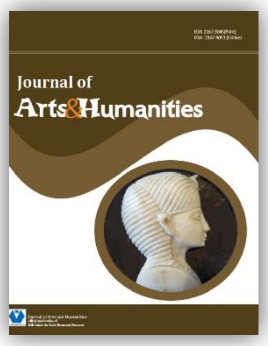

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An Assessment of Solid Waste Management System in the Kumasi Metropolis

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ABSTRACT

Waste products arise from our ways of life and it is generated at every stage of the process of production and development. It spans all stages of human activities, from manufacturing to consumption. The purposes of this thesis were to identify the solid waste management practices in KMA. This research is exploratory research. A sample size of 200 was used out of a total population of the study was 350. Questionnaire was the main data collection instrument used for the study. Quantitative data analysis technique (such as mean, percentages, frequencies and standard deviation) and qualitative data analysis technique (such as content analysis) were used to analyse the collected data. It was found out that all the seven solid waste management practices identified and tested, only two; waste generation practices, and transfer and transport practices were moderately done well. This means that the rest: onsite handling, collection, sorting, disposal, and energy generation practices are not been done appropriately. Based on the findings of this study, it is recommended that, the management of KMA should adopt appropriate waste management practices such as conversion of waste into energy.

Keywords: Kumasi metropolis, management, solid waste, urbanization, waste, waste generation.
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1.0 Introduction

Waste products arise from our ways of life and it is generated at every stage of production and development. It spans all stages of human activities, from manufacturing to consumption (Oyelola, et.al, 2011). It is especially a serious problem in developing countries where generation of waste per unit of output is much higher than that in the developed countries because of inefficiency in manufacturing processes (Cointreau-Levin, 1997). Abagale, et.al (2012) added thatin every aspect of human life, several unwanted materials (newspapers, broken bottles, aluminum cans, flower trimmings, etc) are generated. These materials are discarded simply because they are considered waste to that effect. The total stream of waste generated within a community is often categorised into municipal waste, industrial waste, constructional and demolition waste (CTMA, 2004).

Whilst urbanization is not a new phenomenon in Africa, the current rate of uncontrolled and unplanned urbanization in Africa has given rise to a huge amount of liquid and solid wastes being produced, so much so that these wastes have long outstripped the capacity of city authorities to collect and dispose of them safely and efficiently (Wetherel, 2003). This rapid urbanization in African countries and by the same logic, a rapid accumulation of garbage is what (Onibokun and Kumuyi, 1999) have likened to "a monster that has aborted most efforts made by city authorities, urban planners, states and federal governments", to manage or at least contain it. Urbanisation in Ghana has made the management of solid waste very crucial in the areas of public health and environment, especially in the capital cities, since these areas serve as the gateways to the country for foreign investors and tourists. Poor form of these cities can deter foreign investors (Abagale, et.al, 2012).

Mariwah (2012) indicated that Ghana has almost all the institutions, agencies and policies for waste management at all levels of government; from the central government down to the very grass-root level of unit committees. KMA is no exception to this. However, (Mensah, 2011) believe that, management of solid waste has become a daunting task for KMA. The question that readily comes to mind is what are the solid waste management practices that KMA is practising that have made solid waste management a daunting task? This question is especially valid in the face of the fact that some countries/ cities such as Austria, Netherland, and Denmark have put in place systems that have helped them to effectively manage solid waste problems (Tsiboe and Marbell, 2004). It is in the light of these problems and its resultant negative effects that informed the researchers to undertake this study to look into the solid waste management practices of Kumasi metropolis and to recommend effective and efficient waste management practices for KMA and other Districts/ Municipals/ Metropolitan Assemblies in Ghana and beyond.It is hoped that this paper would help the KMA particularly the waste management department and other Districts/ Municipals/ Metropolitan Assemblies in Ghana and beyond to effectively manage their solid waste to enhance the socio economic development of Ghana. Finally, the study will contribute to existing knowledge on waste management and serve as a springboard for further studies.

2.0 Literature review

2.01 Concept of waste

According to (Urbanbandit, 2012), Waste is one of those words that are so widely used we often forget to question what it really means. Waste(s) (also known as rubbish, trash, refuse, garbage, junk, and litter), is very subjective; one person may deem an item to be waste whilst another might see it as a resource (Williams, 2005).Wastes are materials that are not prime products (that is products produced for the market) for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose (United Nations Environment Programme (UNEP), 2005; European Union, 2005; OECD, 2006).Waste may be unwanted; it does not specifically say that waste is useless. This clearly means waste may be of value. Finally, the

Environment Protection Act 1993 (the Act) of South Australiadefines waste as: “any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; or anything declared by regulation or by an environment protection policy to be a waste; whether of value or not”.

2.02 Classification of waste

According to (Baabereyir, 2009) A number of criteria are usually employed to classify wastes into types including their sources, physical state, material composition and the level of risk associated with waste substances (Table 2.1). Such classification of waste provides a basis for the development of appropriate waste management practice.

Table 2.1 Classification of waste

Criteria for waste classification	Examples of waste types
Sources or premises of generation	Residential, commercial, industrial, municipal services, building and construction, agricultural
Physical state of waste materials	Liquid, solid, gaseous, radioactive
Material composition of waste	Organic food waste, paper and card, plastic, inert, metal, glass, Textile
Level of risk	Hazardous, non-hazardous

(Source: adopted from Baabereyir, 2009)

An example of waste classification based on material composition was conducted by the Surrey County, UK in 2002/2003. An analysis of household waste streams in the county identified nine main types of materials: paper/card, plastic film, dense plastic, textiles,miscellaneous combustibles, glass, ferrous metal, garden waste and food waste (Surreywaste.info, 2013, accessed on 3rd January 2013). This was expanded by (Baabereyir, 2009) table 2.2

Table 2.2 Waste classification based on material composition.

Waste Type	Examples
Paper	Newspapers, cardboards, office waste paper, magazine/glossy
Plastics	Bottles, expanded polystyrene, film plastic, other rigid plastics
Glass	Clear glass, green glass, amber glass, non-recyclable glass
Metals	Steel cans, aluminum cans, other ferrous, other aluminum
Organics	Yard waste-grass, yard waste-other, wood, textiles, diapers, fines, other organics
Inorganic	Electronics, carpets, drywall, other construction and demolition, other inorganic

(Source: Baabereyir, 2009)

Using the physical state of waste substances, the materials in the waste stream can also be categorized into liquid, solid, gaseous and radioactive wastes. Examples of these types are shown in Table 2.3.

Table 2.3 Classification of waste based on physical state of waste substances

Waste Type	Examples
Liquid waste	Sewage sludge, waste water from bath house and kitchens
Solid waste	Food waste, paper, plastic, metal, debris
Gaseous waste	Factory smoke, vehicle exhaust smoke, fumes from burning waste dumps
Radioactive waste	Radiation, uranium, plutonium, excess energy

(Source: Baabereyir, 2009)

Furthermore, the potential health or pollution risk of waste materials is used to classify wastes into hazardous or non-hazardous waste. Hazardous waste refers to wastes with properties that make them potentially harmful to human health or the environment (US EPA, 2008). EPA (2008) further indicated that, hazardous wastes can be liquids, solids, contained gases, or sludge and can be the by-products of manufacturing processes or simply discarded commercial products like cleaning fluids or pesticides.

Because of their potential pollution danger, hazardous waste materials require rigorous and cautious means of disposal (DELM, 1993). In the EPA's Hazardous Waste Listings (2008)the categories of hazardous wastes include ignitable waste, corrosive waste, reactive waste, toxicity characteristic waste, acute hazardous waste and toxic waste. Special waste is one type of hazardous waste which is usually so dangerous to treat, keep or dispose of that it requires special disposal arrangements (US.EPA, 2008). Examples include hard clinical waste such as human parts, contaminated swabs and sharps. On the other hand, non-hazardous waste does not pose a danger and can be dealt with easily, examples being inert materials such as uncontaminated earth and excavated waste such as bricks, sand, gravel and concrete slates (UK Environment Council, 2000).

Waste can also be classified by whether it is biodegradable or non-biodegradable waste. Biodegradable waste typically originates from plant or animal sources and can easily be broken down by bacterial action or by other living organisms and so has a relatively short lifespan in the environment. This type of waste is commonly found in municipal solid waste as food waste, yard waste and paper. Other biodegradable waste materials include human excreta, animal droppings, sewage and slaughterhouse waste (Lapidos, 2007). In contrast with biodegradable waste, non-biodegradable waste, which includes most plastics, metals and ceramics, are waste substances that cannot be broken down by natural processes or living organisms (Lapidos, 2007).

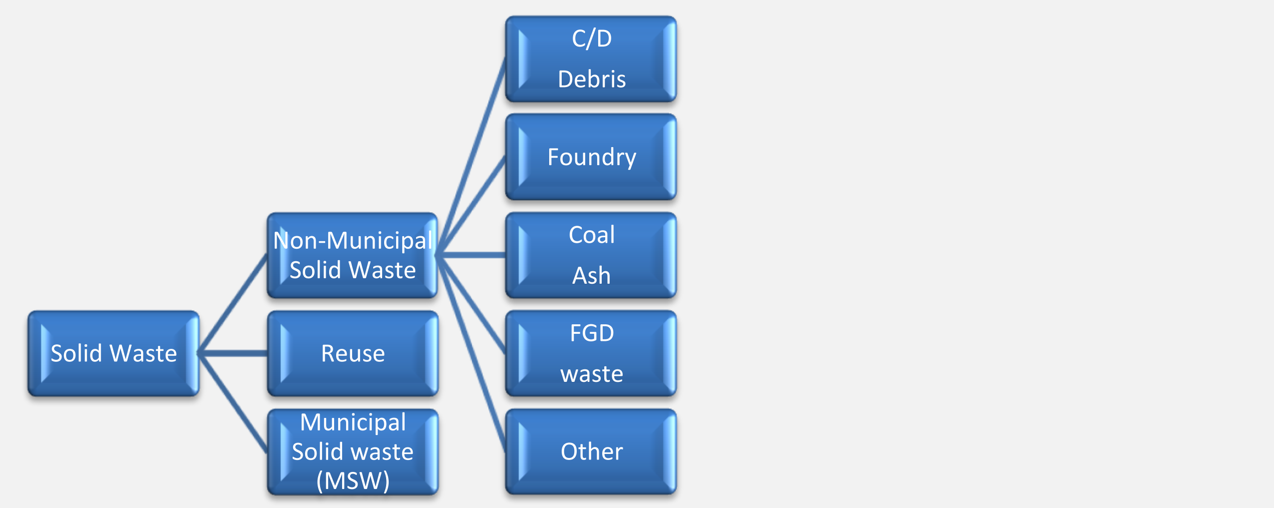
2.03 Solid waste

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded or intend to discard as useless or unwanted. The term solid waste is all inclusive, encompassing the heterogeneous mass of throwaways from the urban community as well as the more homogeneous accumulation of agricultural, industrial, and mineral wastes (Tadesse, 2004; Agwu, 2012; Williams, 2005; Opara, 2009; Allaby, 1988). The fact is that before refuse can be generated, the element must be worthless to its original user; hence it is thrown away or discarded. A material may be unwanted by a person or its original owner, but it may be a source of raw materials for another person (Opara, 2009). To avoid any doubt, solid waste is defined in this study as "any solid or semi-solid materials which have been discarded by its primary owner or original user, and may or may not be found useful by the original owner or user , or any other person for now but constitute nuisance to people's health and environment when left untreated".

2.04 Types and sources of solid waste

Solid waste has been classified into Municipal Solid waste and Non-municipal solid waste as shown in figure 2.1 (IDEM, 2001).

Figure 2.1 Classification of solid waste



(Source: IDEM, 2001)

According to (Baabereyir, 2009), the source classification of waste is based on the fact that waste emanates from different sectors of society such as residential, commercial and industrial sources. A good example of the source classification was provided by the (World Bank, 1999) in a study in Asia which identified the sources of waste as residential, commercial, industrial, municipal services, construction and demolition, processing and agricultural sources.

Table 2.4 Sources and types of municipal solid waste

Sources	Typical waste generators	Types of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government center, hospitals, Prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas
Construction and demolition	New construction sites, road repairs, renovation sites, demolition of buildings	Wood, steel, concrete, dirt
Process (manufacturing, etc)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing	Industrial process wastes, scrap materials, off specification products, slay, tailings
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms	Spoilt food wastes, agricultural wastes, hazardous wastes (e.g. pesticides).

Source: World Bank/SWMA, (1999).

Classifying wastes by their sources is a useful way of determining the relative contributions of the different sectors of society to the waste stream and how to plan for their collection and disposal.

2.05 Solid waste management concept

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 the environment generally. The unhealthy disposal of solid waste is one of the greatest challenges facing developing countries (Kofoworola, 2007). Gbekor (2003), for instance indicated that, waste management involve "the collection, transport, treatment and disposal of waste including after care of disposal sites". Similarly, (Gilpin, 1996) has defined waste management as "purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner" while (Schubelleret al., 1996) focus on municipal solid waste management which they define as "the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas". Magutu and Onsongo (2011) have said that Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Municipal services types of solid waste include Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas (UNEP, 2005).

2.06 Urbanisation and solid waste management

Rapid urbanization and the associated growth of industries and services is an essential feature of economic and demographic development in most developing countries. Cities are currently absorbing two-thirds of the total population increase throughout the developing world (UNCHS, 1993). Another striking growth is the steady growth in size of cities. One of the most important environmental consequences of urbanization is the amount of solid waste that is generated. These wastes have fast outstripped the ability of natural environment to assimilate them and municipal authorities to dispose of them in a safe and efficient manner. The resulting contamination affects all environmental media and has a direct negative effect on human health and the quality of urban life (Magutu and Onsongo, 2011).Most governments all over the world where waste management services have successfully been done subsidize the budgets for solid waste management up-to over 60 percent. In Japan for example before privatization of solid waste management services, government subsidy to SWM used to be 80 percent while in Sweden it is 70 percent despite residents still paying an equivalent of Kshs 800 per month for the solid waste management services. Accra in Ghana, residents pay up to Kshs 700 per month for the solid waste management services (ibid; Rio de Janeiro, 1992).

3.0 Methodology and organisational profile

This research was exploratorybecause, it explores the elements of solid waste management system within KMA. The research strategies used were survey and single case embedded study. Thus the unit of analysis was employees of the waste management department of KMA, which is the case organisation.The choice was madebecause of strategic location of Kumasi as a commercial center of the country and easy access to information. The case was important because, it is the department responsible for ensuring that Kumasi is kept clean.

The population of the study was made up of the workers of waste management department at KMA. The total population was 350comprise management staff, supervisors, and conservative workers (including sweepers, refuse truck drivers, and drain desilters). The sample size used was 200 because, according to (Saunders et.al, 2007), for a population of 400 a minimum sample size of 196 should be used to achieve a 5% margin of error. This was rounded up to 200 for both easy calculation and in anticipation of non response. Convenience sampling method (a non-probability sampling method) was use to obtain data from the employees. This technique involves selecting samples of convenient elements by the interviewer which means that respondents were selected because they were coincidently in the right place at the right time for the questionnaire (Saunders et.al, 2007).The researchers stopped administering the questionnaires after achieving the desired sampling size.However, purposive sampling method was used for Management Staff andSupervisors since all of them were sampled. The breakdown is as follows:

Table 3.1 Sample size and sampling method table

Unit of Analysis (Population Groups)	Population Size	Sample Size	Sampling Method
Management Staff	15	15	Purposive
Supervisors	40	40	Purposive
Conservative Workers	295	145	Convenience
TOTAL	**350**	**200**	

(Source: Author's Fieldwork, 2013)

The sources of data were both primary and secondary.The Secondary data were sourced from the KMA web sites and organisational diary.On the other hand, theprimary source which is first hand information from the employees directly was collected, using Self-administered questionnaire instrument. The questionnaire was prepared to elicit information on waste management variables within KMA waste management department and was conveniently distributed among the employees of that department. The questions were prepared after intensive review of literature from journal articles, books, official publications, thesis reports, interviews, observations, and internet resources; it was developed based on the research questions and objectives. The researchers administered the questionnaire personally and it was easy getting access to the employees and administering the questionnaire to them. The questionnaire was developed using a Likert scale technique and it comprised twenty (20) questions dealt with the solid waste management elements or practices. For the purpose of this study, only

permanent employees were given the questionnaires to fill. In order to ensure that respondents had a fair idea on the waste management practices at KMA.
All data were coded and analysis were carried out using the Statistical Package for Social Sciences (SPSS) version 16.0 and Microsoft Excel 2007 Software to measure the means of all the factors of waste management, standard deviation, correlation coefficient, frequency, and percentages. All the two hundred (200) questionnaires administered were received representing 100% response rate, since the respondents answered them instantly because the questionnaire had a very simple structure. To ensure validity and reliability, the questionnaire was pilot tested to 10 employees of KMA. This helped the researcher to correct any ambiguity. Notwithstanding, some challenges faced during the research, it did not in any way affected the reliability, validity, credibility, and accuracy of the result.

4.0 Data presentation, analysis, and discussions

4.01 Solid waste management practices of KMA

In order to understand the waste management practices of KMA, a 7 stage waste management processes were used. Each of these stages/elements had a number of constructs testing them. The respondents were asked to indicate the extent to which they agree or disagree with the various constructs testing the practices in a five-point likert scale of "strongly agree", "agree", "neutral", "disagree", and 'strongly disagree". Strongly agree carries the highest weight of 5 score, and strongly disagree carries the weight of 1 score.

Table 4.1 Frequency Results of waste generation, onsite waste handling, etc N= 200

Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Waste Generation constructs					
There is adequate system in place to reduce waste generation	15	33	44	46	62
The households generate the highest amount of waste followed by markets, industries, and institutions	61	47	46	31	15
The waste generation is expected to rise in the subsequent years	60	66	44	22	8
Average	**45**	**49**	**45**	**33**	**28**
Onsite Waste Handling					
Waste are properly sorted by generators at source	0	22	66	23	89
Waste are properly stored in containers, etc by generators	16	50	33	67	34
Generators processed waste using techniques like backyard composting	0	80	20	40	60
Average	**5**	**51**	**40**	**44**	**61**
Waste Collection Practices					
Collected waste are transferred to central transfer station first	10	150	5	22	13
The municipality has sufficient transportation facilities	0	40	20	100	40
Average	**5**	**95**	**12**	**61**	**27**
Sorting, Processing, and Transformation					
Waste are properly sorted at transfer stations	40	40	20	60	40
Waste are process to recover conversion products and energy	18	36	22	38	86
Waste are transformed using techniques like shredding, thermal, and chemical means	22	20	30	55	73
Average	**27**	**32**	**24**	**51**	**66**
Transfer and Transport					
Wastes are transfer from smaller collection vehicles to larger transport equipment.	50	100	25	10	15
Waste are transported over long distances to disposal sites	89	111	0	0	0
Waste are properly covered during transportation	20	30	40	50	60
Average	**53**	**80**	**22**	**20**	**25**
Waste Disposal Practices					
Waste are disposed by land filling	200	0	0	0	0

Waste disposal are properly controlled	18	35	61	50	36
Landfill sites do not complain about waste nuisance	12	18	20	125	25
Only residual waste are disposed	0	22	40	64	74
Average	**57**	**19**	**30**	**60**	**34**
Energy Generation					
The metro has energy generation facility	0	0	88	44	68
Waste are used to generate energy	5	4	10	20	161
Average	**3**	**2**	**49**	**32**	**114**

Source: (Computation based on data gathered from authors'fieldwork 2013).

Table 4.2 Result of mean standard deviation, etc on all elements of waste management practices of Kumasi Metropolis.

Variables	N	Mean	SD	Coefficient of variation	Confidence level @ 95% Lower	Upper
Waste Generation constructs						
There is adequate system in place to reduce waste generation	200	2.47	0.16	6.55 %	2.44	2.49
The households generate the highest amount of waste followed by markets, industries, and institutions	200	3.54	0.57	15.98%	3.46	3.62
The waste generation is expected to rise in the subsequent years	200	3.74	0.65	17.33%	3.65	3.83
Average		**3.25**	**0.46**	**13.29%**	**3.18**	**3.31**
Onsite Waste Handling						
Waste are properly sorted by generators at source	200	2.11	0.37	17.43%	2.05	**2.16**
Waste are properly stored in containers, etc by generators	200	2.74	0.31	11.37%	2.69	**2.78**
Generators processed waste using techniques like backyard composting	200	2.60	0.62	23.93%	2.51	**2.69**
Average		2.48	0.43	17.58%	2.42	2.54
Waste Collection constructs						
Collected waste are transferred to central transfer station first	200	3.61	1.28	35.35%	3.43	3.79
The municipality has sufficient transportation facilities	200	2.30	0.42	18.34%	2.24	2.36
Average		2.95	0.85	26.84%	2.84	3.07
Sorting, Processing, and Transformation						
Waste are properly sorted at transfer stations	200	2.90	0.33	11.54%	2.85	2.95
Waste are process to recover conversion products and energy	200	2.31	0.15	6.56%	2.29	2.33
Waste are transformed using techniques like shredding, thermal, and chemical means	200	2.32	0.08	3.67%	2.30	2.33
Average		2.51	0.19	7.26%	2.48	2.53
Waste Transfer and Transport Practices.						
Wastes are transfer from smaller collection vehicles to larger transport equipment.	200	3.80	0.84	22.14	3.68	3.92
Waste are transported over long distances to disposal sites	200	4.45	1.22	27.39	4.28	4.61
Waste are properly covered during transportation	200	2.50	0.12	4.90	2.48	2.52
Average		3.58	0.73	18.14	3.48	3.68
Waste Disposal constructs						
Waste are disposed by land filling	200	5.00	2.24	44.72	4.69	5.31
Waste disposal are properly controlled	200	2.75	0.28	10.06	2.71	2.78
Landfill sites do not complain about waste nuisance	200	2.34	0.45	19.12	2.27	2.40
Only residual waste are disposed	200	1.41	0.27	19.19	1.37	1.45
Average		2.87	0.81	23.27%	2.76	2.98
Waste Energy Generation constructs						
The metro has energy generation facility	200	2.10	0.54	25.75%	2.03	2.17
Wastes are used to generate energy	200	1.36	0.30	22.14%	1.32	1.40
Average		1.73	0.42	23.94%	1.67	1.78

Source: (Computation based on data gathered from authors' fieldwork 2013).
NB: The mean for a five point likert scale is 3.00 with standard deviation (S.D of 1.58) and coefficient of variation of 52.67%.

4.02 Discussion of results

4.2.1 Waste generation elements

From table 4.2, the mean figures for the three constructs tested range from 2.47 to 3.74. The lowest mean figure was recorded on the construct "there is adequate system in place to reduce waste generation". The recorded mean figure of 2.47 is below the mean figure of 3 on a five point likert scale. This means that KMA has not put in place adequate measures to reduce waste generation. The highest mean figure was recorded on the construct waste generation is expected to rise in the subsequent years. This is consistent with the first constructs, since inadequate waste reduction system will automatically lead to rising waste generation. On the confidence level the lower confidence level ranges from 2.44 to 3.65, and the upper confidence level ranges from 2.49 to 3.83. There is a 95% confidence level that the mean figure for the construct waste generation is expected to falls between 3.65 and 3.83. On average the entire waste generation construct had a mean figure of 3.25 which is slightly above the "Neutral" response with a standard deviation of 0.46. There is a 95% confidence level that, the mean figure was 3.18 to 3.31 with coefficient of variation of 13.29%.From Table 4.1 it can be seen that majority 94 respondents 'Agree' that, KMA generate more waste, and these wastes are expected to rise but no adequate measures have been put in place to reduce waste generation. With this, a significant number 61 respondents 'Disagree' with the statement and 45 remain neutral. The result is a confirmation of what is seen in Table 4.2 that KMA generate more waste and wastes are expected to rise but no adequate measures have been put in place to reduce waste generation.

4.2.2 Onsite waste handling elements

From table 4.2, all the constructs tested for onsite waste handling had mean figures below 3. This means that the respondents disagree with the constructs. What this implies is that, wastes are not properly sorted by generators at source. That is waste generators do not properly separate all forms of solid waste. In addition the respondents also agree that wastes are not properly stored in containers by generators. Also generators do not properly processed waste. On average the entire constructs for onsite waste handling recorded a mean figure of 2.48 and a standard deviation of 0.43, all below the mean figure of 3 and standard deviation of 1.58 on a five point likert scale. There is a 95% confidence level that the mean figure for the entire constructs tested falls between 2.42 and 2.54 with a relative distribution variation of 17.58%.According to Table 4.1,61 respondents 'Agree', and majority 105 'Disagree' that, waste is properly handled at the onsite level but 40 remained 'Neutral'. This is in agreement with Table 4.2 that, waste is not properly handled at the onsite level.

4.2.3 Waste collection practices

From table 4.2, a mean figure of 3.61 was recorded on the construct 'collected waste are transferred to central transfer station first'. This is just above the mean figure of 3 on a five-point likert scale. There is a 95% confidence level that the mean figure for this construct falls between 3.43 and 3.79. On the construct the metropolis has sufficient transportation facilities; a mean figure of 2.30 was recorded. This figure is below the neutral response rate of 3. The implication is that the municipality is poorly resourced in terms of transportation facilities. The effect is that waste may not be properly transported. The entire waste collection element had a mean figure of 2.95 and a standard deviation of 0.85. There is a 95% confidence level that the mean for the waste collection element falls between 2.84 and 3.07.Table 4.1also indicatesthe same assertion from Table 4.2 that, KMA has poor waste collection practices. While 100respondents indicate'Agree', 88 'Disagree' and 12 remain 'Neutral'.

4.2.4 Wastes sorting, processing, and transformation

From table 4.2, the construct waste are properly sorted had a mean figure of 2.90 which is below the mean of 3. All the other constructs also had mean figures below 3. Waste are transformed using techniques shredding had mean figures below 2.32. The entire Sorting, Processing, and Transformationelements had mean figure of 2.51 with an average standard deviation of 0.19. The standard error of mean for the tested element is 0.01 with coefficient variation of 7.26%. There is a 95% confidence level that the mean figures for the Sorting, Processing, and Transformation element range from 2.48 to 2.53. The implication of the findings is that the respondents believe there is lack of adequate Sorting, Processing, and Transformation practices. Since a mean figure of 3 corresponds to average (neutral) performance, a mean figure below 3 is a weak performance. This means that from the point of view of respondents waste are neither properly sorted at transfer stations, not converted into energynorother useful products. It is discerning from Table 4.1just as in Table 4.2 that, KMA do not appropriately sort out waste into various components, appropriately processed, or transformed.

4.2.5 Waste transfer and transport practices

From figure 4.2, waste transported over long distances have mean figure of 4.45 with a standard deviation of 1.22. this may be good as dumping site may be far from the city centre hence the city may be spared of the negative effects of dumping sites like rodents, bad odour, insects, etc. waste are properly covered during transportation had a mean figure of 2.50 which is below 3. The implication is that relatively, wastes are not properly covered during transportation. The entire waste transport and transfer had average mean of 3.58 which is above the mean figure of 3, with the standard deviation of 0.73. The standard error of mean is 0.05. This means that the probability that the sample is not representative of the population is 0.05 or 5%. There is a 95% confidence level that the mean figure for the entire waste management transfer and transport element tested is 3.48 and 3.68.Table 4.1shows that waste are moderately transfer and appropriately transported over long distances to sites outside the central business and residential districts by the KMA. It can be seen that majority 133 respondents ‘Agree’, with the statement,45 ‘Disagree’ and 22indicated ‘Neutral’.

4.2.6 Waste disposal practices

From table 4.2, waste are disposed by land filing had the mean value of 5 and a standard deviation of 2.24. This means that the respondents strongly agree that KMA disposes it waste at land fill sites. On waste disposal are properly controlled, a mean figure of 2.75 was recorded. This is below the neutral mean figure of 3; this thus indicates that the respondents disagree with the assertion. What this implies is that the respondents think that wastes disposals are haphazardly done. A mean figure of 2.34 was recorded on the construct residence around landfill sites do not complain about waste nuisance. Clearly this confirms the disagreement on the construct waste disposal is properly controlled. A mean figure of 1.41 on the construct only residual waste are disposed clearly indicates that the Metropolis do not convert waste into energy or recycle them but just disposed them off. The entire waste disposal practices recorded an average mean figure of 2.87 and a standard deviation of 0.81. The lowest standard error of the mean was recorded on the constructs waste disposal are properly controlled and only residual waste are disposed. This means that the probability that the sample size represent the population is higher for these two constructs than the other two. The reason being that, for standard error the higher the sample size the lower the standard error. The coefficient of variation for the entire construct is 23.27%. There is a 95% confidence level that the mean figure for waste disposal practice is between 2.76 and 2.98. It is clearly show from Table 4.1 that KMA do not appropriately dispose its solid waste. This is consistent with Table 4.2

4.2.7 Energy generation practices

From table 4.2, the metropolitan has energy generation facility recorded mean figure of 2.10 just above the “Disagree” weight of 2. There is a standard deviation of 0.54 and a standard mean of deviation of 0.04. The coefficient of variation for this construct is 25.75%. There is a 95% confidence level that the mean figure for this construct falls between 2.03 and 2.17. The implication is that wastes are not converted into energy. This deduction is confirmed by the 1.36 mean figure recorded for the constructs wastes are used to generate energy. There is a 95% confidence level that the mean figure for this constructs falls between 1.30 and 1.40 with a standard error of the mean of 0.02. The average mean of the energy generation practices tested had a mean figure of 1.73 with a standard deviation of 0.42 and a standard error of mean of 0.02. There is a 95% confidence level that the mean figure for this practice falls between 1.67 and 1.78. The managerial implication is that by not converting wastes to energy, a developing country like Ghana is bound to have waste disposal problems.From Table 4.1 majority 146 of the respondents 'Disagree' that there is effective energy generation from waste within the Kumasi Metropolis; While only 5 respondents 'Agree', with the statement49 remained 'Neutral'.

5.0 Summary of key findings, conclusions, and recommendations

5.01 Summary of key findings

The following are the summary of key findings with respect to the analysis of empirical data:

5.02 Waste management practices of KMA

The following are the key findings of the elements of waste management practices of KMA:

1. It was found that, waste generation recorded a mean figure of 3.25 which is just above 3. This means that KMA generate more waste. These wastes are expected to rise but no adequate measures have been put in place to reduce waste generation.
2. Onsite waste handling recorded a mean figure of 2.48 which is below 3. This shows that waste is not properly handled at the onsite leveland that wastes are not properly sorted, stored and processed by generators.
3. Waste collections recorded a mean figure of 2.95;this is also an indication of poor waste collection practices.
4. Waste sorting, processing, and transformation recorded a mean figure of 2.51. This once again shows that KMA do not appropriately sort waste into various components, not appropriately processed, and not transformed.
5. Waste transfer and transport recorded a mean figure of 3.58 showing that waste are moderately transferred and appropriately transported over long distances to sites outside the central business and residential districts.
6. Waste disposal recorded a mean figure of 2.87 also clearly showing that KMA do not appropriately dispose its solid waste.

Finally, Energy generation from waste also recorded the lowest mean figure of 1.73. The implication is that KMA is not making good use of waste which has become a major resource for some countries.

5.03 Conclusions

From the above, it can be concluded that on the waste management practices, what KMA seems to be doing appropriately are having moderate waste generation system and waste transfer and transport systems. However, on other practices: onsite waste handling; waste collection; waste sorting, processing, and transformation; waste disposal; and energy generation practices are far from being appropriate.

5.04 Recommendations

On the basis of the findings the following managerial recommendations are made:

1. KMA should put in place adequate measures to ensure that waste is handled appropriately at the onsite stage.
2. Waste must be properly and adequately collected.
3. Waste must be properly sorted, processed, and transformed using techniques like shredding, thermal, and chemical means.
4. Waste must be properly disposed, such as proper control of waste, managing the menace of landfill sites, and only residual waste should be disposed.
5. KMA should put in place measures to generate energy from the solid waste generated in the metropolis.
6. Technical issues like sophisticated waste equipment and city infrastructure must be looked into.
7. The civil society should actively involve themselves in waste management issues.

Finally, it is recommended that further studies needs to be conducted to identify all other factors other than those identified in this study that leads to inefficiencies in KMA solid waste management practices.

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