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Logistic Challenges in Urban Waste Management in Ghana (A case of Tema Metropolitan Assembly)

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ABSTRACT

Waste handling is one of the greatest challenges facing humankind in modern times in spite of the numerous technological advancements that the world has experienced in recent times. The issue of waste management is a major problem confronting Ghana with detrimental effects on the nation's economy, health of the citizenry and the social standing of the nation among community of nations. This problem is of keen concern to Ghana, particularly when it is clear that Ghana is one of the nations in South Saharan African with the potential of becoming a major tourism destination to many nationals the world over. The study therefore sought to identify the logistical issues that confront the most industrious metropolis of Ghana - the Tema Metropolitan Assembly (TMA), in the management of waste within the metropolis. The researchers employed a combination of simple random and purposive sampling techniques to conduct cross sectional survey on 182 samples during the conduct of the study. The study found that waste management companies operating within the metropolis seriously lack the desired logistics to execute their mandates of ensuring a clean city. The study further established inadequacy of household waste collection bins as the key logistics that the waste management companies lacked. This therefore prevents households from separating waste into the various components for easy management. Food debris, plastic solid waste, paper waste, bottles, cans/metals as well as old clothes were the main waste generated in the TMA. The study concludes that there is a general lack of key logistics (waste collection bins, trucks and site technologies) to manage waste in the Tema Metropolitan Assembly.

Key words: logistics, waste, management, climatic, humankind

1.0 Introduction

"Waste handling is one of the greatest challenges facing humankind in modern times in spite of the numerous technological advancements that has been experienced in recent time. Technology alone has not been able to effectively control waste generated in communities worldwide. Rather, it appears that new technologies bring new types of waste into the environment to add to the complex accumulation puzzle" (Kwawe, 1995: 53). Waste management is the collection, transportation, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effects on health, the environment or aesthetics. Waste generally involves solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for handling each.

"Recent events in major urban centres in Africa have shown that, the problem of waste management has become a monster that has aborted most efforts by city authorities, states and federal governments, and professionals alike". (Onibokun, 1999: 2).

"As industrialized countries run short of sites for dumping waste, the need to recycle more rubbish grows increasingly urgent" (Chazan, 2002: 1).

Events of the 20th century and early into the 21st century however indicate that waste, in whatever form or classification: solid, liquid, or toxic, has become a major consequence of modernization and economic development. It is well known that until recently the Rhine in Germany and most of the rivers in Britain had dangerously high levels of nitrate, coal and iron deposits as a result of chemical and/or toxic waste dumped into them from iron and steel industries. In most of these developed countries such as Britain, USA, Ireland and France there has been a tendency to rely on landfills to reduce waste accumulation, which compared to other means of waste disposal like incineration and composting has the ability to contain and dispose greater proportions of waste produced and seemed to be relatively less costly (Kwawe, 1995: 53; Chazan, 2002: 1). However the current upscale in issues related to landfills sites such as pollution of ground water, "Not in my backyard", and competition for housing development complexes raises questions as to the sustainability of landfills as a panacea to waste accumulation problems in developed countries (Kwawe, Chazan and Botkin et al, 2003). Kwawe (1995: 54) reports that by 1995 half of a million tons of waste generated in central London were being transported for a distance more than 64 kilometers to be dumped because all dumping sites in central London were full. Botkin and Keller (2003) also point to the same problem involving the cost of construction, transportation and managing landfill sites in the USA and warn that the USA may be close to running out of landfill space because of the sheer amount of refuse produced on daily basis. There is nevertheless a small group of countries namely Austria, the Netherlands, and Denmark, that have evolved necessary management processes

to efficiently resolve the waste disposal problem by essentially coaxing their citizens to separate their domestic solid waste into glass, paper and plastic categories; thereby enabling easy collection and subsequent reuse. According to the Institute of Waste Management, UK recycles only 11% of its household waste, Italy and Spain only 3%, Netherlands 43%, Denmark 29%, and Austria 50% respectively (IWM cited in Chazan: ibid).

Developed countries are not the only ones struggling with rapid accumulation of waste.

Whilst in the past, solid, liquid and toxic waste disposal was perceived as problems of *over* development, today the questions of urban waste management and by extension those of environmental degradation pose some of the daunting tasks facing African countries. According to Ole Lyse (2003:1), 9 out of every 10 African cities are facing serious waste disposal problems. Indeed, a visit these days to some towns and cities in Ghana will reveal manifestations of the waste management problem such as heaps of uncontrolled rubbish bags, polythene bags and unmanaged disposal sites constituting a health hazard to residents who live near the dumping sites.

This situation is not so different in many other countries in south of the Sahara. In South Africa, Zambia and Zimbabwe rubbish bags is a major eyesore (Chazan, 2002: 1; Lyse, op. cit: 1;Wetherell, 2003: 1). South Africans refer to black polythene bags as the "national flower" because it blights landscapes and can be seen hanging on fences, in gutters and blocking drains (Chazan, op. cit.: 1).

In Ghana it has been infamously dubbed "the Father Christmas bag" because it is the most common polythene bag used by shops and roadside vendors when one purchase their goods which, inevitably end up in gutters, drains and high voltage electric lines.

1.1 **The study focus**

The issues of environmental challenges caused by inefficient waste management strategies are more pronounced in Africa for that matter Ghana. This study therefore seeks to explore the various logistics challenges imbedded in the management of urban waste in Ghana with a focus on Tema Metropolitan Assembly. For the purpose of our study, we would limit our selves to solid waste management which is a kind of waste mostly generated by households.

1.2 O**bjectives of the study**

The study seeks to:

(1) Identify the types of waste that Tema Municipal Assembly deals with
(2) Investigate the role of various stakeholders in the management of waste in the Assembly.
(3) Analyse the logistical challenges that confront the Assembly in its waste management efforts.

2.0 Literature Review

2.1 The waste management scene in Ghana: the socio-cultural milieu

In the Ghanaian societal settings, cleanliness is broadly embraced as a virtue but most of the time the perception of cleanliness is restricted to one's immediate environs with little care for what happens outside one's household. The belief is that the state will take care of things hence one should not be bothered. This kind of orientation has some historical underpinning since in the colonial days; Ghanaians were alienated from events that took place outside their homes Tsiboe et al (2004). Moreover, sanitation and its related issues were seen as the preserve of the colonial administration that usually employed sanitary officers to take care of the environs (Kendie, 1999). In general terms, Kwawe (1995), Benneh (1993), Agbola (1993) and numerous researchers have proved how traditional beliefs and practices in Ghana are in fact pro-environmental. There are for example dozens of folklores and myths about environmental protection and good sanitation and hygienic behaviour. The earth is regarded as 'mother god' and must be treated with reverence hence explaining why the rural folks see it expedient to separate waste to avoid contaminating 'Mother god'. In a sense, poor waste management and unhygienic conditions in the communities in the urban areas are often traced to the new wave of urban culture in Ghana. This new wave of urban culture has been necessitated by economic hardships, and high urban population growth rates in Ghana from the 1980s onwards (Kendie, 1999: 2). Since the 1980s, urban population in Ghana has been growing by 3.9 % on the average per annum (Amis, 1989: 12). The econometrics assumption under the invented 'U' argument is that urban population is actually good for the environment since it means an increase in urban productivity which in turn leads to the availability of funds earmarked for environmental health improvement (Ayres; 1998: 139). On the contrary, in the case of Ghana, this assumption is an illusive one since the growth in urban population has led to unemployment (because the rural folks who migrate to urban centres come with virtually no skill). The consequence of this is untold pressure on the limited infrastructure hence poor environmental and sanitary conditions in the cities. The other facet of the perception and attitude towards waste is the way the educated ones perceives it. It is quite rare to see young graduates who have the aspiration to work with anything connected to waste. In the 1960s and 70s, it was even considered to be a stigma to work with the ministry of local government and the TMA since they deal directly with local politics and environmental and sanitation issues. Even though civic awareness and re-orientation have largely suppressed this mentality, official records indicate that the TMA still lacks the requisite personnel to conduct its work in waste handling indicative of the fact that the problem may still exist on a much lower scale (Post and Obireh, 2003; Porter et al 1997).

2.2 Interface between logistics, the environment and solid waste management

The interface between logistics and the environment viz – a – viz waste management embedded in the value adding functions a firm performs. Adapted from (Porter M.E. (1985)'s, value chain concept, illustrates the resource conversion and pollutant generation relationships. As resources are used to create desired utilities, pollutants are implicitly produced as byproducts during each step of the integrated supply chain process. For example, packaging is used to protect the products from damage and is an undesired item once the products are consumed. Proper management and awareness of the environmental implications of logistics activities can significantly reduce the negative impact. Integrative environmental management means that every element in the corporate value chain is involved in minimizing the firm's total environmental impact from start to finish of the supply chain and also from beginning to end of the product life cycle. Managers must reassess their logistics decisions in such a way that they can respond to impacts coming from other functions such as marketing and manufacturing and from external sources such as the government and the consumer. Logistics managers play a critical role in the company's environmental management programme because their decisions, though affected by other functional decisions in the supply chain, have a direct impact on the environment. Logistics decisions intimately interact with other business functions. Inventory management, for example, is an important part of logistics from purchasing all the way to service parts management. (How–Jan Wu 1995:20 -38). The challenge for logistics managers is to determine how to incorporate environmental management principles into their daily decision-making process. (Aron,1994) intimated that Paramount to accomplishing this is understanding the trade-offs between environmental impact and optimal supply chain efficiency.

Environmental issues involve matters of public concern which can have a negative impact on the natural or physical environment (Porter M.E. 1985). Environmentalism has been characterized as the most significant force shaping most economies, as well as the most important issue facing business during the 1990s. Some corporate executives, in fact, believe that the 1990s will be the "decade of the environment." A similar sentiment pervades the logistics discipline. T.A. Foster (1992) argued that "for logistics, the environment will be the issue of the 1990s''. Likewise, according to Cooke (1991), "the issue of the times for logistics managers will be to handle the burgeoning environmental restrictions imposed on transportation and distribution."

Similarly, Cavinato (1991:32) suggests that public policy in the 1990s is likely to emphasize environmental and social considerations, rather than economic ones. The growing importance of environmentalism is suggested to have two major impacts on logistics management: 1) a broadening of the scope of logistics, and 2) an influence on the way logistics managers do their jobs. With respect to broadening the scope of logistics, the logistics discipline has generally focused on transportation, warehousing, inventory management, and so on, from the perspective of forward distribution, i.e., producer-to-consumer movement of products. Because of environmentalism, the concept of "reverse" distribution, that is, consumer-to-producer movements, has become more prevalent. In fact, the Council of Logistics Management recently sponsored a research project focusing on "reverse logistics", which is defined as "...all issues relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials, and disposal." As pointed out above, environmentalism will have a tremendous influence on the way that logistics managers do their jobs. For example, concerns about solid waste disposal have caused firms to develop more efficient packaging and to recycle packaging materials.

2.3 **The way out of logistics challenges and environmental menace**

Reverse logistics, a fairly new concept in logistics, has gained increasing importance as a profitable and sustainable business strategy and a way out of the logistics challenges that confronts companies and the environmental menace posed by companies' activities. The strategic factors consist of strategic costs, overall quality, customer service, environmental concerns, and legislative concerns. The operational factors consist of cost-benefit analysis, transportation, warehousing, supply management, remanufacturing and recycling, and packaging. Insights about these factors together form the state-of-the-art knowledge about the keys to successful design and use of reverse-logistics systems. Reverse logistics is a process in which a manufacturer systematically accepts previously shipped products or parts from the point for consumption for possible recycling, remanufacturing, or disposal. A reverse-logistics system incorporates a supply chain that has been redesigned to manage the flow of products or parts destined for remanufacturing, recycling, or disposal and to use resources effectively. Reverse logistics has received a great deal of attention from operations managers and company executives. The issues surrounding functions, channels, differences between forward and reverse operations, cost, and other general information about reverse logistics have been described by Kopicki et al. [1993], Pohlen and Farris [1992], Sarkis [1995], Stock [1992], and Thierry et al. (1995).

2.3 Logistical challenges (issues) in urban solid waste management

2.3.1 Collection and Transport

Transportation of waste from households, factories, and other generation sites is a growing problem. The rapid urbanization of much of the developing world leaves little time for adequate layout and planning; many of the most rapidly growing parts of cities are at the periphery of existing settlement. Garbage dumps, with their associated disease, odor and frequent fires (in some cases) would ideally be located on suitable land away from the most densely populated areas. These areas are becoming harder to find as population urbanized and

municipal traffic increases; the transportion of waste becomes longer and more time-consuming, and therefore more expensive and less efficient. Many communities employ neighborhood-level collection points, where households are responsible for transport to the transfer point and the municipal or private enterprise transports the waste from there to the ultimate disposal location. Transport also relies on operational vehicles, and frequent breakdowns coupled with parts shortages can immobilize collection vehicles for extended periods of time. UNEP (1996) estimates that in cities in West Africa, up to 70% of collection/transfer vehicles may be out of action at any one time.

In areas where there exist collection services which remove waste from individual households or streets, often there are no standardized containers used to store waste prior to pickup. Headley (1998) states that in Barbados, there are no containers designated by municipalities or collection companies to "set out" waste for collection; it is up to individual residences to designate some sort of collection container. Frequently, these are plastic barrels or discarded oil drums, however the majority of households simply place grocery bags full of waste on the street to await collection. There may be physical dangers to waste workers in dealing with the former; weather, animals, and other disturbances prior to collection threaten the integrity of the latter. In an examination of current problems in Kenya, Mungai (1998) agreed that the first step in "sanitary and efficient" waste management must be to ensure that all households use some form of corrosion-resistant container with lids in order to facilitate collection. Lidded containers would exclude most animal pests, reduce the amount of rainfall soaking into garbage and help to reduce trash blowing about on the street.

2.3.2 **Nature of waste and logistics implication**

A higher solid waste density has many implications for the 'traditional' methods of collection and disposal; collection and transfer trucks which are able to achieve compression rates of up to 4:1 in industrialized nations may achieve only 1.5:1 in developing countries, and landfill compression technology which averages volume reduction of up to 6:1 in industrial nations may only achieve 2:1 compaction with these increased waste densities (Cointreau 1982). Compactor trucks would therefore probably not be useful in many applications; as income level increases and the amount of post-consumer waste such as packaging increases correspondingly, such technologies may be more appropriate. Additionally, the high moisture content and organic composition of wastes in the developing world may lead to problems of increased decomposition rates in areas with high average daily temperatures; high seasonal or year-round rainfall would only compound these problems, presenting additional challenges with insect populations and conditions conducive for disease. To mitigate these problems, much more frequent collection is needed in hot, humid areas to remove organic wastes before they are able to decompose than would be needed in cooler, drier climates. Although daily collection has proven unreliable or unworkable in many cities (Cointreau 1982), perhaps a twice-weekly collection of organic material (possibly in conjunction with a municipal composting operation), would be sufficient to reduce decomposition.

3.0 Methodology of the study

3.1 Study design

This study adopted an exploratory design as it seeks to unearth issues that have not received extended investigation especially in the Ghanaian context.

3.2 Population and Sampling techniques

The population of the study is 3400 households in the Tema Metropolis. The researchers employed simple random sampling technique to draw 200 household out of a population of 3400 (GSS PHC, 2000) households that made up the population of the study.

Additionally, five (5) officials made up of staff of TMA, EPA and the private waste management agencies which operate in the area were purposively selected for in-depth interview to explore further into the issues under investigation.

3.3 Methods of data analysis

The statistical methods used for the data analysis involved descriptive statistics. At each level of the analysis, cross tabulations and chi-square tests were employed to detect any dependency of the responses on the independent variables of the study. Lind et 'al (2005) mentions one use of the chi-square test as contingency test where it is used to determine whether the value of one discrete variable is contingent upon the value of a second variable. Thus, for a contingency table that has *r* rows and *c* columns, as in cross tabulated tables, the chi square test can be thought of as a test of dependence/independence. The chi-square distribution statistic is defined as follows by Lieberman (1971):

$$\chi^2 = \frac{\sum (O_{ij} - E_{ij})^2}{E_{ij}}$$

With df = (I-1) x (J-1) and where:

O_{ij} = the frequency of the observed data of the i^{th} and j^{th} row and column respectively;

E_{ij} = the frequency of the expected values of the i^{th} and j^{th} row and column respectively;

I = total number of rows of the contingency table

J = total number of columns of the contingency table

Using 5% level of significance (α = 0.05), the p-values of the chi-square statistics were compared to the α of 0.05 and those of the response found to be less than the α-value were concluded to be dependent on the independent variables for the study.

For the responses of the open ended questions of the questionnaire and the interview guide, the study adopted a purely thematic and content data analysis approach as result of the qualitative nature of the collected data. Thus, every piece of information was read carefully, and the text sub-divided into meaningful units. Information were then condensed to formulate answers to the researchers' identified questions. The stepwise description of the data analysis approach is as presented by Merriam (1998) as follows: The first step is to organize the data in topical or chronological order so it can be presented in a descriptive manner. The next step is to classify the data into categories, themes, or types. The final step involves making conclusions, developing models, or generating a theory. The researchers finally employed Statistical Package for Social Sciences (SPSS) version 16 as a tool to analyse the field data.

4.0 Data analysis and discussion of the findings

The study achieved a response rate of 91.0% as 182 out of the distributed 200 questionnaires were retrieved. The researchers deemed this response rate acceptable to give a faire picture of the population from which they were drawn since according to Armstrong and Ashworth (2000) response rates of 60% and over are necessary to ensure that the replies of those responding will give an accurate picture of the population from which they are drawn. In their study of the corporate social responsibility practices of leading firms in Ghana, Ofori and Hinson (2007) also described a 90% response rate as remarkable as far as a Ghanaian survey is concern.

4.1 Waste generation in the metropolis

Table 1 presents the different types of solid waste generated by the respondents.

Table 1: Solid waste generated in the metropolis

Solid Waste Type	Frequency	Percent of Total Respondents
Food Debris	169	92.9
Plastic	117	64.3
Paper	65	35.7
Bottles/Cans	86	47.3
Old cloths	39	21.4
Others	1	0.5

Source: Field Survey (2011)

Food debris forms the major solid waste generated in the Tema metropolis. Out of the 182 respondents, 169 (92.9%) generates food debris as solid waste; 117 (64.3%) of the total respondents generate plastic solid waste; 86 (47.3%) generate waste that are of bottles and can nature; 65 (35.7%) generate paper waste; and 39 (21.4%) generate old clothes as solid waste. A respondent indicated other waste which was specified as jute bags.

The compositions of wastes generated in the metropolis have serious logistic implications. There is a higher solid waste density which according to Cointreau (1982), also has many implications for the 'traditional' methods of collection and disposal; collection and transfer trucks which are able to achieve compression rates of up to 4:1 in industrialized nations may achieve only 1.5:1 in developing countries, and landfill compression technology which averages volume reduction of up to 6:1 in industrial nations may only achieve 2:1 compaction with these increased waste densities. Compactor trucks would therefore probably not be useful in many applications; as income level increases and the amount of post-consumer waste such as packaging increases correspondingly, such technologies may be more appropriate. Additionally, the high moisture content and organic composition of wastes in the developing world may lead to problems of increased decomposition rates in areas with high average daily temperatures. High seasonal or year-round rainfall would only compound these problems, presenting additional challenges with insect populations and conditions conducive to disease. To mitigate these problems, much more frequent collection is needed in hot, humid areas to remove organic wastes before they are able to decompose than would be needed in cooler, drier climates although daily collection has proven unreliable or unworkable in many cities (Cointreau 1982).

The high generation of food debris can be attributed to the high frequency that respondents indicated for its generation. On a scale of 5 = Every day; 4 = Within couple of days but not more than a week; 3 = If can't tell; 2 = Within weeks and months; 1 = More than semi-annual (6 months), the most frequently generated waste was also found to be food debris. Food debris registered a mean score of generation of 4.10 followed by plastic and polythene, paper and paper products and bottles, metal and cans in that order with means of 3.70, 3.43 and 3.33 respectively. The result suggests respondents cannot really tell when they generated paper and paper products as well as bottles and cans.

In a more detailed evaluation during the interviews, the study found that solid waste is generated from various sources in the Tema Metropolitan Assembly. The types and quantities of waste depended on seasonal variations, socio-economic status of the individual generator, culture and productive activity. The main sources were found to include:

1. Domestic - predominantly made up of organic from kitchen and garden;
2. Commercial and institutional - waste from hotel, shops, markets, offices schools. Others are street and drain cleaning, sand, industrial and construction waste.
3. Industrial waste – various (slag from steel industries, etc,)
4. Other special waste – bio-medical waste. (Hazardous)

4.2 Waste management practice

This covers the assessment of the management practices used in solid waste disposal. It covers the storage items used, whether respondents separate their waste before storing them and if these stored solid waste are covered or not.

Table 2a: Storage items used for solid waste

Storage Item	Frequency	Percent
Plastic bin	56	30.8
Baskets	47	25.8
Polythene bags	32	17.6
Paper box	16	8.8
Old buckets	8	4.4
Others	25	13.7
N =182		

Source: Field Survey (2011)

As indicated in the table, the most predominant waste storage items used by respondents were plastic bin which recorded 56 (30.8%) of the respondents. Followed closely by basket which was 47 (25.8%) of the respondents. The result suggests high usage of permanent items as storage items in the study area. The remaining respondents make use of polythene bags (17.6%), paper box (8.8%) and old buckets (4.4%). A significant number, 25 (13.5%) indicated "Others" which was mainly specified as sacks with the most being fertilizer and jute sacks. This finding is similar to the one found in Barbados by Headley (1998). Headley (1998) states that in Barbados, there are no containers designated by municipalities or collection companies to "set out" waste for collection; it is up to individual residences to designate some sort of collection container. Frequently, these are plastic barrels or discarded oil drums, however the majority of households simply place grocery bags full of waste on the street to await collection. There may be physical dangers to waste workers in dealing with the former; weather, animals, and other disturbances prior to collection threaten the integrity of the latter. In an examination of current problems in Kenya, Mungai (1998) agreed that the first step in "sanitary and efficient" waste management must be to ensure that all households use some form of corrosion-resistant container with lids in order to facilitate collection. Lidded containers would exclude most animal pests, reduce the amount of rainfall soaking into garbage and help to reduce trash blowing about on the street.

When subjected to a chi-square dependency test, the type of item used as storage item was found not to depend any of the independent variables of the study except gender. For instance, the households with females heads were found to use more of basket (31.5% of the females) whilst the males mostly use plastic bins (40.0% of the males). Table 2b gives the cross tabulation of type of storage item in the household and the gender of the head of household. The Pearson chi-square statistic and the corresponding p-value recorded for the dependency of type of storage item used by a household and the gender of the household representative were 59.431 and 0.000 ($N = 182$, $df = 5$, $\alpha = 0.05$). This suggests a significant dependency at even 5% significance level since the p-value of 0.000 is less than the α-value of 0.05.

Table 2b: Gender and storage item used

Storage Items			Sex		Total
			Males	Female	
	Polythene bags	Count	15	17	32
		% within Sex	16.7%	18.5%	17.6%
	Basket	Count	17	29	47
		% within Sex	18.9%	31.5%	25.3%
	Paper box	Count	10	6	16
		% within Sex	11.1%	7.6%	9.3%
	Plastic bin	Count	36	19	56
		% within Sex	40.0%	20.7%	30.2%
	Old buckets	Count	2	6	8
		% within Sex	2.2%	6.5%	4.4%
	Others	Count	10	15	25
		% within Sex	11.1%	15.2%	13.2%
Total		Count	90	92	182
		% within Sex	100.0%	100.0%	100.0%

Source: Field Survey (2011)

Table 2c: Result of the chi-square test for the dependency of storage item used and gender of household head

Statistic	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	59.431[a]	5	.000
Likelihood Ratio	60.398	5	.000
N of Valid Cases	364		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.71.

Source: Field Survey (2011)

4.3 Waste Management in the Household Collection Stage

Out of the total of 182 respondents, only 32 (17.6%) indicated separation of solid waste at the household collection point. The extent to which respondents separate waste generated in their homes was the same across all sections of the independent variables of the study. Thus, the observed low waste separation attitude is the same across all educational backgrounds, gender, age, employment status, and marital status.

With regards to covering of generated waste however, 136 (74.7%) of the respondents indicated covering their household waste whilst awaiting transfer to dumping sites. When subjected to the chi-square dependency test, the extent of covering of waste was however found to depend on the educational background of the respondents. The result suggests that the higher the educational qualification of the respondents, the more the likelihood of indicating covering of generated waste. Tables 3a and 3b present the cross tabulation and the result of the chi-square test of dependency for covering of waste and educational attainment respectively. As indicated in table 4a, whilst 39.1% of the respondents with no formal education and 45.5% of those that indicated "Others" as their highest educational qualification do not cover the waste, only 10.8% of those with tertiary education qualification do not cover their household waste. The Pearson t-statistics and p-value results indicated the significant dependency of covering of waste and educational attainment is 13.321 and 0.021respectively (N = 364, df = 5, $\alpha = 0.05$).

Table 3a: Covering of waste and highest educational attainment

Cover Waste		Education					
		No formal	Basic	Secondary	Tertiary	Others	Total
Yes	Count	14	60	22	33	6	136
	% within Education	60.9%	73.2%	75.9%	89.2%	54.5%	74.7%
No	Count	9	22	7	4	5	47
	% within Education	39.1%	26.8%	24.1%	10.8%	45.5%	25.3%
Total	Count	23	82	29	37	11	182
	% within Education	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field Survey (2011)

Table 3b: Pearson chi-square test of dependency of waste covering on educational qualification

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.321[a]	5	.021
Likelihood Ratio	14.224	5	.014
N of Valid Cases	364		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is .72.

Source: Field Survey (2011)

4.4 Transportation of Domestic Waste

Household wastes are mainly transported to community waste disposal site by paid collection agents. Sixty four point six percent (64.6%) of the respondents indicated using this particular mechanism in transporting waste from their homes to the community waste disposal points. A lot of households however still make use of children and house-helps in conveying waste to community collection points. As indicated in table 4, 44 (24.2%) and 26 (14.3%) of respondents indicated the use of these mediums respectively in conveying waste to community collection points. The remaining respondents transport waste to community collection points by themselves (42, representing 23.1%) and other means (7, representing 3.8%). The result brings to light the significant role that private waste collection agencies play in the waste management process of the Tema community.

Table 4: Transportation of solid waste to the disposal site

Transport Mechanism	Frequency	Percent
Self	42	23.1
Children	44	24.2
House-help	26	14.3
Paid collection	63	34.6
Others	7	3.8
N = 182		

Source: Field Survey (2011)

At the general level, respondents seem not to be satisfied with the services of waste collection agencies. Out of the 182 respondents only 68 (37.4%) indicated satisfaction with the waste collection agencies whilst 89 (48.9%) indicated otherwise. The remaining 25 (13.7%) did not respond to this particular question.

4.5 Logistic issues in waste management

Majority of the household, seventy four 74 (40.7%) and 42 (23.1%) of the respondents indicated greatly inadequate and inadequate levels of available logistics respectively. Thirty nine 39 (21.4%) of the respondents were not sure whether the available logistics for the management of waste in the Tema Metropolitan Assembly is adequate or not. The remaining respondents 3 (1.6%) and 24 (13.2%) indicated greatly adequate and adequate respectively. The skewness of the response to the inadequacy side was confirmed by the mean score value registered which was 2.49 which is less than the mid-point of 3. Table 5 gives the details of the household perception on the adequacy of waste management logistics in the Area.

Table 5: Household perception of adequacy of waste management logistics

Available logistics	Frequency	Percent
Greatly Inadequate	74	40.7
Inadequate	42	23.1
Not Sure	39	21.4
Adequate	24	13.2
Greatly Adequate	3	1.6
Mean = 2.49		Std. Dev. = 1.039
N = 182		

Source: Field Survey (2011)

The inadequacy of waste management logistics was also noted by the interviewees. According to the Programme Officer of the EPA: "*No, Waste management of any kind needs capital and effective organization at all levels to be successful. The assembly lacks these.*"

Responding to the logistic adequacy with regards to the private waste management agencies, the same interviewee asserted, "*Logistics and public education on waste management the entire Ghanaian community need attention from all stakeholders*". This was confirmed by the Operations Manager of one of the private

agencies: "*presently no, because most of our trunks are broken down and because we are not paid regularly, it takes a long time to effect repairs. Thus, at any point in time, there is limited logistics for work*". Both interviewees from the TMA (from both the Waste Management Department and the Public Health Department) indicated the lack of logistics for both the TMA and the private agencies. According to them: "*the local assembly has not got enough logistics to manage the waste generated within the Municipality because of inadequate funding and support from the Central Government……..No, they also have inadequate logistics to carry out the collection and storage. You know,……..waste management is a capital intensive venture*". The remaining one interviewee who was from the private agencies however indicated otherwise for his company. This particular interviewee asserted, "*I can not speak for the other companies, but for Zoomlion, yes, we have enough logistics to collect waste. For the Assembly however, I believe they do not and that is why they have brought other private waste management companies to help in the waste management*".

The following were recommended by some of the private partners of waste management in the Metropolis:

"*Households should be supplied at cost with containers big enough to store refuse for at least 3 days……Waste contractors should be adequately funded to acquire trucks and other logistics……Payment for work done should be regular and prompt by the Assembly to enable contractors to replace off-road trucks*"

The following were also recommended by the managers of the waste related departments of the TMA: "*All service providers/contractors should supply waste bins to the registered residents and households. This must be supported by the GoG, or the Assembly*"

"*During opening of tender, the Assembly must ensure that there is adequate equipment to be provided by the tenderer before he/she is chosen or recommended*".

"*Government should provide the right incentive to attract the best private capital into the sector*"

5.0 CONCLUSION

The study concludes that Tema Metropolitan Assembly has a serious logistic challenge as the Assembly lacks the requisite logistics to manage waste within the metropolis despite the increased in the population of the metropolis which should have resulted into increased resources. This position supports the views of (Ayres; 1998) which disproved the econometrics assumption under the invented 'U' argument that urban population is actually good for the environment since it means an increase in urban productivity which in turn leads to the availability of funds earmarked for environmental health improvement (Ayres; 1998: 139). Ayres therefore held that "on the contrary, in the case of Ghana, this assumption is an illusive one since the growth in urban population has led to unemployment (because the rural folks who migrate to urban centres come with virtually no skill). The consequence of this is untold pressure on the limited infrastructure hence poor environmental and sanitary conditions in the cities." Even private agencies which were contracted by the metro authorities to help were also confronted with inadequate logistics to effectively execute the contract of managing waste in the metropolis. This situation resulted in the followings:

1. waste generated by household not being separated into their various categories by a large number of household before being sent to the community disposal points making the management of waste a daunting task for the Assembly.
2. Waste generated being left for days or weeks in some cases before being attended to by the Assembly or the contracted agencies.
3. Waste being scattered in the metropolis with gutters chocked posing serious health problems to the populace.

This was compounded by the types of wastes generated in the metropolis and the tropical climatic condition which requires for read disposal of waste as the climatic effects gets most of the waste generated getting decomposed within days in the face of the acute logistics shortage.

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