities that oppose the disposal of wastes in their neighborhood. The city is now served by the new Tema sanitary landfill, located at Kpone, 30 km from the city center. This facility was constructed and operated by Zoom lion Ghana.

STATEMENT OF THE PROBLEM

A typical solid waste management system in a developing country displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities. These public health, environmental and management problems are caused by various factors which serve as constraints to the development of effective solid waste management systems.

Waste collection in Accra is divided into two parts: 80% of the city's waste collection is handled by private contractors, whereas the other 20% is handled by AMA's WMD. In 1992, soon after the start of economic reforms in Ghana, a pilot project initiated by World Bank started privatization of waste management in Accra. The percentage of private waste collection has since increased from nearly 11% to the current level of 60% of all waste generated. Simultaneously, due to population increase and urbanization, the waste collection coverage in Accra has increased from 51% to the current level of 70%. The Waste Management Department (WMD) under AMA is unable to fulfill its obligation of collecting 30% of the city's waste due to inadequate funds, poor technology and other socio-economic constraints, hence, generating

environmental hazards (Osei, 2010). As a result of poor waste management, flooding, malaria and outbreak of cholera is common in Accra Metropolis.

Waste is collected using different types of vehicles ranging from manually driven tricycles, small trucks equipped with compactors, large trucks and large trucks equipped with compactors. The company Zoom Lion (ZL) used tricycles to access areas with narrow lanes and small trucks to access hilly regions with narrow lanes. Large trucks equipped with compactors were used in places like vegetable markets and corporate areas which generate large quantities of waste every day. Adjei et al. (2013) in their study reported that the city of Accra generates about 2,000 tons per day (TPD) of solid waste, out of which 70% is collected and transported to Tema dump site at a cost of US\$ 3.45 million per year (GHS 6.7 million) (12 km by road from the city centre). Uncollected waste is openly burnt or dumped in storm water and sewage water drains. Open burning of waste is common even in high income communities.

Solid waste management has over the years been a challenge among city authorities in Ghana. Particularly in the two big cities (Accra and Kumasi) in Ghana, where over 4,000 tons of solid waste is generated daily. Waste management departments still grapple with the collection of this huge amount of solid waste. Undoubtedly, the capacity of AMA and Zoom Lion has been greatly overwhelmed by the ever-increasing amounts of waste in the Metropolis. Consequently, heaps of solid wastes are common sights in the cities mostly near market centers and low income areas. This presents a host of problems as these huge piles of waste pose grave risks to human life and the environment as well. Although, numerous researchers attributed this principally to lack of resources and weak institutional capacities, there seems to be some disregarded factors that also contribute substantially to the status. It is in this regard that the research seeks to find out the main constraints and factors impeding waste management in Accra Metropolis.

Solid waste management is the process of collecting, storing, treatment and disposal of solid wastes in such a way that they are harmless to humans, plants, animals, the ecology and environment generally. Solid waste can be defined as "any substance or object in solid form which the holder discards or intends to discard. The 'holder' can either be the producer of the waste or be in possession of the waste (Chalam et al., 2009). Waste, however, is very subjective; one person may deem an item to be waste whilst another might see it as a resource (Williams, 2005). Research by Hristovski et al. (2007) also highlighted due to resource appraisal what seems to be waste could be a resource to another person depending on the technology or skill one has to convert that into a useful product for human use. The way solid waste is managed for different types of sectors is important as the nature of each industry or sector varies. The dynamic nature of consumer/end user products, packaging materials, environmental

regulations and public attitudes has made the development of solid waste management strategies an increasingly complex task (DEA, 2012).

The existence of waste pickers/scavengers creates often an obstacle to the operation of solid waste collection and disposal services mostly because their activities scatter gathered refuse and the lighter refuse like the polythene bags fly away. However, if organized properly, their activities can be effectively incorporated into a waste recycling system (Osei et al., 2010). Such an opportunistic approach is required for sustainable development of solid waste management programmes in developing countries where technology of reuse or recycling is still low.

As a result of a low priority given to the waste management sector, the institutional capacity of local government agencies involved in solid waste management is generally weak, particularly in small cities and towns. Local by-laws on solid waste management is not also well enforced and as a result, people who dump waste at unauthorized places are not punished to deter others from that act. Local government institutions are not provided with clear mandates and sufficient resources to fulfill their mandatory objectives. In large metropolitan areas where there are more than one local government, co-ordination among the local governments is critical to achieve the most cost-effective alternatives for solid waste management in the area. For instance, the siting of a solid waste transfer station or disposal facility for use by more than one local government is cost-effective due to its economy of scale. However, as these facilities are usually considered unwanted installations and create not-in-my-backyard (NIMBY) syndromes among the residents, no local government is willing to locate them within its boundary. The lack of a co-coordinating body among the local governments often leads to disintegrated and unsustainable programs for solid waste management.

Good waste management system must involve all stakeholders from the local level to the national level to enhance collaboration. As most Africa countries continue to dispose about 80% of solid waste at landfill sites and recycling only about 20%; there is the need for good outline procedure in the waste management sector, starting from sensitization of residents about the need to dispose waste in appropriate manner so as to make collection and transfer to final disposal site easy, environmentally friendly and cost-effective (Sanko, 2012).

According to UNEP (2013), sensitization of local residents should include encouraging separation of waste into recyclable and non-recyclable for easy disposal and recycling. Furthermore, equipment such as dustbins, disposal tracts with or without compactors, tricycles, skip containers and other tools that contribute to efficient solid waste management should be supplied regularly and obsolete ones replaced. Fuel allocations and maintenance should be properly planned to ensure regular waste collections. The new paradigm shift framework which researchers and many international organizations deem



Figure 1: Integrated solid waste management hierarchy.

feet to curb high rate of waste generation globally should follow the following trend: (1) Prevent the production of waste or reduce the amount generated; (2) Reuse the toxicity or reduce the negative impact of waste generated; (3) Reuse in their current forms the material recovered from the waste stream; (4) Recycle, compost or recover materials for use as direct or indirect inputs for new products; (5) Recover energy by incineration, anaerobic digestion or similar process; (6) Reduce the volume of waste prior to disposal; (7) Disposal of residual solid waste in environmentally sound manner, generally landfills. Figure 1 gives a clear picture of the new paradigm shift that serve as framework of many international organizations and governments globally.

Theoretical framework of the study

It is important to recognize that, the major portion of solid waste comes from domestic sources. However, its proper disposal depends heavily on availability of skips containers, dustbins and attitudes of the people. The waste that is disposed of from the households has to be collected and transported for final disposal. Poor co-ordination between major partners or stakeholders in waste management industry leads to the selection of inappropriate technology in terms of the local climatic and physical conditions, financial and human resource capabilities and social or cultural acceptability (Okot-Okumu, 2012) (Figure 2). This can lead to inefficiency

thereby, wasting the resource allocations and making the project unsustainable. The framework adopted by this study is that, there should be co-ordination among all the stakeholders directly or indirectly involving in waste management, starting from the source of waste generation (household) to the landfill site or recycling plant. This implies that, for proper functioning of any solid waste management project to achieve its objective, the main component of the waste management technology used should involve local stakeholders who have knowledge on the kind and nature of waste generated and the local ways of appropriately disposing off the waste. Many solid waste technology is often selected without due consideration to its relevance in the overall solid waste management system. Hence, the coverage of solid waste collection services may be so low that solid waste generated is dumped at many unapproved sites (for example, open areas, water channels and streets, etc).

Efficient waste management systems ensures that all the processes, technology, policies and key stakeholders coordinate effectively to promote prudent solid waste management. The framework perceive waste management as core environmental challenge and should be tackled in a holistically integrated manner, where there would be collaboration among all stakeholders and government so as to create raw materials for industries, energy and compost as well as, creating jobs for the masses. Main source of waste such as household and industries should be collected and properly disposed while stakeholders must also ensure that the appropriate ways of waste

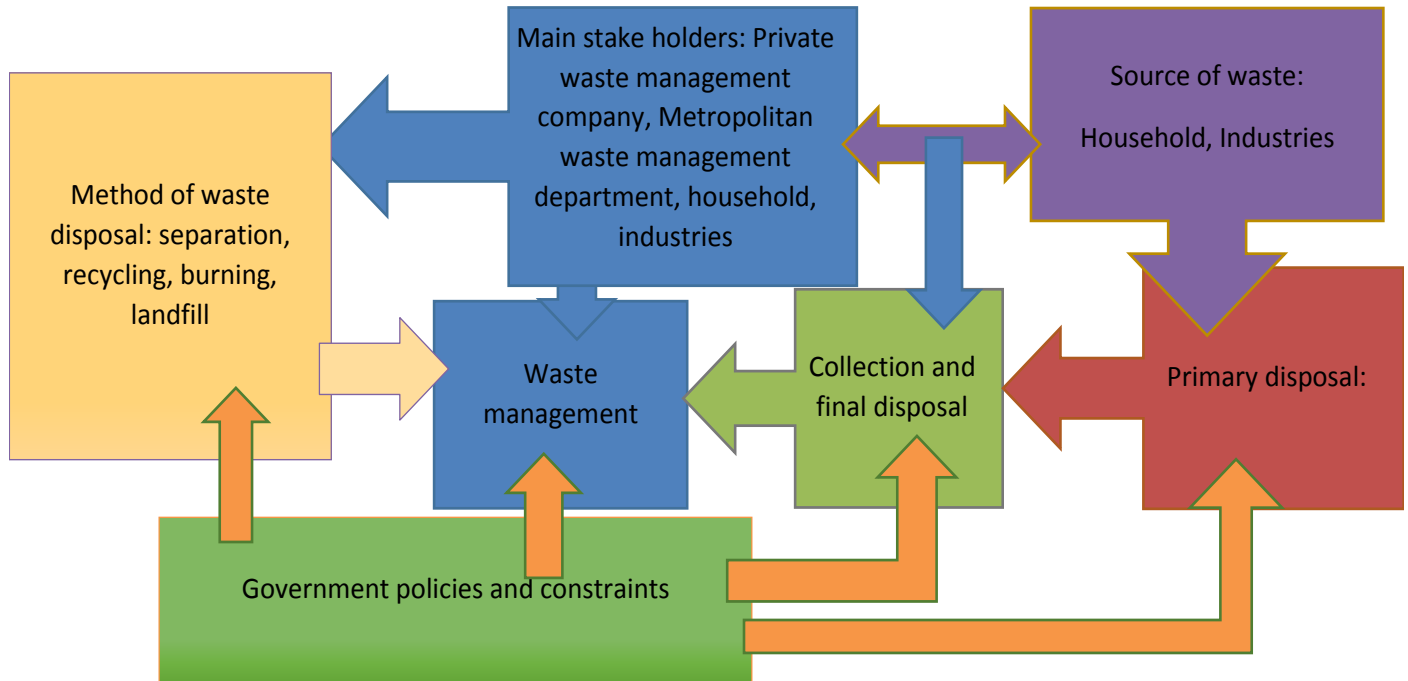


Figure 2: Theoretical framework of the study.

management practices earmarked to enhance efficiency in waste management should not be undermined. Government should also be instrumental in putting policies in place enhancing co-ordination among all the sectors of waste management scheme and also be able to strategically reform any policy within the waste management chain programs that may pose threat to overall waste management system.

Study area

The total population of Accra Metropolis according to Ghana Statistical Service (2014) updated report is 2,291,352 million people made up of 1.188 million females and 1,103,352 males giving a population density of 12 persons/km². It covers a total land area of about 894 km² (345.18 square mile) which is about 25% of the total landmass of the Greater Accra Region. Its population growth rate is 4.2% per annum due to rampant rural urban migration as against 2.7% for the national. The average household size is 10 persons.

The population is dominated by the labor force (15 to 64 years) and small proportion of the elderly persons (above 64). The proportion of population below age 15 is about 44.7% while that of the elderly represents about 6.3%. On the other hand, the proportion of the labor force (between 15 and 64 years) stands at 49% of the total population. The sex composition of the population indicates that there are 49.2% males and 50.8% females in the metropolis. Figures 3 and 4 shows the map of Ghana indicating the

location of Accra Metropolis.

Study design

The study design adopted was a descriptive and analytical sample survey. This design was chosen in view of the fact that the study involves a systemic collection and presentation of data to give a picture of the real situation. The descriptive sample survey was used to give clear understanding of what is happening in Accra Metropolis and the methods used to gather concrete information for analyses and recommendation. It aims at getting information on constraints of waste management in Accra Metropolis. Key Ministries, Departments, Agencies and individuals who matters in solid waste management were contacted for information. The Officers from Accra Metropolitan Assembly, Zoom Lion waste management company as well as, key informants such as assembly men, chiefs, opinion leaders and focused groups were interviewed. Other elements of the sample were women.

Simple random sampling is a sampling techniques in which each member of the sample population has equal chances of being selected. Justification for using simple random sampling is its ease of assembling the sample. It is also considered as a fair way of selecting a sample from a given population since every member is given equal opportunities of being selected. Theoretically, the only thing that can compromise its representations is luck. An unbiased random selection and a representative sample are important in drawing conclusions from the results of a



Figure 3: Map of Ghana (Source: Ghana web).

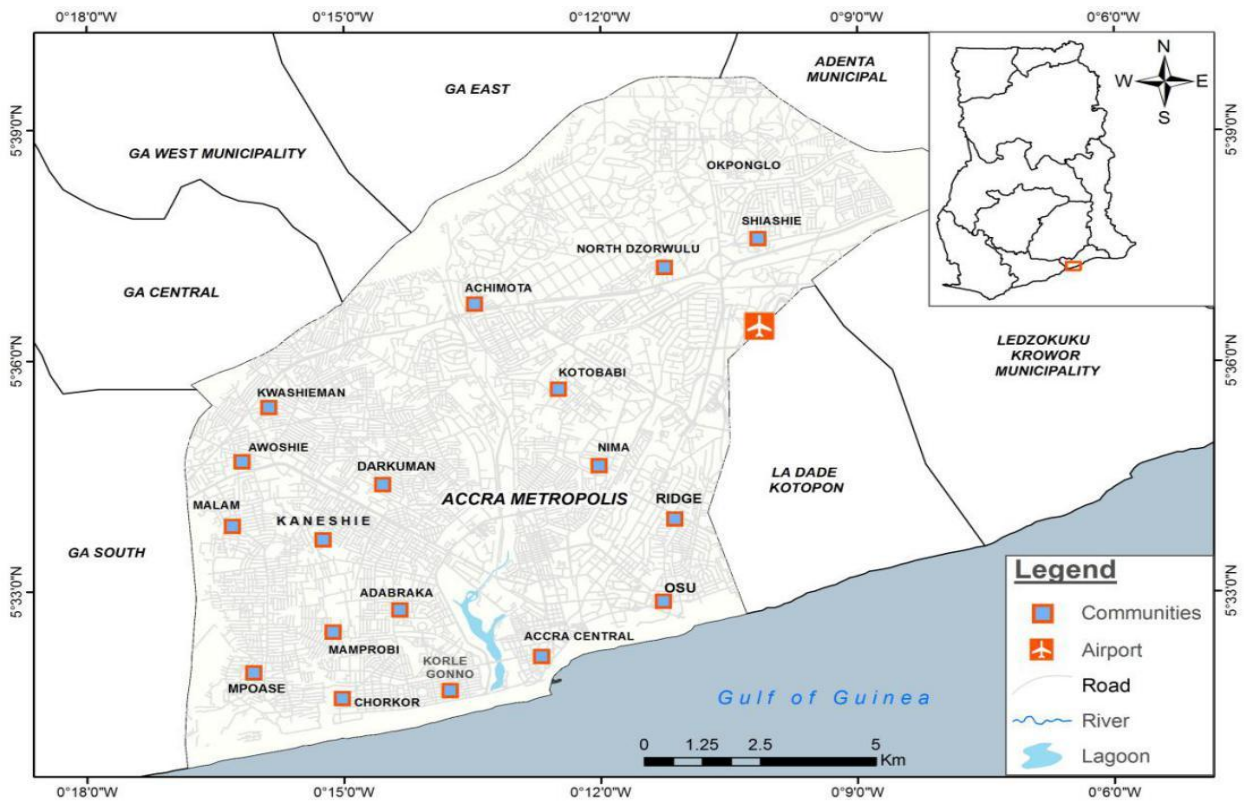


Figure 4: Map of Accra Metropolis (Source: Accra Metropolitan Assembly).

Table 2: Number of sampled population per community.

Sampled area	Estimated population	Number of respondents sampled
Mamprobi	96788	30
Kaneshie	75615	30
Chorkor	64945	30
Korle gonno	64621	30
Darkuman	89245	30
Adabraka	81964	30
Kwashieman	83792	30
Mallam	68,267	30
Ridge	48462	30
Nima	84586	30
Osu	52654	30
Achimota	67986	30

study as the goals of research is to be able to make conclusions pertaining to the population from the results obtained from a sample. Due to the representativeness of a sample obtained by simple random sampling, it is reasonable to make generalizations from the results of the sample back to the population.

Study population and sampling techniques

Target population for the questionnaire survey was women between the ages 20 years and above. This is because they were mostly in charge of sweeping and gathering of all sorts of domestic solid waste in homes and disposing of them. Men were not considered in the survey because in Ghana domestic waste are mostly handled by women.

Sample frame and sample size determination

A total number of (806875) female population between the age group of 15 and 65 was obtained from Ghana Statistical Service (GSS) for AMA. This represented the sample frame of the questionnaire survey. Furthermore, the mathematical method was used to determine the sample size for the survey given as:

$$\text{Formula: } n = N / 1 + N(\alpha)^2$$

Where n =sample size, N =sample frame (806875) and α represented the margin of error which is 0.05 with confidence level of 95%. By substituting 806875 and 0.08 into the formula: $n=399$.

Therefore, the sample size for the survey was three hundred and ninety- nine (399). This was to ensure that the sampled mean was closer to the population mean so as to minimize errors. It is however important to note that the sample size depended on financial resources and the stipulated period of the study. In the light of this, out of the 399 sample size, only 326 respondents participated in the survey.

Methods of data collection

The methods used for collection were In-depth interview, focus group discussion and key informant Interview.

In-depth interview

Three hundred twenty- six (326) respondents comprising 250 household women and 76 traders whose activities leads to waste generation were randomly selected for the interview. Due to the large number interviewed, the study employed four field assistants to help administer the questionnaires under strict supervision. Purposive sampling was used to randomly select respondents from sampled areas (Table 2). The justification for the in-depth interview was to find answers to as many questions as possible leading to the achievement of the study objectives.

Focus group discussions

The focus group discussion was organized for some of the waste management workers consisting of waste collectors, skip site caretakers and staff of waste management company. Respondents were sampled using the purposive sampling method. A discussion guide was designed; it considered research questions and objectives of the study. Justification for the focus group discussions was to ensure that vital information from different sources or group of peoples were obtained.

Key-informant interview

It was also used to obtain information from opinion leaders, officials from the Metropolitan Assembly, Assembly men and waste management company. The key informant interview was to get reliable and relevant information. Face-to-face interviews were used to collect data from the following key stakeholders as far as solid

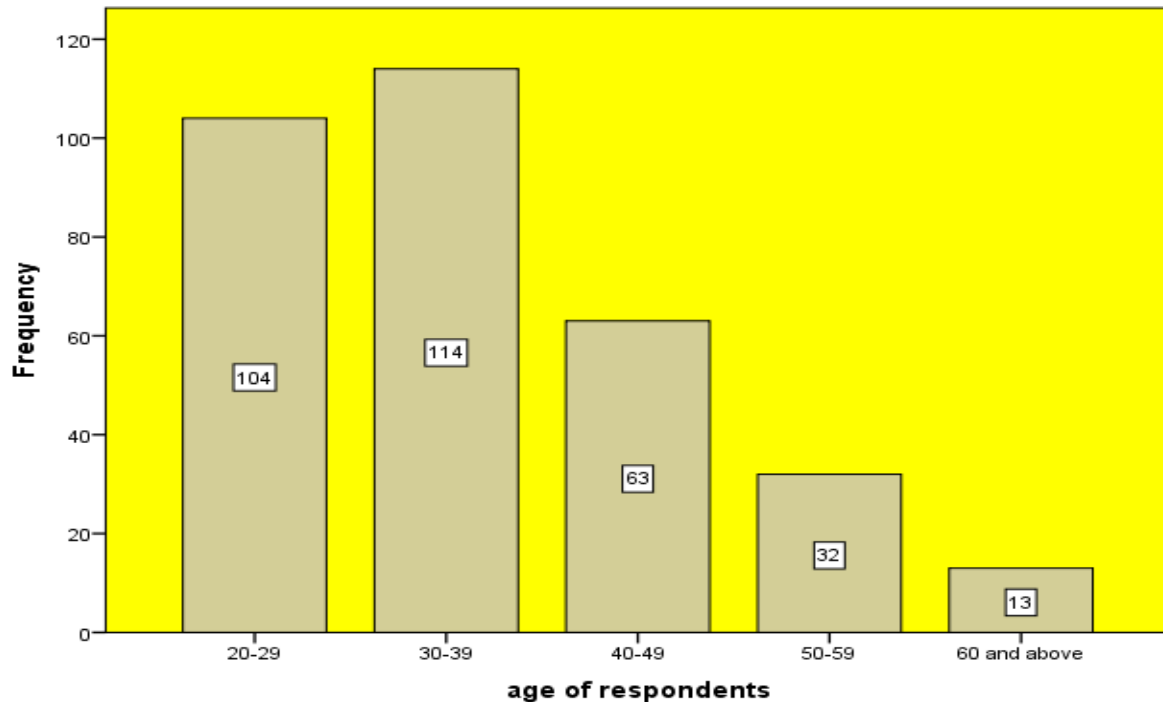


Figure 5: Age of respondents.

waste management is concerned in the study area. The key stakeholders of the solid waste management are:

- Assemblymen in the selected areas;
- Accra Metropolitan Assembly (Metropolitan Environmental Officer);
- Waste Management Department (Landfill Manager) and
- Zoom Lion Company Limited (regional operations manager).

Data analysis

After collecting the data by both qualitative and quantitative techniques, editing and coding was done before presentation. In the presentation of the data, descriptive statistics such as frequencies, percent and cross tabulation were used. Data was analyzed using Statistical Product and Service Solution (SPSS), version 21(2015 edition).

RESULTS AND DISCUSSION

This deals with the analysis, results and discussion of the findings from the survey, focus group discussions and key informant interview. The analysis is guided by the research questions and the objectives of the study. It covers social-demographic characteristics of the respondents, their views about constraints and factors affecting waste management.

Socio-demographic characteristics of respondents

This section presents the characteristics of the respondents sampled. This is done by analyzing the age and occupation. This is to give clear picture about the respondent's demographic information and how their age affects solid waste management.

Age of respondents

Age of respondents was taken into consideration to find out whether age affects waste management. Usually people who are old are more responsible as society would condemn any social deviant. In Ghana, adult are expected to behave in matured way that the young and up and coming young ones can emulate (Figure 5).

The research revealed most of the people responsible for household waste are the youth. Those living together with their parents have to see to it that waste generated in the house should be disposed in a more acceptable way. The study showed that majority of the respondents responsible for waste management in their various homes and work places were the youth between the ages of 20 to 39. As part of their duties, they ensure that household waste generated mostly are properly collected and disposed (Figure 6). The elders among the respondents range from 50 to 59 and 60 and above. Most of the elders are those not busy or mostly in the house to dispose the household waste on behalf of the family while the rest of the household go to work or engage in daily activities that



Figure 6: Household waste collection containers.



Figure 7. Picture of communal waste dumping site

raise money for the family.

Types and components of solid waste generated

Knowledge on types and the components of solid waste generated will inform management to use the appropriate technology and suitable logistics to effectively deal with the various components in solid waste management. Methods such as source separation, recycling and

composting can be used depending on the component of waste in the waste stream. Integrated waste management approach which creates opportunities such as composting, biogas, recycling, reuse and employment as well as, reducing environmental hazards is the best. As a matter of fact, about 90% of household waste generated in Accra is dumped at landfill sites which also have adverse effect on the environment (Figure 7).

According to Asase (2012), Waste Management Department (WMD) and Zoom Lion Ghana Ltd, estimated

Table 3: Types and components of solid waste generated.

Sampled area	Components of household solid waste daily															
	Organic		Metals		Plastic and rubber		Paper and cardboard		Textiles		Glass		Miscellaneous		Inert	
Darkuman	60	61	3	2	9	10	7	8	2	3	2	2	11	12	2	3
Mambrobi	61	62	2	3	7	9	8	7	3	2	1	3	10	11	2	2
Korle Gonno	62	61	3	3	8	9	7	7	3	2	2	3	11	13	2	2
Chorkor	61	60	2	3	9	8	6	8	2	1	2	1	10	11	2	3
Mallam	60	62	2	2	8	7	7	7	3	2	3	2	10	10	3	2
Aworshie	63	60	3	1	7	9	8	7	3	2	2	3	11	10	3	1
Kwashieman	60	59	2	1	10	8	8	8	2	2	2	3	11	11	3	2
Central Accra	60	60	2	2	7	9	6	8	3	2	1	2	10	9	4	3
Mpoase	62	61	2	3	9	8	7	7	2	2	2	2	11	10	2	2
Osu	62	60	2	3	9	9	10	9	2	3	2	3	12	11	3	2
Shiashie	61	62	3	2	10	11	11	11	2	3	2	2	10	11	2	2
North Dzorwulu	62	60	2	2	9	10	10	12	3	3	2	3	10	10	2	3
Kotobabi	63	61	2	3	11	9	11	10	2	2	3	2	11	10	2	2
Ridge	61	62	3	2	11	10	10	11	2	3	2	2	12	9	2	3
Nima	61	60	1	3	10	10	12	11	3	2	2	3	10	12	1	3
Adabraka	60	60	2	3	10	11	12	11	2	3	1	3	10	11	2	2
Achimota	59	61	2	2	12	10	11	10	3	2	4	2	12	9	2	3
Kaneshie	61	62	3	2	13	10	10	11	2	2	2	3	11	11	2	1
Average total	58	60.8	2.2	2.4	9.6	9.8	9.1	9.3	2.3	2.3	2.2	2.4	10.7	10.6	2.4	2.3

Source: 2015 data collected from dumping and skip containers site.

that 0.73 kg per capita waste is generated daily by household in the Metropolis. The average per capita household waste generation obtained for the Accra Metropolitan cities was comparable to the 0.75 kg/person/day generation rate reported for all metropolitan cities in Ghana by the Ministry of Local Government and Rural Development (MLGRD, 2010) in a forecast of National Environmental Sanitation Strategy and Action Plan (NESSAP) 2010 to 2015. This amounts to 1552 tons of household waste per day. According to the Zoom Lion and WMD, the commonest types of waste generated in the area were food waste, rubbish and ashes. The research also took sample data of waste from some respondents to compare to actual figures from Accra Metropolitan waste department. Using the following method:

Percentage composition of waste fraction =

$$\frac{\text{Weight of separated waste}}{\text{The total of mixed waste sampled}} \times 100$$

This was done to roughly ascertain the average figures that constitute solid waste in the metropolis in various areas within the metropolis with that of figures obtained from AMA. The Table 3 shows the average percentage of a component of waste generated daily. This was to compare the secondary data obtained from the metro waste department. Two sets of data were collected at each waste dumping site located within the sampled areas of the respondents. The component was analyzed to find the characteristics of domestic waste generated so as to know the fractions of

domestic waste that can easily be sorted, recycled or disposed. The research showed that bulk of the waste generated is organic which 60% is on the total waste generated domestically. Food waste forms bulk of the organic waste and therefore using anaerobic digestion to treat this kind of waste could be environmentally friendly.

Organic waste is commonly used in Ghana for composting and it is practiced by few groups and individuals, however, only few commercialized projects on composting utilizing MSW are available in Ghana as reported by Bensah et al. (2015). Personal data collected from some household at dumping sites showed that averagely 60.8% of most household waste is organic. There were similarities in the fractions of the various waste streams although; few variations were also seen

Table 4: Types and components of solid waste generated.

Components of waste	Percentage generated daily
Organic	60
Metals	3
Plastics and rubber	9
Paper and cardboard	7
Textiles	2
Glass	2
Miscellaneous	11
Inert	2

Source: Accra Metropolitan Assembly.

with some of the fractions. The organic fraction was the highest (Table 4) and compares to the range reported for some developing countries such as 50 to 74% in some cities of China (Tai et al., 2011) and 51 to 58% in India (Ranjith, 2012).

Plastic and rubber which forms about 9% of the domestic waste is the major challenge in Ghana. Fobil et al. (2006) outlined the different plastic compositions in the waste stream of Accra; it is moved from 1.4% in 1979, 4% in 1993 and 5% in 1997 to 8% in 2000. In this study, the average plastic in the waste stream was 9.8%. This is lower than the 20% plastic reported by Puopiel (2010) in Tamale and 16% in Aburi in the Eastern Region (Asamoah-Okyere, 2011) and Tarkwa in Western Region (Ansah, 2014).

Plastic recycling has not received the needed attention; it is believed that less than 2% of plastics are recycled in Ghana; the rest form major pollutants in public places and environmental receptacles in Ghana. Most open drains and gutter are choked with plastics and rubbers preventing water flow which leads to flooding in Accra during the rainy season. These rubbers and plastics can be recycled to produce raw materials for industries instead of allowing it to pollute the environment. The study also showed that paper and cardboard represent 7% of household waste generated daily.

Paper recycling has not been initiated on a larger scale, though few individuals have been recycling smaller portion as sanitary tissues (Osei-Mensah, 2014). This implies that when integrated waste management system is adopted, papers and cardboard could easily be separated and recycled for other alternative uses. In addition, this can also generate employments as people can sort waste and sell the recyclable material for money. The data collected showed that metals, textiles, glass and inert represents 3, 2, 2 and 2% respectively of the domestic waste generated daily which fall within the range of some 1 and 3% of fraction of metals, glass and textiles as determined by Ansah (2014) compared with other studies. Scrap metal is one fraction of MSW that has a great market in Ghana and beyond. This reason makes them attractive to scrap collectors and itinerant buyers thereby, reducing their composition in the waste stream to about 2%. They are utilized in local steel industries and are even exported.

Metal scraps collection now serves as source of employment for some of the youth who move door to door to buy scrap metals in homes. According to UNEP (2013), apart from percentage component of waste generated daily which is easily determined, waste generation rates across Ghana irrespective of the socio-economic considerations ranged from 0.2 to 0.8 kg/person/day. However, higher generation rates have been reported for OECD countries, 1.39 kg/person/day (OECD, 2010).

Methods of disposal of household solid waste

The disposal of household solid waste is one of the functional elements in the management of waste. Waste can be efficiently managed if the stakeholders as well as, mechanisms put in place to manage waste work effectively in an integrated manner. Waste generation in sub-Saharan Africa is approximately 62 million tons per year. Per capita waste generation is generally low in this region as compared to annual waste generation in East Asia and the Pacific Region which is approximately 270 million tons per year (UN-Habitat, 2009). This implies that waste generation in Africa is not above the threshold of waste management capacity levels in most big cities in Africa. A study carried by Momoh and Oladebeye (2010) showed that, the methods of solid waste disposal include dumping of waste in gutters, drains, by roadside, unauthorized dumping sites and stream channels during raining season and burning of wastes on unapproved dumping sites during the dry season. This has gone to confirm that the practices of solid waste disposal in the 1950s still exist today and study area is not an exception. This implies that indiscriminate waste disposal has been a challenge for long time. Table 5 illustrates the various ways of solid waste disposal by respondents in AMA. The survey conducted revealed that all the respondents have different reasons which encourage them to dispose solid waste in the manner they do. According to the survey, 39 of the respondents representing 12% burn their waste in their compounds or any open space in their houses. Most of them are of the view that, burning their waste as means of disposal is cheap, saves time and also does not have much effect on the environment as most burning takes place at

Table 5: Methods of disposal of household solid waste.

Respondents	Frequency	Percent
Burning by household	39	12.0
Buried by household	53	16.3
Dumping in containers	128	39.3
Dumping at communal dumpsite	14	4.3
Waste collection agents	28.2	92
Total	360	100

night or early in the morning when neighbors are not awake to inhale smoke or any bad odor the burning might generate.

The research also indicated that 53 of the respondents representing 16.3% dispose their waste by burying them in their compounds. These respondents mostly dig big trenches on their piece of land and dispose their household waste in these trenches until they become full and bury it with sand. Most of these methods occur in places where household have large reserve land on their compounds which they have no immediate intention of developing that portion of land. The size of the trenches depends on the volume of waste generated by the household per day and availability of land. The respondents think this is the best method to handle waste since their houses are far from the skip site and also the private waste collectors they engage are not mostly reliable. Some of these private waste collectors charge exorbitant amount before they carry the waste, hence, most of them see it as quite expensive. Dumping at communal dump site also represents 14 respondents which also makes 4.3% of the total respondents. Due to environmental hazards solid waste generates in the Metropolis especially during the rainy season causing flood in the flood prone areas, the government discourages this system of waste disposal in the country.

Moreover, due to population explosion in the metropolis generating land scarcity, most communities who use to reserve portion of community land for waste dumping have stopped that act. The respondents who dump their waste by this means live in the suburb of the Metropolis where they have no place for dumping their waste so the community earmarked portions of community land for disposal. This is mostly done when the chiefs and the custodians of the land agree to devote portion of stool or communal lands for waste dump site.

The research also showed that 128 respondents representing 39.3% of the total respondents dump their waste at skip container sites (Figure 8). Though some of them are faced with challenges of distance to skip container site or high rate charged by the skip caretakers, they have no option than to cope. Most of them pile the waste in polythene sacks, dustbins or big polythene bag till it get full before they send it to the skip containers site. Some of them confessed that at times they are tempted to dump the waste in opens drains during the rainy season if they cannot send it to the skip container sites due to

distance and the bad occur of the waste.

From the survey, it was also realized that 92 of the respondents representing 28.2% indicated that, private waste collectors come to their homes to collect their waste. The main private waste management company in Ghana (Zoom Lion) has the services of door to door waste collection. The waste collectors moves with tricycle or big trucks with compactors and collect waste in areas with good road network. Some of the residents pay monthly or weekly depending on the agreement with the waste management company. Furthermore, there are other private individuals who have also created employment from waste disposal. They have their own means of transport and move to houses and collect their waste. Though their services are expensive as compared to the Zoom Lion Company, most residents think their work is efficient and reliable. The system of paying fees for waste removal or disposal works well and represents sound practice when individuals want to get rid of their waste and can afford the fees. It works poorly when people are too poor to pay fees, when the fees are simply too high, or when there are ready alternatives and no controls for disposing of wastes, such as by throwing them into the countryside (Kodwo, 2012).

Availability of skips and dustbins for waste storage

The urban poor living in slums in Accra are vulnerable to public health impacts of improper waste management. The poor always tend to be the most adversely affected by environmental hazards due to improper waste management, poor access to health services to get treatment and poor means to avoid everyday proximity to waste management related problems (UNSD, 2009). This situation is also prevalent in Accra. High income households who can buy door-to-door waste collection services get a special plastic bin for waste, but low income communities use large skip containers. Various studies comparing these two methods of waste collection found that the door-to-door plastic bin system had a higher quality service as opposed to the low quality service at skip site.

There have been numerous attempts to solve this problem of service delivery to Accra's low income communities. AMA and Zoom lion are undertaking a project to provide plastic containers for waste collection to



Figure 8: Public solid waste dumping container.

individual households for free. The freely distributed plastic containers were being used for water storage or other alternative uses as opposed to waste collection. To discourage such alternative uses like water storage, the authorities provided free metal wire containers, which were later stolen or sold as metal for money.

An interview with the Assembly men in the twelve (20) selected areas revealed that lack of skips and dustbins was the major problem in the Metropolis. Zoom Lion Ghana Ltd. which was the main private company in charge of waste collection was unable to supply skips and dustbins to areas they served. The Accra Metropolitan Accra (AMA) in collaboration with other donor partners distributed new dustbins to various households in the Metropolis but most household use the new dustbins to store water and other household items. Some household also over fill their dustbins with waste which easily break the wheels of the dustbin when pushing it to the skip site or when trucks empty the bins. Table 6 shows the selected areas, estimated population, number of dustbins and skips available as well as the number required for storing waste.

Personal interview with the AMA waste management department indicated that the funds allocated to sanitation and waste management is woefully inadequate. This affected the distribution of skip containers and household dustbins. According to the AMA, they use their own internally generated funds (IGF) to manage waste as Government funds does not come timely and is also not enough to run the activities of the Metropolis not alone manage waste. Discussions with the private waste management company (Zoom Lion) indicated that government funds received for operations is not enough preventing them to manage the waste effectively. Due to

inadequate funds, maintenance and operations cost mostly affects their capacity.

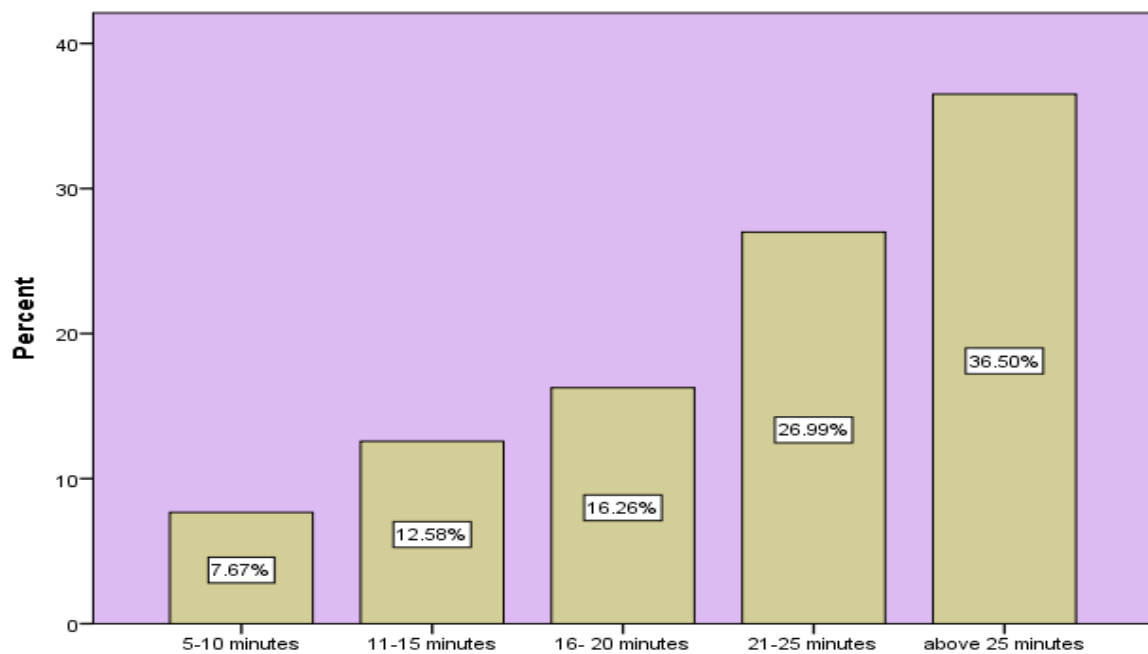
Time spent to dispose of waste in skip

Time spent to dispose of waste is very crucial for efficient waste management. Moving long distance to dispose waste at dumping or container site can be frustrating and discouraging especially if the waste produces bad odor (Adjei, 2013). Time spent by respondents to dispose waste was realized in the course of the research. The survey showed that majority of the respondents representing 36.50% travel above twenty- five minutes to dispose their waste at the skip site or authorized places (Figure 9). Interview and discussion with the respondents showed that most of the household who are far from the dumping sites find their own alternative means of disposing their waste. Either they engage and pay people to come and convey it to the dumping site or they dig big trenches in their homes if there is available land. Others also said they burn theirs in situations where they cannot send it far to dispose them. 26.99 and 16% of the respondents travel twenty-one to twenty- five minutes and sixteen to twenty minutes respectively to dispose their waste. These respondents are of the opinion that most households and individuals dump their waste at unapproved places or in gutter due to the distance they cover before disposing their waste. The survey indicated that only 7.67% of the respondents move for less than ten (10) minutes to dispose their waste. They are able to dispose their waste regularly at dumping sites dues to proximity of their houses to the site. They said it is good to have skip

Table 6: Distribution of dustbins and skips in study area.

Communities	Estimated population	Number dustbins available	of Estimated number of required dustbins	Number of skips available	Estimated number required
Darkuman	89245	5451	9500	14	30
Mpoase	66987	1671	2400	16	25
Mambrobi	96788	3561	12000	18	35
Chorkor	64945	951	2300	14	20
Kaneshie	75615	2691	3450	11	25
Accra Central	63432	1541	4500	23	40
Kotobabi	54789	893	2400	13	30
Osu	52654	1032	6000	12	25
Achimota	67986	1572	5600	11	30
Shiashie	59642	1261	5200	15	25
Adabraka	81964	983	7300	19	25
Ridge	48462	456	900	12	20
Kwashieman	83792	574	800	19	30
Mallam	68,267	393	5000	14	25
Nima	84586	689	3000	16	30
Awoshie	68583	700	2000	13	20
North Dzorwulu	75893	200	1000	17	25
Korle Gonno	64621	940	4000	14	25

Source: Accra Metropolitan Assembly, April, 2015.

**Figure 9:** Time spent to dispose waste at skip site.

containers near houses so that people can easily dump their waste should the need arise. Nearness of dumping site or skip containers near residence encourages people to dispose their solid waste in an acceptable manner.

Regularity of waste collection

Regular collection is an important exercise in solid waste

management. The survey conducted showed number of waste collection on weekly bases. Figure 10 showed that 42% of the respondents get the trucks to come and empty their dust bins once a while. The trucks do not come on regular bases as expected. These create a lot of problems when the dust bins are full and thus generate bad stench. The study indicated that 22.1% of the respondents empty their bins once a week. This also poses a lot of threat to households who generate more waste on daily bases. The

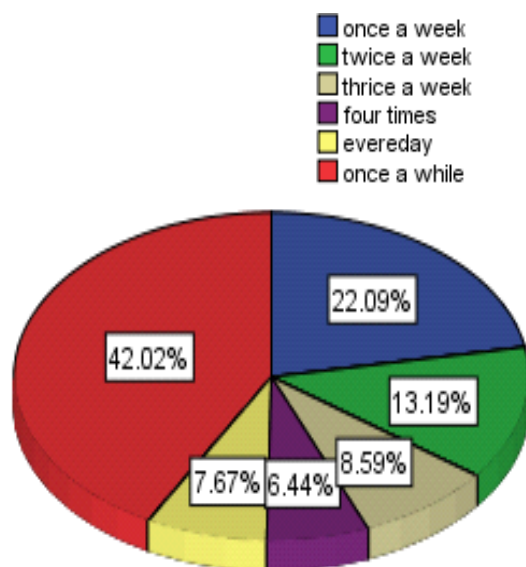


Figure 10: Waste collection frequency.

respondents who get their bins emptied everyday are those in the residential areas who give tips to most of the waste collectors thereby encouraging them to always come to their homes regularly. The key informant interview showed that most of the houses that get their dust bins emptied every day or on regular bases are either close to main roads, tip waste collectors or engage private individuals who pick their waste and dump them at skip sites. Personal observation in the study area showed that households whose houses do not have access to good roads have problems with waste collectors who are supposed to empty their dust bins on regular bases.

Interview with skip site care takers revealed that most of the skip containers are not also regularly picked and this makes some of the containers get full to the brim. Some of the waste falls out when people continue dumping waste in filled containers. Personal observation revealed that most skip sites do not get regular service hence; there are huge pile of waste at some skip sites.

Types of constraints affecting waste management.

Waste management comes with a lot of constraints that poses threat to most waste management companies and even the most developed countries also face constraints from the waste management sector. Figure 11 shows the main constraints affecting waste management in Ghana. The research conducted showed that each constraint has no correlation with any other constraints.

The research conducted indicated that as a result of current economic challenges, the government does not provide enough funds timely for the waste management companies in the Metropolis to discharge their duties efficiently. As a result, the city is engulfed with filth and

outbreak of cholera and malaria is rampant. Sound practice in financing waste management systems usually entails differing treatment of costs so as to allocate enough funds. Adequate funds which establish efficient waste or materials collection, processing, or disposal capacity, may be paid from general tax revenues government accrued. The rationale for this is that there are benefits to all members of society for having the overall solid waste management system in place (Ghana Audit Service, 2011). Survey showed that 28.92% of opinion letters and focus group discussion indicated economics constraints are the main predicament of poor waste management in Accra Metropolis.

The study also showed that 21.85% of the respondents made of opinion leaders believed that social constraints is one of the main constraints that hinder efficient waste management in the Metropolis. Batool (2009) explained that in developed or developing countries, there are social or cultural norms accepted by the society and there are other norms that society does not conform with. Such norms affect designs of solid waste management systems. Where the society allows only a certain social class or group to deal with solid waste, the availability of work force for solid waste collection and disposal becomes constrained by this rule. In some countries, directly handling human waste is a traditional taboo which prohibits application of compost of human waste.

In most developing countries, there is lack of human resources at both the national and local levels with technical expertise necessary for solid waste management planning and operation (Ngoc, 2009). Many officers in charge of solid waste management, particularly at the local level, have little or no technical background or training in waste management. Without adequately trained personnel, a project initiated by external consultants could not be continued. Therefore, the development of human resources in the recipient country of external support is essential for the sustainability of the collaborative project. The focus group discussion involving major stake holders among Zoom Lion waste management company, Metro Environmental management officers, Environmental Protection and other government agency indicated that most of the officers in charge of waste management have no requisite skills. Though most are highly educated, their area of specialization is not waste management.

Another technical constraint in developing countries is the lack of overall plans for solid waste management at the local and national levels. As a result, a solid waste technology is often selected without due consideration to its appropriateness in the overall solid waste management system.

In some cases, foreign assistance is given to a component of a solid waste management system for which the use of resources may not be most cost-effective. For instance, an external support agency provided its support to improve a general disposal site. However, the coverage of solid waste collection service is so low that solid waste generated is

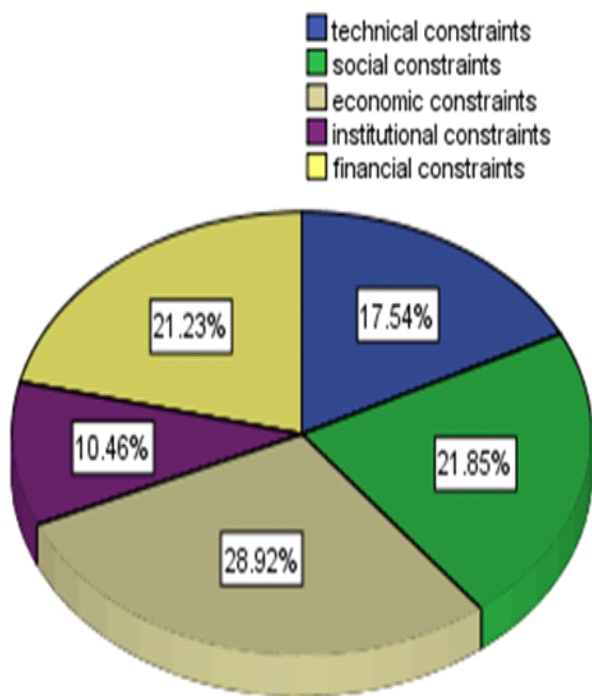


Figure 11: Types of constraints.

dumped at many undesignated sites (for example, open areas, water channels and streets, etc). As a result, improving the disposal site may not be a bad project but would have little impact on the overall solid waste management effectiveness. In such a case, the low collection coverage is a bottleneck in the overall solid waste management system in the city and it would be most cost-effective to provide resources to upgrade the collection service. The research showed that 17.5% of the respondents were of the opinion that poor waste management in the Accra Metropolis is due to technical constraints. According to the respondents from the focus group discussion, technically, the Metropolis lack the capacity to manage the volumes of waste generated daily. Lack of environmental engineers who supposed to coordinate, supervise and also draw effective waste management programs pose serious technical constraints in the Metropolis.

Furthermore, institutional constraints were also seen as one of the serious threat to waste management. Due to poor economics challenges, the government does not release funds timely for MMDAS in Ghana to enable them discharge their core mandate of which waste management is one. The survey showed that 21.23% of the respondents due to financial constraints the Metropolis in collaboration with the private waste management companies cannot invest adequately in areas such as equipment maintenance, adequate staff and fuel to collect and discharge waste timely as required. Institutions which supposed to coordinate activities of other stakeholders to

manage waste effectively is lacking in the Metropolis. The study showed that 10.46% of the respondents also think institutional constraints are a challenge. The two major institutions which are responsible for waste management are Zoom Lion Waste Management Company and AMA waste management department. The volumes of waste generated are far beyond the capacity of Zoom Lion and the Metropolitan Waste Department. This always creates problems mostly at the skip site. Most skip containers get full quickly and if not collected, residents dump the waste near the skip sites mostly at midnight when the care takers of the skip containers are not around to prevent them.

Factors affecting waste management

Waste management is a big task in every country because it could be a nuisance or generate negative consequences if not properly managed. There are several factors that hinder proper waste management (Table 7). The research conducted showed that there are a lot of factors preventing the government and the waste management companies from properly managing solid waste in Accra Metropolis.

The research indicated that the main challenge in waste management is poor public attitude towards waste management. The survey showed that 30.4% of the respondents from key informant interview attested to the fact that the public attitude to waste management is very appalling. They claimed most citizens keep waste in their homes and dump them in open drains during heavy rains. Some of them also keep waste in their homes and dump them at unauthorized places especially at midnight and early in the morning when people are asleep. Interview with waste management officers revealed that the Metropolitan Authority in collaboration with the main waste management company in Ghana (Zoom Lion) distributed free dustbins to about 80% households so as to collect and properly keep domestic waste until the waste disposing tracks comes to collect them finally for disposal but unfortunately most of these households used the bins to store their personal items. Some even used it to store water for drinking and food items because they claim it is new for waste storage.

The research also showed that 82 respondents representing 25.2% indicated that poor enforcement of sanitation bye laws in the metropolis encourages citizens to dump refuse anywhere or anyhow. The AMA has not fully enforced its sanitation bye laws to punish people whose activities poses environmental threat to the entire metropolis. In Ghana particularly Accra, people defecate in polythene bags and dump them in gutters and other open places due to lack of toilet facilities in most houses especially in slum areas. Most residents along the coast use the beaches as place of convenient since they lack toilet in their homes. During rainy seasons people dump their waste in running waters and open drainage system which

Table 7: Factors affecting waste management.

Factors	Frequency	Percentage
Low waste management technology	37	11.3
Inadequate and untimely release of government funds	69	21.2
Loopholes in waste management strategies	10	3.1
Poor public attitude towards waste management	99	30.4
Poor education and Ignorance among Citizens	29	8.9
Poor enforcement of sanitation by Laws	82	25.1
Total	326	100

all end up at the Korle Gonno lagoon and the sea. Most gutters in Accra are choked with solid waste mostly domestic ones due to poor enforcement of bye laws by AMA. Due to poor attitude towards waste management, The Accra Metropolitan Assembly (AMA), Environmental Protection Agency and other stakeholders mostly engage contractors to drain major storm drains filled with waste in the metropolis. However, lack of law enforcement to punish those who dispose waste was at undesignated places have led to major gutters and storm drains continuously choked with solid waste. The consequences of these are flood, cholera and malaria in the metropolis.

Inadequate and untimely release of funds by government was also seen as one of the main challenges of waste management in the metropolis and Ghana as a whole. Due to economic crises, the government does not release funds on time to the MMDAS to tackle their annual activities of which waste management is a major component of their action plan (Osei-Mensah et al., 2014). The government allocations to waste management are woefully inadequate. The study showed that 69 respondents representing 21.2% are of the view that inadequate and untimely release of funds leads to poor performance of the waste management companies and the metro waste management department. Poor maintenance and replacement of obsolete tools for waste management pose health hazards to those who come into direct contact with the waste during disposing of the waste. Most of the big trucks are not efficient in disposing the waste because they do not have enough fuel allocation to visit their approved skip collection site at the supposed number of times. Hence, there are more back-locks of waste in most places creating filth and nuisance. The tricycles used by most of the waste officials who go door to door to collect waste in small quantities are broken down compelling residents to travel far distance to dispose waste in skip containers.

The study showed that 3.1% of the respondents think loopholes in waste management strategies are one of the main factor that hinder proper waste management in the Metropolis. The loop holes are as a result of check and balance in the waste management system. Some of the skip care takers collect money from the waste disposers but do not give proper account to the waste management company. Also, the skip loader drivers mostly go to areas where they get bribe from the skip care takers leaving

other areas where waste are supposed to be collected and disposed. Most of the door to door waste collectors also take bribe from some household and dispose their waste regularly instead of following the routine schedule so as to cover all the designated areas. Low waste management technology was also seen as one of the main challenge serving as bottle necks in the entire waste management process. As GDP/c goes up, it is expected that by 2050 the demand for agricultural goods will rise by 70% and the demand for meat will double. Besides the serious issues related to food production and sustainability, those changes will change the waste composition in a large part of the world.

The organic fraction will be more dominant in MSW (UNEP, 2013). Apparently, there is the need to improve technology that will harness organic waste into compost and other useful by-products rather than indiscriminate disposal. Though 60% of household waste are organic materials mostly kitchen waste and plants, they are not converted to compost to supply farmers with organic manure. About 90% of the waste generated in Accra is dumped in landfill sites mostly located at suburbs of Accra. Only 10% are recycled at the recycle plants recently built by Zoom Lion Company. They are rather dumped in their raw state. Nevertheless, only about 7% of the daily household generated is polythene bags and plastics but due to poor technology of the waste manage company most of the plastics and polythene are dumped at the landfill sites which also pose threat to the environment as they do not decompose. Some of these polythene bags litters the environment as well as, choking gutters.

The survey indicated that 37 respondents representing 11.3% are of the opinion that poor waste management technology is the main issue bedeviling effective waste management in Ghana for that matter Accra. They are of the view that if technology is improved, waste especially polythene and other organic materials in the waste can be recycled to feed the agricultural sector as well as, industries who use polythene as their raw material for production. Poor education and ignorance represented 8.9% of the respondents view. Key informants interview showed that most people in the metropolis do not care much about the adverse effect of waste to the environment. They perceive waste management as government obligation no matter how it is disposed by households or industries. Due to poor education and

Table 8: Correlation between constraints and factors affecting waste management.

		Types of constraints	Huge gap between research and policy development	Low involvement of entrepreneurs waste management	Poor public attitude towards waste	Poverty and ignorance among citizens	Waste collection per week	Non-regulation of waste management companies
Types of constraints	Pearsons correlation	1	.052	-.066	.091	.012	-.027	-.100
	sig. (2 tailed)		.345	.232	.100	.825	.627	.070
	N	326	326	326	326	326	326	326
Huge gap between research and policy development	Pearsons correlation	.052	1	.129*	-.006	-.030	.091	.016
	sig. (2 tailed)	.345		.020	.914	.585	.099	.769
	N	326	326	326	326	326	326	326
Low involvement of entrepreneurs waste management	Pearsons correlation	-.066	.129*	1	-.019	.016	.014	.177**
	sig. (2 tailed)	.323	.020		.737	.775	.797	.001
	N	326	326	326	326	326	326	326
Poor public attitude towards waste	Pearsons correlation	.091	-.006	-.019	1	.086	.016	.065
	sig. (2 tailed)	.100	.914	.737		.121	.780	.242
	N	326	326	326	326	326	326	326
Poverty and ignorance among citizens	Pearsons correlation	.012	-.030	.016	.086	1	.050	.077
	sig. (2 tailed)	.825	.585	.775	.121		.367	.167
	N	326	326	326	326	326	326	326
Waste collection per week	Pearsons correlation	-.027	.091	.014	.016	.050	1	.137*
	sig. (2 tailed)	.627	.099	.797	.780	.367		.013
	N	326	326	326	326	326	326	326
Non-regulation of waste management	Pearsons correlation	-.100	.016	.177**	.065	.077	.137*	1
	sig. (2 tailed)	.070	.769	.001	.242	.167	.013	
	N	326	326	326	326	326	326	326

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

ignorance most residents dump refuse indiscriminately forgetting that during the raining season these waste block major storm drains causing floods in Accra and its environs. As a result of filth engulfed Accra, outbreak of cholera and malaria is rampant in Accra.

Determinant of correlations between constraints and factors affecting waste management

Correlation among variables which help to determine an outcome of a research is worth

determined so as to know the multi-collinearity level between the variables under study and to know which decision to make in relation to the objectives of the research. Table 8 shows correlations between factors affecting waste management and the constraints of waste management. The figure indicated that there is no strong correlation between factors and constraints of waste management. The weak correlations among the variables shows each variable is independent on it own hence, affects waste management without necessarily relying on other variables to trigger it. The research also showed more correlation among some variables is

significant at 0.05 levels than correlations at significant levels of 0.01. This implies that constraints such as technical, economic, institutional, social and financial are not necessarily the cause of the factors affecting waste management, though, there is some level of link to that effect. For instance, it is apparent to note that financial constraints directly have effect on inadequate and untimely release of funds for waste management but have no direct relationship with poor attitude towards waste management. Similarly, social constraints have impacted on poor education and ignorance among citizens but do not directly correlate to loop holes in waste

management strategies.

Conclusion

The research conducted detected numerous factors and constraints that negatively impact on sustainable waste management in Accra Metropolis. Provision of adequate skip containers, waste collection vehicles and other logistics could prevent indiscriminate waste dumping, burning and other forms of waste disposal to curb the menace of environmental hazards solid waste generates. Introduction of good integrated waste management system could promote more recycling of waste materials into compost, bio-energy and other forms of raw materials that could be used by industries as well as, reducing environmental pollution. These can be achieved if the government focus attention more on the waste management sector by incorporating prudent policies as well as, allocating enough funds for all operations to work efficiently as scheduled to achieve formidable result. Introduction of Public Private Partnership (PPP) in the waste management sector could also help to address some technical, economic and financial challenges in solid waste management.

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