KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF SCIENCE

DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY

SOLID WASTE COLLECTION AND WILLINGNESS TO PAY FOR BETTER SERVICE IN TEMA, GHANA

BY

DZIENYO AKUTOR AKAFIA (BSc. Biological Science)

(PG 4168210)

A THESIS SUBMITTED TO THE DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI IN PARTIAL IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MSC DEGREE IN ENVIRONMENTAL SCIENCE

May, 2014

DECLARATION

I hereby declare that this thesis is my own work towards the MSc. and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree by the university or any other university, except where due acknowledgement has been made in the context.

Dzienyo Akutor Akafia …… ……

(PG 4168210)

(Students Name and ID) signature date

Certified by:

Dr. Joseph Ackora-Prah …… ……

(Supervisor) signature date

Certified by:

Rev. Stephen Akyeampong …..……..…… ……..……

(Head of Department) signature date

ABSTRACT

The underlying rational for the study was to develop a conceptual statistical model upon which social, economical and environmental factors can be combined to deduce a workable and suitable Solid Waste Management strategy. The study yielded useful results that made it possible to elicit the willingness of individuals to pay for improved solid waste collection services. Approximately 51.6% of the respondents expressed willingness to pay for improved solid waste management. On the average, majority of the participants indicated a response to pay a premium reflecting the current service charges of the Tema municipal Assembly, between (3-5 cedis) monthly. As it is expected, respondents' Willingness To Pay was skewed towards individuals earning between 950-1500 cedis. Furthermore, individuals who indicated a satisfactory response to the current frequency of waste collection were all willing to pay and vice versa. Education is also seen as a variable which can affect people's WTP; consequently, people in the highest quartile of the education category were more (58.1%) predisposed to paying for better waste management than their counterparts who are less educated. Though on the whole, factors such as education, current salary, owning a waste bin and general socioeconomic status affected willingness to pay. An analysis with the Wald Criterion demonstrated that four main variables used in the study affected WTP significantly: These are; current frequency of collection, preferred frequency of collection, age and educational background.

ACKNOWLEDGEMENT

My sincere gratitude goes to my supervisor Mr. Joseph Ackora-Prah for accepting to be my supervisor and guiding me through this project though he had other pressing obligations. I am grateful for all I have learnt through him.

I would like to thank Professor Obiri-Danso for his help and encouragement. Irrespective of the fact that he had his own students to supervise, he willingly offered me assistance any time I called.

I especially thank my dear brother, Atsu Awayevoo, my brother –in-law Samuel Akafia and all their friends for being so instrumental in the administration of my questionnaires. I also thank my parents, parish priest and ever-loving husband for their unflinching support and encouragement during the entire study period. Even when my health was failing me, they spurred me on.

I wish to acknowledge Mr. Mba and his staff of the Waste Management Department of the TMA as well as the head of Zoomlion Ghana Limited, Tema for their openness and willingness to provide me with information to enable me carry out my study.

Much gratitude goes to the lecturers and staff of the Theoretical and Applied Biology Department of the KNUST for accepting me into the Environmental Science Program and guiding me through to this end.

Last but most importantly, I wish to thank the Almighty God for blessing me so much with His graces, giving me helpers each step of the way and seeing me through to a successful end.

TABLE OF CONTENT **Page**

CHAPTER ONE

CHAPTER TWO

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1. Background

The management of solid waste continues to be a major challenge in urban areas throughout the world particularly in the rapidly growing cities of the developing world (Foo, 1997). A high rate of population growth and increasing per capita income have resulted in the generation of an enormous volume of solid waste, which poses a serious threat to environmental quality and human health (Snigdha, 2003). Access to sanitation services and clean adequate water are therefore regarded as crucial to the health and wellbeing of people.

As more cities become industrialized, the congenital problem of waste management comes along with it. Technological and economic advancement has made the types and kinds of Solid Waste very diverse and their management much more complex. The complex nature of disease outbreaks; cases of cholera as well as other diarrheal diseases in recent times corroborate this fact. Furthermore, the changing economic trends and rapid urbanization complicate solid waste management (SWM) in developing countries. Consequently, solid waste is not only increasing in composition but also changing in quantity from a few kilograms to tonnage proportions recently (Bartone, 1993).

In Ghana, the government started privatizing Solid Waste Collection (SWC) in order to meet the collection demand of the enormous waste being generated. The privatization is believed to have taken place in the mid 1990s (Baud and Post, 2002).

Even though the government privatized SWC, the public sector still collected half of the city waste.

Moreover, in Accra, the collection systems differed from the high-income to low-income residents. Low-income groups cannot afford to pay for proper garbage disposal and they tend to dump domestic garbage near their houses, in rivers, into sewage drains, and at other illegal sites. On the other hand, high-income groups tend to pay waste collection fees.

According to Boadi and Kuitunen (2003), in 1998, 80 percent of waste was from the low-income residents, 17 percent came from middle-income residents, and three percent of waste was from high income groups. Most of the waste generated from the low-income residents in Accra is not effectively collected.

Before 1995, 60 percent of waste was collected by the Waste Management Department (WMD) (Boadi & Kuitunen, 2002). According to Post *et al.*, (2003), by 1999, about five years after privatization of SWC, the ratio of waste collection by the public and the private sectors increased up to 70 percent. Ten years down the lane, even with the proliferation of more private waste management firms it is possible 10 percent of solid waste is not collected.

There is the paucity of published data on the Solid Waste Collection (SWC) situation in Tema; a rapidly growing metropolitan area in the Greater Accra region. This thesis seeks to fill the gap by looking at the impact of socioeconomic indicators, such as income, education, and family composition, on environmental quality and public health through SWC and management.

1.2. Rational for the Study

As mentioned earlier, Tema is an industrial city and just like many other urban cities, it does face migration and infrastructural challenges. Many immigrants troop in, to cash in on the supposedly high cash flow within the industries and at the seaport.

Nevertheless, the uniquely planned communities of Tema as well as the available infrastructure were not designed to cater for the current large and ever growing population.

As is the case, many Ghanaian cities including Tema lack the financial resources and more importantly the institutional capacity to provide the most basic infrastructure.

Within the last few years, the high number of households that have sprung up throughout Tema and the large volumes of solid waste being generated, has left the Tema Metropolitan Assembly (TMA) overwhelmed and unable to efficiently collect and dispose solid waste. Subsequently, waste management has gradually degenerated in the once well organized and neat residential areas of Tema. Moreover, many households have only had the lean opportunity of choosing between the TMA's service and the private services of Zoomlion Ghana Limited.

Linkages exist between deficient infrastructure and health outcomes of urban residents.

For instance, information obtained from a case study in Kampala indicated that inadequate provision of proper sanitation accounts for 7 percent of all deaths and diseases worldwide, with children and women being most at risk.

In the first quarter of 2012, cholera and other diarrheal diseases broke out in some cities within the country and Tema was no exception. As was reported, respiratory infections and diarrheal diseases are the two biggest causes of death among the poorest 20 percent of the world's countries as ranked by national GDP per capita (Gwatkin and Guillot, 1999).

The poor solid waste management problem has become one of the major concerns for a number of environmental events. It is an important element to consider in safeguarding public health and ensuring environmental protection: i.e. protection against short-term direct and indirect health risks due to poor waste collection and disposal.

1.3. Justification for the Study

Tema is the larger of the two harbor cities of Ghana and one of the major and fastest growing cities with a population of about 160,939 (Ghana Statistical Service, 2012).

Information gathered from the TMA indicated that, though the volume of waste generated daily is unknown, about 1600 to 2000 tonnes of solid waste from the metropolis is hauled to the dumpsite daily. This is assumed by Zoomlion Limited to be about 70 percent of the total waste available for collection daily further implying that about 30 percent of the waste generated is being improperly disposed of throughout the Metropolis. In the meantime the actual volume of waste generated within the metropolis daily is unknown.

This improper disposal is witnessed through littering of streets, dumping of refuse in drains thereby choking them or in bushy areas causing an eyesore and more importantly creating breeding grounds for disease vectors and pathogens.

The result is the general unsanitary conditions created within the Metropolis with the subsequent breeding of mosquitoes and other flies which cause diseases not to talk of the perennial flooding of some parts of the city.

It has also been observed that domestic, industrial as well as commercial wastes are poorly managed giving rise to the degradation of the environment. Open spaces are abused in terms of use. They are used for defecation and indiscriminate citing of disposal points for refuse (Abankwa *et al.*, 2009).

Municipal solid waste management is a very important public service which benefits all residents within the municipality.

It is therefore only sound and feasible to include even those who do not pay in the service provision, because public cleanliness and the safe disposal of waste are essential to public health and environmental protection.

As a result of these characteristics, solid waste management is a public good for which local or metropolitan governments are typically responsible (Cointreau-Levine, 1994).

1.4. Objectives

This work is aimed at examining the performance of public and private municipal solid waste collection institutions in the Tema Metropolis and how much the residents are willing to pay for the service provided, and to provide a basis for addressing some of the lapses through an analysis of the willingness to pay for better solid waste management.

The main objective of this study is:

1. Determine household's willingness to pay more for better SWC services

The specific objectives of this study are:

1. To measure the level of household's willingness to pay for better SWC
2. To ascertain the relationship between household's educational background, socio-economic status and willingness to pay for better SWC and further management.
3. To develop strategies for the better management of solid waste based on information obtained and recommend these strategies for better solid waste management in Tema.

CHAPTER TWO

2.0 LITERATURE REVIEW

Once waste generation is an inevitable aspect of life, it becomes a matter of urgent need to observe the process from generation to disposal in order to determine the areas of critical concern and tackle them in order to avoid pollution to a large extent and also preserve good health. Solid Waste Management (SWM) is defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with best practices of public health, economic and financial, administrative, legal and environmental considerations (Othman, 2002).

Human technological and economic advancement has made the types and kinds of Solid Waste very diverse and the problem of waste management more complex. Furthermore, poor institutional framework and low capacities as well as lack of resources; both human and capital has put waste management and sanitation conditions in many cities of the Developing World, particularly in Africa, in very deplorable state (N E H A, 2005).

For instance, the high demand for plastic and/or rubber products, which are mostly non-biodegradable, poses both health and economic drawbacks. Such waste could be recycled. However, illiteracy, lack of self-control and lack of willingness to pay for Solid Waste Management are contributing factors that make recycling a big hurdle to surmount. Solid, liquid and gaseous forms of waste are increasingly becoming a menace to society.

According to UNEP (2004), solid waste generation has become an increasing environmental and public health problem everywhere in the world, particularly in developing countries; Ghana is no exception.

It is difficult to find realistic estimates of the amount of waste generated in Ghana per day, much less the average volumes or percentages of the various components of waste generated periodically in Ghana.

This is because waste segregation is hardly practiced, not to mention inherent poor record keeping practices by most institutions. In addition, the culture of recycling, which is a very prominent factor in waste management issues, is a concept yet to be fully grasped, accepted and practiced on a large scale.

The problem of solid waste in most parts of Greater Accra has been characterized by single and ad hoc solutions such as: mobilizing people to collect waste and desilt chocked gutters after a flood disaster or for a special imminent occasion /event. Some other solutions include temporal allocation of waste collection contracts and damping, or building a central solid waste composting plant. Read (2003) observed that solid waste management is characterized by ready-made prescribed answers, with single-issue interest groups promoting a single solution, at the expense of others. The truth, he contended, is that no single solution can manage society's waste adequately.

The numerous cases of cholera outbreak as well as other diarrheal diseases especially in recent times will clearly attest to this fact. These mishaps results from the poor disposal of the thousands of tons of solid waste generated daily into open dumps and wetlands, contaminating surface and ground water and posing serious health hazards.

A careful study of the waste management process, in turn, makes it possible to identify opportunities for households to practice various forms of waste reduction, as well as put in more efficient measures where needed by the authorities to improve collection and disposal services in order to enhance household willingness to pay for better SWM.

The Solid waste management process is looked at in the sections below;

2.1 The Solid waste management processes

2.1.1 *Waste generation*

Waste generation rates have been increasing rapidly due to urbanization and industrialization. As a result of population growth and urbanization in developing countries, overall volumes of waste generation is much higher than most developed countries and the industrial waste generation rates are also very high as most of the industries are primary industries producing raw materials for industrial production. Furthermore, due to improved living standards, improved healthcare and due to globalization, a number of new waste streams have emerged, especially e-waste and hazardous waste. (UNEP, Division of Technology, 2009)

Human nature is such that waste generation cannot be avoided. The volume of waste generated is also dependent on the economic status of the people. This is buttressed by the fact that higher incomes result in increased consumption patterns and further generation of more waste. A vivid example can be sited in the case of a low income earner who cannot afford his own home and therefore resides in a rented apartment, whereas an affluent person on the other hand is likely to own a home with beautiful landscaping; Though both may be single individuals living on their own,

the more affluent is likely to generate more waste through the sheer packaging of the brand new items he purchases as well as probable yard waste that could be generated from the trimmings of the landscaping.

This waste when placed in the environment becomes a contaminant and in uncontrolled circumstances results in pollution of the environment.

The International Energy Agency recently released its World Energy outlook in a presentation to the press in London on Nov., 9th 2011. The report said, "The affluent (about 20% of the global population) use close to 80% of the world's raw energy resources and contribute the lions share to the world's waste and pollution"(http://EzineArticles.com/6720502).

Developing countries have solid waste management problems that differ from those found in fully industrialized countries. Indeed, even the very composition of their waste differs from that of 'developed' nations.

Notwithstanding, in low-income countries, solid waste generation rates average only 0.4 to 0.6 kg/person/day, as opposed to 0.7 to 1.8 kg/person/day in fully industrialized countries (Zerbock, 2003).

In several parts of Africa, thousands of tonnes of solid waste are generated daily. Most of this waste ends up in open dumps and wetlands, thereby contaminating surface and ground water and posing major health hazards (EGSSAA, 2009).

The waste generation rates, available only for selected cities and regions, are approximately 0.5 kilograms per person per day—in some cases reaching as high as 0.8 kilograms per person per day (EGSSAA, 2009).

The residents of Accra, including Tema currently generate large volumes of solid waste far beyond the management capabilities of the existing waste management system.

It is interesting to note that due to the inadequacy of the solid waste management infrastructure, over 80 percent of the population does not have home collection services (Boadi and Kuitunen, 2005). In previous studies, only about 13.5 percent of respondents were served with door-to-door collection of solid waste, while the rest dispose of their waste at communal collection points, in open spaces, and in waterways. The majority of households store their waste in open containers and plastic bags in the home (Boadi and Kuitunem, 2005).

According to Anomanyo (2004), waste disposal from households in AMA took different forms. These are represented in figure 1.1 below.

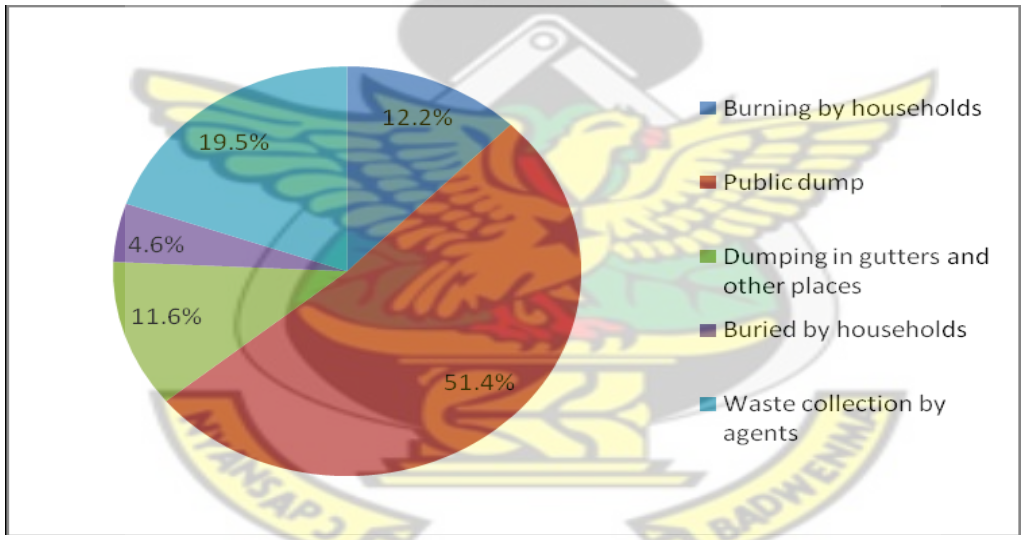

Figure 1.1: Forms of waste disposal in the Accra Metropolis in year 2004

According to Anomanyo (2004) about 1800 tonnes of municipal solid wastes is generated per day in the Accra Metropolis and the average waste generated per capita per day was estimated at 0.5 tonnes .This was based on the projected population of 1,610,867.

According to Tuani (2011), in spite of the strategies put in place for the collection of waste in Accra, all is not well for maximum waste collection. According to the Waste Management Department (WMD) of the Accra Metropolitan Assembly (AMA), only 45% to 55% of waste generated everyday is collected. Also, information from the KMA in 2006 indicated that the current domestic waste generation in Kumasi rate was approximately between 1000-1500 tonnes a day.

It is established that population growth greatly contributes to an increase in waste production. It has also been empirically established that waste generation has increased rapidly over the years (Martin, 2011). In Tamale for example, the amount of solid waste generated per day was 150 tonnes in 2009 and currently 810 tonnes per day (Abankwa *et al*., 2009 and Puopiel, 2010).

The situation in Tema; which remains a fast growing industrial city in Ghana, is no different. Residential waste quantities are determined by population and generation rate (pounds per capita per day). The generation rates will vary based on the level of disposable income available to a community to spend on goods and services (Gershman *et al*., 1986).

Some public and private organizations have come up with nationwide estimates of the rate at which municipal solid waste is generated. These estimates are simply average generation rates, which fail to account for local variations in income level and the types of businesses and institutions in a particular community. With these average generation rates and population data a rough calculation can be made of the quantity of residential, institutional, and commercial and light industrial solid waste discarded (Gershman *et al*., 1986).

2.1.2 Storage

Waste generated even in the home is usually diverse and needs to be held together in a receptacle until collection time is due. Storage should be on a short-term basis only and should prevent the waste from being released to the environment. In some conditions, improper storage could be deemed disposal and could trigger more stringent regulation of the waste (US EPA, 2008).

Due to the irregular generation of waste and in some cases not so efficient infrastructure in place for solid waste collection, it is essential for waste to be stored temporarily prior to collection.

The storage of wastes generated by households before collection and transportation to the dump site involves the use of various receptacles. These receptacles include polythene bags, propylene sacks, metal bins, and disposing waste into pits dug at the back of the house (Downmore *et al.,* 2011).

A research conducted by Martin (2011), in the Accra metropolitan area revealed that, solid waste was stored in polythene bags, card board boxes, and old buckets, which was quite prevalent in both the low and middle-income areas and the standard plastic containers in the high-income neighbourhoods. Another observation he made in Kumasi also showed that though some middle-income residents claim to be using standard containers, practical observation revealed the use of impoverished galvanized containers, possibly due to the high cost of the former.

Martin (2011) also stated that, the use of unapproved storage facilities and the concept of children in waste disposal, especially in the low-income areas present its own problems.

This is because, in most cases, children find it difficult to properly access the containers due to their height. It thus becomes more convenient for them to throw waste on the ground.

Storage of solid waste appropriately, is one of the major steps of handling solid waste within our communities.

MEFN (2000) outlined certain criteria that should be taken into account when establishing and maintaining storage facilities for solid waste which includes;

a) Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities.
b) A storage facility shall be so placed that it is accessible to users.
c) Storage facilities to be set up by municipal authorities or any other agency shall be so designed that waste stored are not exposed to open atmosphere and shall be aesthetically acceptable and user friendly.
d) Storage facilities shall be easy to operate and designed for easy handling, transfer and transportation of waste.
e) Bins for storage of bio-degradable waste shall be painted green, those for storage of recyclable waste shall be painted white and those for storage of other waste shall be painted black.
f) Manual handling of waste shall be prohibited. If unavoidable due to constrains, manual handling shall be carried out under proper precaution with due care for safety of the worker.

2.1.3 Collection

Throughout most of sub-Saharan Africa, solid waste generation exceeds collection capacity. This is in part due to rapid urban population growth: while only 35% of the sub-Saharan population lives in urban areas, the urban population grew by 150% between 1970 and 1990 (EGSSAA, 2009).

According to Anomanyo (2004), solid waste collection in Accra for instance is both on franchise and contract basis. The volumes of waste generated and estimated percentages collected, is not known, due to the city's vastness and poor documentation.

Basically, there are three modes of solid waste collection in Accra. These are; the curbside, communal container and house-to-house collection.

On the franchise basis, the house-to-house collection service is provided in the high income areas where contractors charge stipulated fees for a weekly collection frequency. These high income areas are well-planned residential communities with first and second class access roads. Each household has plastic containers with covers for waste storage. These contractors then pay a tipping fee to the AMA for the use of its dump site (Anomanyo, 2004).

On the other hand, the waste management department of the TMA is located in Tema, Community One. The department has a staff strength of about 200 with 12 technical officers being environmentalists. The department manages both solid and liquid waste and has about 30 contractors for solid waste management; each contractor with not less than 4 laborers. Some of the contractors include companies like J. Stan Owusu and Co, Culture, Zoomlion Ghana Ltd., Push Agricola, and Terry White.

The department has officers assigned to various zones, streets, drains, markets, public toilets, etc. These officers oversee the work of the contractors. The Tema main market, being a critical waste generation and dumping area has 8 laborers permanently assigned to the place. This however seems quite inadequate.

The department is equipped with a side loader truck, a pay loader and a compactor which is minimally used due to the constraints of fuelling.

In low income communities characterized by limited access to refuse collection trucks or carts, door-to-door collection services is not economically feasible, and only a communal container or bell system is viable (Cointreau-Levine, 1994).

Zoomlion Ghana limited is the largest waste management institution contracted by the TMA though it also does some work on private basis. Zoomlion, unlike the other contractors is not assigned to specific areas or zones within Tema but are rather all over.

Collection by communal systems inherently involves collection from a public area not from a private establishment or household and requires the participation of the residents who bring their refuse to a communal container or to an attending refuse collecting vehicle (upon belling) (Cointreau-Levine, 1994).

These containers are therefore placed at certain vantage points where the population is high and the trailers accessible. There are no household collection points. Instead, individuals, mostly children, carry the waste to the disposal points, which in certain areas are as far as about 200 m away from their houses. The required maximum distance is 100 metres (KEEA, 2006).

Anomanyo (2004) also added that, residents at Chorkor; a suburb of Accra for instance, with a population of 45,379 have only two collection points where each of these points has two old containers. These are filled to the brim in the early hours of the morning and late comers are turned away by the attendants. In the absence of attendants, garbage is left there and accumulates on the ground.

In Tema, skips and roll offs are placed in the less affluent communities such as Communities One, Two and Nine where the households close by can dump refuse without any fee being collected from them. These skips and roll offs are picked up daily or weekly depending on the location and level of activity within the area.

The scene in figure 2.1 clearly indicates some inefficiency in waste collection. For instance, the very busy Tema main market located in Community One is provided with skips that quickly fill up daily and need to be emptied and replaced.

Figure 2.1: An overflowing waste collection container at Community 2.

In contrast with the Community-1 market scenario, the picking up of waste bins is better observed in the well organized and more affluent areas like community 12 and 6.

The collection of waste from dust bins is planned in accordance with frequency of container becoming full. The present location of dust bins and the waste collection point have been classified into daily collection (A type), weekly twice collection (B type) and weekly once collection (C type) as part of the Nirmal Nagara Programme (Yadav *et al.*, 2009).

Below is a table that clearly indicates the Environmental Guidelines for Small-Scale waste collection activities.

Table 1.1: Recommended frequency of waste collection

Region	Season	Frequency
Tropics	Dry	Daily
	Wet	Daily
Temperate	Summer	Every 2days
	Winter	Every 3 days
Cool Climates	Summer	Twice a week
	Winter	Once a week

Source: Environmental Guidelines for Small-Scale Activities in Africa

2.1.4 Transfer and transport

Waste once collected is moved from source to another point (transfer station) for further transport to a treatment or disposal site. Waste transfer stations are facilities where municipal solid waste is unloaded from collection vehicles and briefly held while it is reloaded onto larger long-distance transport vehicles for transport to landfills or other treatment or disposal facilities (US EPA, 2011).

Transfer stations are not common in municipal waste management in African cities. Tema is no exception. One such facility was operated by the City of Abidjan in Cote d'Ivoire but is no longer functional. In almost all cases, the point of disposal of the MSW is located on the perimeter of the city, within easy reach of vehicles and collection crews. The collection vehicles are generally of the 6 - 7 m^3 capacity and go directly from their point of last pickup to the disposal site (Palczynski, 2002).

The same is observed in Tema. However, there is an unofficial transfer station at the Market place in community one. This serves only the community, most especially the market.

In the transport of waste, vehicles or containers used for the collection such as the skips, Roll off/on, side loaders and tipper trucks in certain areas. These are expected to be loaded and moved in such a manner that the contents do not fall, spill or leak. Covers are to be provided especially in the case of skips and tipper trucks to prevent littering and spillage. MEFN, (2000) also indicated in their criteria for the transportation of MSW that, vehicles used for the transportation of waste shall be covered. Waste should not be visible to the public, nor exposed to open environment preventing their scattering. The criteria also indicated that storage facilities set up by municipal authorities shall be daily attended to for clearing of waste. The bins or containers wherever placed shall be cleared before they start overflowing.

Figure 2.2: An uncovered solid waste transport truck broken down at Kpone barrier towards the landfill site.

Transportation vehicles shall be so designed that multiple handling of waste, prior to final disposal, is avoided.

Ideally littering and spillages are to be resolved immediately they occur, but probably due to negligence and lack of awareness the mess when created is left unattended to pollute the environment.

In most communities in Tema, the compactors are used in house-to-house waste collection and transfer. Zoomlion compactors are those most commonly observed on the streets within the communities. These compactors are to pick a total of about 125 bins per zone to fill up and immediately go to the Kpone dump site for final disposal.

2.1.5 Processing and recovery

Solid waste is not only rising in quantity but also changing in composition (from less organic matter to more paper, packing materials, plastics, glass, metal, and other substances), which is exacerbated by low collection rates (Bartone and Bernstein, 1993; Medina, 2002). Municipal Solid Waste (MSW) contains organic as well as inorganic matter. Reduction of quantity of wastewater, reduction of Biological Oxygen Demand (BOD) value and recovery of solid waste is essential to make the waste more environmentally friendly and also to recover valuable energy for reuse.

Solid waste is easier to handle and has more prospects for being recycled as compared to liquid waste (http://www.fao.org/ag/againfo).

The latent energy present in its organic fraction can be recovered for gainful utilisation through adoption of suitable Waste Processing and Treatment technologies.

The recovery of energy from wastes also offers a few additional benefits as follows:

- The total quantity of waste gets reduced by nearly 60% to over 90%, depending upon the waste composition and the adopted technology;
- Demand for land, which is already scarce in cities, for land filling is reduced;
- The cost of transportation of waste to far-away landfill sites also gets reduced proportionately; and
- Net reduction in environmental pollution.

It is, therefore, only logical that, while every effort should be made in the first place to minimize generation of waste materials and to recycle and reuse them to the extent feasible, the option of Energy Recovery from Wastes be also duly examined. Wherever feasible, this option should be incorporated in the over-all scheme of Waste Management.

Currently there are 86 facilities in the United States for combustion of municipal solid waste (MSW), with energy recovery. These facilities are located in 25 states, mainly in the Northeast.

Energy recovery from waste is the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas (LFG) recovery. This process is often called waste-to-energy (WTE).

In general, recovery from solid waste is very minimal in most parts of Ghana. The criteria of MEFN, (2000) stipulated that municipal authorities adopt suitable technologies or a combination of technologies to make use of waste so as to minimize the burden placed on landfills. Though it is common to see scrap metal and glass bottle collectors within the communities of Tema, it is impossible to say there is significant waste recovery, reuse and or recycle.

Some of the technologies used in waste recovery include; composting biodegradable wastes, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing waste in specific cases.

2.1.6 Disposal

As opposed to reuse and recycle, disposal at a landfill or dumpsite (in most African cities) is usually the final destination of solid waste. Solid waste disposal in Ghana poses an issue of great concern especially regarding the poor administration and management of waste collection services, indiscriminate dumping, lack of fitting disposal sites, troubles with proper solid waste disposal due to deterioration of road ways, breakdown of vehicles and escalating traffic woes.

At the dumpsite or landfill, there are sometimes cases of accidental fires. These are either auto-ignited from the decomposition of organic waste, started by scavengers in the temperate regions either for heating, for cooking or for recovering of metal scrap from certain waste components. Smoke from these fires is often toxic and very hazardous to health. Solid waste dumps remain unregulated; have no provision to guide against groundwater contamination and no separation, treatment or burying of solid waste is done. In addition wild dogs and other animals also carry waste from open dumps to nearby residential areas as seen below in the scene captured from just beside the Kpone dumpsite.

Figure 2.3: Animals moving between open dump and human settlement just metres away from the Kpone landfill site.

The current dumpsite being used by the TMA is on the outskirts of the city in a town called Kpone. This is about 10 minutes drive from the Tema roundabout. Meanwhile there are people living as close as 20 meters or less away from the dumpsite.

This may not have been so alarming if the site was an engineered landfill. Several volumes of bad, smoky toxic odour goes up each day and is inhaled by many posing severe health hazard to the inhabitants of Kpone and surrounding communities.

The roads leading to the dumpsite are in quite good order but the poor maintenance of vehicles causes regular breakdowns on the roads and subsequently the inability to complete the transfer of waste to the final disposal site.

2.2 Benefits of Solid Waste Management

Safeguarding the environment is increasingly becoming an issue of immense concern especially in Ghana.

Some of the most prominent concerns resulting from not protecting the environment are; high incidence of pollution, urban noise, the emerging oil and gas industry and its attendant adverse effects, natural disasters as well as the influx of e-waste into the country.

Ghana is endowed with abundant natural resources, which have played very important roles in the agricultural, industrial, economic and social development efforts of the country.

However, as a result of persistently poor waste disposal and the incessant exploitation of these natural resources to meet the legitimate socio-economic aspirations of the people, adequate care has often not been taken to guard against the depletion and mismanagement of the resources.

There are several advantages that come with efficient waste management. This may be direct benefits that can be readily valued and indirect benefits or advantages that can only be experienced. Much of the concern of empirical environmental economics has been with the economic benefit of changes in the level of environmental quality. That is, environmental and resource economists have been preoccupied with how changes in the provision of environmental public goods impact upon individual's utility or welfare and estimating it in monetary terms.

In this regard, two most common approaches that have been used constitute; The Marshallian Consumer Surplus and the Hicksian Compensated Demand.

The Marshallian demand approach tracks the 'full price effect' and has been typically used to show how much the quantity consumed of a normal good increases when its price falls.

In the case of environmental public goods, however, the individual is usually faced with a quantity rather than a price constraint with the good in question often being un-priced. Furthermore, these goods often have much higher income elasticity than those associated with many ordinary market goods (Bateman *et al.*, 1992).

Therefore the Hicksian Compensated Demand approach is preferred and is a theoretically more accurate approach of measuring welfare change in this context.

Basically nonetheless, efficient solid waste management ensures a safer environment whereby there is only little air, soil or water pollution. Further ensuring the presence of fewer disease-causing agents or vectors and maintaining a sound ecosystem balance whereby the full benefits of ecosystem services such as those listed below can be harnessed. These services are extensive and diverse, affecting the quality of our land, water, food, and health.

These ecosystem services include:

Moderate weather extremes and their impacts, seeds dispersal, mitigation of drought and floods, protection from the sun's harmful ultraviolet rays, cycling and movement of nutrients, protection of streams, river channels and coastal shores from erosion, detoxification and decomposition of wastes, control of agricultural pests, maintenance of biodiversity, generation and preservation of soils and renewal of soil fertility, contribution to climate stability, purification of the air and water, regulation of disease carrying organisms and pollination of crops and natural vegetation.

2.3 General Terms and Definitions

2.3.1 Solid waste

This is referred to as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or an air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, agricultural operations and from community activities (US EPA, 2011).

In the words of Misra and Panday (2005), "*a material becomes waste when it is discarded without expecting to be compensated for its inherent value"*.

Solid waste is composed of combustibles and non-combustible materials.

The combustible materials include paper, plastics, yard debris, food waste, wood, textiles, disposable diapers, and other organics. Non-combustibles also include glass, metal, bones, leather and aluminium (Zerbock, 2003).

2.3.2 Components of solid waste

Municipal solid waste contains waste products from all aspects of human activity and as such is an extremely complex and heterogeneous material. Increasingly, it has been shown that a few chemical compounds within municipal solid waste contribute significantly to environmental and health impacts (Whitworth, 2005).

The characteristics of solid waste vary from place to place. Factors that influence the composition are the average income level, the sources, the population, social behavior, climate, industrial production and the market for waste materials (Yadav *et al.,* 2009).

2.3.3 Sources and types of solid waste

2.3.3.1 Rubbish

Rubbish consists of combustible and non- combustible solid wastes of households, institutions and commercial activities.

This excludes food wastes or other highly putrescible materials. Typically, combustible rubbish consists of materials such as paper, cardboard, plastics, textiles, rubber, leather, wood, furniture, and garden trimmings.

Non-combustible rubbish consists of glass, tin cans, aluminium cans, ferrous and other non-ferrous metals, and dirt (Tchobanoglous *et al.,* 1993).

2.3.3.2 Trash

Trash is defined as all non-putrescible waste that would normally be in a residential household including brush and waste from minor household repairs that is burnable. Specifically excluded is inherently dangerous, toxic, and hazardous wastes which shall from time to time be designated as "hazardous wastes" by State and/or Federal regulatory authorities having appropriate jurisdiction as well as significant liquid waste and any agricultural waste, excavated earth, stones, brick, rubble concrete and waste parts occasioned by major demolitions, installations and repairs, sinks, toilets, bathtubs, plumbing parts, automobile or truck parts, vehicle batteries, machinery, tree logs and limbs exceeding 6 inches in diameter and tree stumps (Castanino, 2011).

2.3.3.3 Food waste

Food wastes are any food substance, raw or cooked, which is discarded, or intended or required to be discarded. Food wastes are the organic residues generated by the handling, storage, sale, preparation and cooking and serving of food (US EPA, 2010).

Food waste includes uneaten portions of meals and trimmings from food preparation activities in kitchens, restaurants and cafeterias (Miller, 2004).

2.3.3.4 Yard waste

This is referred to as solid vegetative waste resulting from landscaping and yard maintenance such as pruning and dropping of plant part such as brush, tree limbs and leaves and similar vegetative material that has a C:N ratio higher than 75. Where 'C: N' refers to carbon to nitrogen ratio.

2.3.3.5 Ashes and residues

Municipal solid waste combustion creates a solid waste called ash, which can contain any of the elements that were originally present in the waste. Municipal solid waste power plants reduce the need for landfill capacity because disposal of MSW ash requires less land area than does unprocessed MSW.

However, because ash and other residues from municipal solid waste operations may contain toxic materials, the power plant wastes must be tested regularly to assure that the wastes are safely disposed to prevent toxic substances from migrating into ground-water supplies (US EPA, 2012).

In urban areas, burning is not advisable, as the fly ash, toxic gases and acidic gases pose a much greater health threat in more densely populated urban environments than in rural areas (EGSSAA, 2009).

2.3.3.6 Special waste

Special waste is defined as any waste material which, because of its physical characteristics, chemical make-up, or biological nature requires either special handling procedures or permitting, or poses an unusual threat to human health, equipment, property, or the environment (Miller, 2004).

2.3.3.7 Hazardous waste

Hazardous wastes endanger many different classes of people, placing waste producers, collectors, landfill workers, waste pickers, and nearby residents at risk. The leachate from a landfill may be dangerous as well; its level of toxicity is directly related to the quantity and toxicity of hazardous materials mixed in with other solid waste.

Management of hazardous wastes needs urgent attention in Africa. The variety and classes of materials and sources from households to industrial and medical facilities makes this particularly challenging (EGSSAA, 2009).

2.3.3.8 Solid Waste Management (SWM)

This is defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with best practices of public health, economic and financial, administrative, legal and environmental considerations (Othman *et al.*, 2002). Waste management in recent years in Ghana, is a dicey issue that has been of major concern to the governments and international donors.

Solid waste management in Tema has gone through a series of phases as expatiated below. Tema, which is the study area for this thesis is a city about 25 kilometres east of Accra the capital of Ghana, and covers an area of about 368.3 square kilometres. The Tema Municipal Assembly is one of the municipal authorities of the Greater Accra region. This city is mostly urban, yet a small rural population exists that covers a rather wide geographical area. In effect, the provision of social amenities has followed the rural urban dichotomy. While the urban areas enjoy organized solid waste collection services as well as pipe borne water supply and other social amenities the sub-urban and rural areas are not so 'fortunate'.

At the national level, the principal authorities of relevance to waste management are; the Ministry of Local Government and Rural Development which play an important role in planning and execution of municipal roles through the Town and Country Planning and Community Development, etc.

The Environmental Protection Agency, Ministry of Health and Ministry of Trade and Industry as well as many multi-sectoral and multi-disciplinary government agencies are relevant in waste management.

At the local level the TMA is responsible for all operations and technical aspect of waste management. Under the TMA are several departments of which one is the Solid Waste Management Department. Another is the Municipal Finance Department which is responsible for all financial transactions including revenue collection. There is also the Department of Urban Roads which also engages in cleaning of some drains and a host other departments who deal in one way or the other with certain elements of solid waste management. Nevertheless, in recent times, Zoomlion Ghana Limited and other private agencies play an equally important role in waste management.

In Tema solid waste is generated from various sources. The types and quantities of waste depends on; seasonal variations, socio-economic status of the individual generator, culture and productive activity among other factors. The main sources of waste are domestic, commercial and institutional, industrial, special waste such as bio-medical waste and others from construction, street and drain sweepings.

Organised solid waste collection in Tema dates back to the 1960's. The population then, was less than 28,000 and every household was provided with a free dustbin for the storage of domestic waste which was emptied daily except for Sundays. Even staircases of high rise buildings and hedges around individual houses were maintained by the Tema Development Corporation (TDC) which was in charge of waste management. By the mid 1970's the system undoubtedly broke down. This was mainly due to fast population growth and the consequent increase in the waste produced.

The TMA took over the management of solid waste in 1974 when the population had reached about 102,000 people whose waste was being removed free of charge from their doorstep without any income generation towards the repair and replacement of waste management equipment not to talk of improving workers remuneration.

With the collapse of waste management due to the breakdown of equipment the TMA introduced a system of communal solid waste collection, where households dumped their solid waste into bins placed at street corners and open spaces. This system also broke down shortly due to two main factors; one was inadequate institutional arrangement, where not enough resources were made available to manage waste. The other major factor was dissatisfaction among workers leading to rampant labour unrests and inadvertently low productivity. This consequently gave rise to indiscriminate dumping of solid waste into drains and open spaces all over the city.

The mountains of refuse generated had socio-economic and health implications among which were:

1. Dumps serving as breeding grounds for disease vectors and the spread of diseases as well as causing environmental degradation.
2. Smoke and offensive odour constituting serious nuisance and health risk.
3. Children exposed to dangers of the road while crossing to throw away waste into nearby bushes.

In 1988, the TMA mobilized resources from private firms to help manage and clear the solid waste heaps. By 1990, under the circumstances, a privatization decision was taken where it was approved that the formal private sector be involved in the collection of solid waste.

The TMA however remained responsible for the collection of waste from at least 25% of the geographical area, mainly the low income areas or communities not yet fully developed with a low occupancy rate. The conditions under which the TMA implemented the programme of privatization of solid waste management was that of desperation since they had to avoid a backslide into the days of indiscriminate dumping of solid waste.

This ad hoc intervention has not been most effective due to major issues such as lack of experience in private sector participation in solid waste management, bureaucratic lines of communication between the TMA and contractors, lack of efficient waste management data as well as public education and awareness creation which should have preceded the privatization decision altogether. There is the hope for a way forward where contracts are being converted into franchise agreements and the elicited information of households' willingness to pay enabling the provision of better services to alleviate the solid waste menace now plaguing the Tema metropolis.

2.3.4 *Contingent Valuation Method (CVM)*

The Contingent Valuation method (CVM) is used in environmental surveys to obtain a consumer's valuation of certain goods and services that affect them through the environment but cannot be purchased from the market place. This is done by calculating their Willingness to Pay for that service or good.

The CVM method has been employed in many fields of study. The method has widely been used in the valuation of non-market resources such as recreation, wildlife, health and environmental quality.

A couple of decades ago, only a few rudimentary contingent valuation (CV) studies had been conducted in developing countries. In those times the problems associated with posing hypothetical questions to low-income, perhaps illiterate respondents were assumed to be so overwhelming that one should not even try. Nevertheless, in recent times, it is now assumed by many environmental and resource economists and policy analysts working in developing countries that contingent valuation surveys are more straightforward and easier to carry out.

With reference to waste management services, willingness to pay refers to the motivation felt by household members to pay higher fees for waste collection, management and disposal at their own discretion for better waste management services.

In order to estimate the determinants of respondents' willingness to pay for better solid waste management services, the contingent valuation model was used to note down public stated perception. Education is among the most important variables in most analysis. Education is always considered as a crucial factor to achieve higher degree of awareness.

According to theory, if demand for the service exists, then it must be reflected by willingness to pay. Reliability of willingness-to-pay data may be affected where a good has no demonstrated personal significance, or minimal perceived need, to the respondent.

A study carried out by Dale Whittington, (1998) examined some of the issues that have arisen and some of the lessons learned from administering contingent valuation surveys in developing countries. The paper focused on five issues in particular: (a) explaining to enumerators what a contingent valuation study is all about; (b) interpreting responses to contingent valuation questions; (c) setting referendum prices; (d) constructing joint public-private CV scenarios; and (e) ethical problems in conducting such surveys.

It is argued that there are numerous issues that arise in contingent valuation work in developing countries that demand careful attention, but that in many respects it is easier to do high-quality contingent valuation surveys in developing countries than in industrialized countries.

In the United States for instance the method was used in the analysis of consumer attitudes and their willingness to pay for functional foods. The survey data collected from randomly selected participants within the four geographical regions of the U.S. were used to evaluate consumer attitudes towards functional foods and determine their willingness to pay for these foods. Contingent valuation using the payment card method was used to elicit premiums that consumers were willing to pay for a couple of bread spreads with special health benefits and a special loaf of bread that may reduce the risk of heart disease and certain cancers. Ordered probit regression analysis was used to evaluate the effect of different explanatory variables on the willingness to pay a premium for the three different functional food products.

Overall, it was found out that four factors significantly affected the respondents' willingness to pay a premium for all the three products evaluated:

Beliefs about the link between nutrition and health, concern about different chronic diseases, current purchasing and consumption patterns, and attitude towards functional foods. The significance of demographic variables depended on the particular product being valued.

Hence the method combines various forms of analyses to yield suitable results yet it must be noted that individual interest as well as demographics may result in certain biases.

Another study involved the use of the method to elicit the individual willingness to pay (WTP) for a quality-adjusted life-year (QALY). This is a common measure of health in this context and comprises both length and quality of life. Recent literature has seen a lively debate on implicit and explicit cost-effectiveness threshold(s), although without reaching consensus on the nature or height of an appropriate monetary value of a QALY.

In the mean time, various institutions and governmental bodies (such as the National Institute for Health and Clinical Excellence [NICE] in the UK, Swedish Pricing and Reimbursement board, Pharmaceutical Benefits Advisory Committee in Australia, CVZ in The Netherlands) have adopted threshold values in the process of optimizing the allocation of health-care resources, albeit sometimes implicitly and inconsistently. The acceptable ranges of the monetary value of a QALY used in such decision-making, however, appear to be broad and tend to lack empirical underpinning. This underlines the importance of further investigating the monetary value of a QALY.

Decisions regarding reimbursement and allocation of funds within the health-care budget increasingly are influenced by the results of cost-effectiveness analysis (CEA). CEA evaluates two or more alternative interventions in terms of their benefits (expressed in a nonmonetary measure) and costs, and summarizes the result in an incremental cost-effectiveness ratio (ICER).

This was done by the means of a Web-based questionnaire containing contingent valuation exercises. Upon studying the results by various means, including; heterogeneity in WTP per QALY ratios, clustered multivariate regressions, etc., it was concluded that the Individual WTP per QALY values elicited in the study are similar to those found in comparable studies. However, the use of individual valuations in social decision-making deserves attention.

An appropriate approach is to directly ask households or individuals to state their willingness to pay for improved solid waste management using the survey techniques. Despite the arguments that strategic bias will invalidate survey results, the survey technique is most relevant to this study.

Also results of using the survey approach for estimating the value of public goods or services are internally consistent, replicable and consistent with demand theory.

Strategic bias arises when respondent attempts to influence the results of a willingness to pay survey by answering in such a way as to serve his own interest rather than reveal his true valuation of the good or service.

For instance, the respondent might give very low amount of willingness to pay if he/she feels that the answer given would influence the amount he would be charged for the improved SWM. The values generated through use of the hypothetical market are treated as estimates of the hypothetical market.

2.3.5 Willingness To Pay (WTP)

Generally, people are likely to take an option based on the best alternative that gives them higher utility. A good or service associated with highest willingness to pay would be the one that yields highest utility to the consumer and vice versa.

Logically, a service that satisfies one most is also highly valued. The value of a service would be expressed through willingness to pay for the service.

In assessing willingness to pay, two approaches are usually viable. The first is the demand curve approach, which entails making observations on prices and quantities in a market. A demand curve is then estimated from which willingness to pay is inferred.

The other approach is the Contingent Valuation Method which is a survey-based method that uses responses to some questions posed to the consumer as to their preferences and willingness to pay for a hypothetical product or service.

Furthermore, in order to streamline and control the study, researchers; for the most part resort to studying willingness to pay using mostly closed-ended questions in the form of binary-with-follow-up (BWFU) technique. This makes it difficult for some respondents to be very clear about their peculiar circumstances; hence, certain pertinent variables are not factored into the study.

Other examples may be seen in a study conducted by Jelena Zoric in 2011 on household WTP for green electricity in Slovenia. The study basically analysed the WTP for electricity generated from renewable energy sources in Slovenia.

While Slovenia is still lagging behind most developed countries, it seems that the achieved income levels enable consumers to partly support renewable electricity generation.

Findings from the study indicated that age, household income, education and environmental awareness played the most significant role in explaining how households responded to green electricity programmes.

Results obtained from this analysis show that a large majority of respondents were prepared to support a green electricity scheme at the end of 2008.

Also, the study enabled a clear implication that green marketing targeted younger and better educated households with higher income and the need for awareness-raising campaigns.

Compared to other studies these findings spoke in favour of an increase in the feed-in tariffs enforced by the Slovenian government at the beginning of 2010 to pursue the ambitious 2020 objective of a 25 percent share of renewable.

The results may hold important implications for policy making as well as for electricity supply companies when marketing green electricity and developing the most preferable product mix to be offered to different groups of residential consumers.

Although it is possible that a survey based on stated preferences might result in an overstated actual willingness to pay, the results provide a valuable insight into consumers' preferences in a fairly developed ex-transition country.

2.3.6 Mathematical Model

Eykhoff (1974), defined a mathematical model as 'a representation of the essential aspects of an existing system (or a system to be constructed) which presents knowledge of that system in usable form.' Household willingness to pay (willingness to pay) for better solid waste management services depends upon a number of important determinants. Studies using the Probit model for instance have shown that some variables that are significantly related to providing positive willingness to pay values are household income and respondents' awareness of environmental quality while respondents' age has negative significant relation with the likelihood that the respondent will provide a positive willingness to pay value.

All of the signs of these three variable coefficients (coefficients of income, awareness of environmental quality and age) make intuitive sense and significant at 1%, 5% and 5% respectively.

The rest of the variables have no significant impact on the likelihood that the respondent will provide a positive willingness to pay value.

In statistics, regression analysis includes many techniques for modelling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables.

More specifically, regression analysis helps one understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. Most commonly, regression analysis estimates the conditional expectation of the dependent variable given the independent variables — that is, the average value of the dependent variable when the independent variables are held fixed.

- Regression analysis is widely used for prediction and forecasting, where its use has substantial overlap with the field of machine learning. Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. (http://en.wikipedia.org/wiki/Regression_analysis. visited 2010/05/07).

- Logistic regression analysis (LRA) extends the techniques of multiple regression analysis to research situations in which the outcome variable is categorical. In practice, situations

involving categorical outcomes are quite common. In the setting of evaluating an educational program, for example, predictions may be made for the dichotomous outcome of success/failure or improved/not-improved. Similarly, in a medical setting, an outcome might be presence/absence of disease. The focus of this document is on situations in which the outcome variable is dichotomous, although extension of the techniques of LRA to outcomes with three or more categories (e.g., improved, same, or worse) is possible (Dayton, 1992).

In this study, household's willingness to pay is treated as the dependent variable. It is taken as a categorical dummy variable which assumes only two values. If a household is willing to contribute monetarily for improved SWM services,

The willingness to pay variable assumes the value of 1 while 0 depicts not willing to pay. Logistic regression model is one of the important econometric techniques that are used for regression analysis when the dependent variable appears to be a categorical variable.

It helps in calculating the elasticity of different independent variables upon a dependent variable. As willingness to pay is treated as dependent variable in this study therefore, the binomial logistic regression is the appropriate econometric technique to find out the determinants of household's willingness to pay. Among the set of independent variables different variables including education level, income, awareness etc were identified. These variables are believed to affect household's demand and consequently their willingness to pay for better solid waste management services.

Education is considered the most important variable in explaining the household's behavior towards better SWM service. To proxy education, the highest education among the household members is taken as a variable. This represents that as the education within a family increases, it will positively affect the health concerns of that particular household. To control for huge variations in the years of schooling, the education among the household is categorized into four categories; junior high, senior high, tertiary or any other.

Thus education is explained as a categorical variable which take the value of Zero (0) or One (1). Among the given categories, primary is kept as a base category. Another important determinant in defining household's willingness to pay is their income level. Households are categorized into four income quartiles, according to their income level, with keeping Q1 as a base category

A sample of a model that was used for determination of household willingness to pay for better solid waste management services is

$$willingness\ to\ pay_i = \beta_0 + \beta_1 E + \beta_2 I + \beta_3 HHS + \beta_3 A + u_i$$

willingness to pay= Willingness to Pay

E= Education of household

I=Income of household

HHS=household Size

β = *linear factor*

This model may not suit all communities or sampled populations.

2.4 Solid Waste Management in Ghana

By and large, the uncontrolled dumping of refuse in both acceptable and unacceptable locations, the stock piling of different forms of waste and much inefficiency characterize Municipal Solid Waste Management (MSWM) services in several West African cities including Tema. This often times results in air and water pollution as well as air and water borne diseases, yet no drastic efforts are directed at improving these services.

Problems associated with utilities such as water, electricity and communication services are treated with greater urgency. Nevertheless, the problems associated with solid waste have not been handled in a similar manner. Röhrs *et al.* (1999), identified that in addition to the low level of infrastructure in developing countries, waste management is perceived to be less important than the provision of other municipal services. "Waste management is one of the public infrastructure that is based on a specific type of physical infrastructure to provide the goods or services, and in this respect it resembles the electricity, natural gas, and water sector" (Dijkema *et al*, 2000).

Generally conditions of waste management in Ghana are similar to those in many developing countries within the tropical climates. Based on an estimated population of 18 million (2005) and an average daily waste generation per capita of 0.45 kg, Ghana generates annually about 3.0 million tons of solid waste.

Several other studies have been carried out within the country, yet archiving and access to records leaves much to be desired.

In Tema and many other rapidly growing cities, the issue of solid waste is a major source of concern owing to the inefficiency observed in the sanitation management services provided by poorly resourced regulatory authorities.

Solid waste is supply-driven, limited only to local authorities, who are much slower in adjusting to the demands of the residential areas, industries, institutions and even streets and market places despite the various charges levied by the city council.

2.4.1 Waste Generation

The residents of Accra, including Tema currently generate large volumes of solid waste far beyond the management capabilities of the existing waste management system. There is significant variation in the composition of household wastes; the dominant materials are putrescibles and polyphone/cellophane.

Though observation indicates that food and yard waste as well as paper waste are generated in large volumes, the menace of plastic, polyphone or cellophane bag waste cannot be overemphasized since this form of waste is most unfriendly to the environment. Principally, this is due to the fact that plastic materials are not easily biodegradable, hence, their persistence in the environment which inadvertently is an eyesore as well.

For this, seemingly simple solutions exist to curb the plastic waste menace.

A cue can be taken from a country like China where, many super markets or shopping centres do not package purchased groceries in bags for customers unless the customers are willing to pay for the plastic bag into which the items are to be packaged. The idea of spending money on the bags naturally makes it difficult for the owners to throw them away easily.

A clear example is observed from how easily sachet water bags are disposed off indiscriminately as opposed to the re-use of plastic bottles several times after bottled water is purchased.

According to Anomanyo (2004) about 1800 tonnes of municipal solid wastes were generated per day in the Accra Metropolis and the average waste generated per capita per day was estimated at 0.5 tonnes .This was based on the projected population of 1,610,867.

According to Tuani (2011), In spite of the strategies put in place for the collection of waste in Accra, all is not well for maximum waste collection. The Waste Management Department (WMD) of the Accra Metropolitan Assembly (AMA) states that, only 45% to 55% of waste generated every day is collected. Meanwhile, the waste generation rate of AMA was about 2000 tonnes a day with per capita waste generation of 0.45 kg.

Information from the KMA in 2006 indicated that the current rate of domestic waste generation in Kumasi was approximately between 1000-1500 tonnes a day.

It is established that population growth greatly contributes to an increase in waste production, it has also been empirically established that waste generation has increased rapidly over the years (Martin, 2011).

In Tamale for example, the amount of solid waste generated per day was 150 tonnes in 2009 (Abankwa *et al*., 2009) and currently 810 tonnes per day (Puopiel, 2010).

The situation in Tema, which remains a fast growing industrial city in Ghana, is no different.

2.4.2 Storage

Majority of the households in Ghana especially Accra store their waste in open containers and plastic bags in the home (Boadi and Kuitunem, 2005). A research conducted by Martin (2011), in the Accra metropolitan area revealed that, solid waste was stored in polythene bags, card board boxes, and old buckets, which was quite prevalent in both the low and middle-income areas and the standard plastic containers in the high-income neighbourhoods. Another observation he made in Kumasi also showed that though some middle-income residents claim to be using standard

containers, practical observation revealed the use of impoverished galvanized containers, possibly due to the high cost of the former.

Below is a survey that indicates the types of waste storage containers commonly used in the Accra metropolis.

Table 1.2: Household Solid Waste Storage Containers

Containers	Number	Percentage
Sack	24	34.3
Plastic Containers	20	28.6
Baskets	9	12.8
Old Buckets	7	10.0
Polythene Bags	6	8.5
Dustbins	4	5.7
Total	**70**	**100.0**

Source: Field Survey 2004

Martin (2011) also stated that, the use of unapproved storage facilities and the concept of children in waste disposal, especially in the low-income areas present their own problems. This is because, in most cases, children find it difficult to properly access the containers due to their height. It thus becomes more convenient for them to throw waste on the ground.

2.4.3 Collection

It is interesting to note that due to the inadequacy of the solid waste management infrastructure, over 80 percent of the population does not have home collection services (Boadi and Kuitunen, 2005).

In previous studies, only about 13.5 percent of respondents were served with door-to-door collection of solid waste, while the rest dispose of their waste at communal collection points, in open spaces, and in waterways.

According to Anomanyo (2004), solid waste collection in Accra for instance is both on franchise and contract basis. The volumes of waste generated and estimated percentages collected, is not known, due to the city's vastness and poor documentation.

On the franchise basis, a house-to-house collection is done in high income areas and the contractors charge the households some fees with weekly collection frequency. These areas are well-planned residential areas with good access roads such as Airport residential area and Cantonments. On the contract basis, the collection may be done by private collectors in the name of the responsible governmental agency.

There are three modes of solid waste collection in Accra; that is the curb side, communal container and house-to-house collection.

The waste management department of the TMA is located in Tema, Community 1. The department has staff strength of about 200 with 12 technical officers being environmentalists. The department manages both solid and liquid waste and has about 30 contractors for solid waste management; each contractor with not less than 4 laborers. Some of the contractors include companies like J. Stan Owusu and Co, Culture, Zoomlion Ghana Ltd., Push Agricola, and Terry White.

This is however a weak attempt at private partnership considering some of the terms and conditions of contract, as well as the large volumes of waste generated as against the low capacity of the TMA and is its contractors to effectively collect the waste.

In recent times, a critical observation of waste collection and management service in Tema leaves much to be desired. A case in point occurred from December 2011 through to February 2012, where the Tema municipal waste collection trucks which serve a greater majority of the population were not seen until late February.

Several households complained of maggot infestation and terrible odours in their homes and neighbourhoods as a result of long standing waste that had not been collected, the author's house was very much in the same predicament.

It was alleged that the waste management department of the Tema Municipal Assembly (TMA) was undergoing restructuring after which homes would be required to pay on the spot fees to have the household's waste collected.

A visit to the TMA partially confirmed this. Furthermore it was also confirmed that some private collectors had been contracted by the TMA to serve certain communities within Tema. These contracted collectors were however, observed to have conflicts due to overlapping duties, hence shirking their duties on certain occasions as described in the previous paragraph. In view of this, a rezoning exercise was underway to indicate clear boundaries for contractors to work within.

2.4.4 Transfer and Transport

There are only few transfer stations for solid waste in Tema. These are mostly in the low income and highly populated areas. The TMA Waste Management department has officers assigned to various zones, street, drains, markets, public toilets, etc.

These officers oversee the work of the contractors. One prominent transfer station is located in the Tema main market to serve the market and its environs since it is a densely populated area with high waste generation.

Since it is a critical waste generation and dumping area, 8 laborers from the waste management department have been permanently assigned to the place. This however seems inadequate considering the volumes of waste generated.

The department is equipped with a side loader truck, a pay loader and a compactor which is minimally used due to the constraints of fueling. Nevertheless, most communities in Tema have quite good access roads hence door-to-door pick up should not have been a challenge if not for the waste management department's own resource constraints.

In low income communities characterized by limited access to refuse collection trucks or carts, door-to-door collection services is not economically feasible, and only a communal container or bell system is viable (Cointreau-Levine, 1994).

Zoomlion Ghana limited is the largest waste management institution contracted by the TMA though it also does some work on private basis. Zoomlion, unlike the other contractors is not assigned to specific areas or zones within Tema but are rather all over.

2.4.5 Processing and Recovery

Johannessen and Boyer (1999) observed that the design and optimization of solid waste management technologies and practices that aim at maximizing the yield of valuable products from waste, as well as minimizing the environmental effects have had little or no consideration in the Africa region.

Nevertheless, when few individuals, scavengers and or sachet water producers collect large volumes of plastic waste, there are a couple of plastic processing plants who accept the waste for recycle. Metals also recovered from the waste are sold by the scavengers as scraps and either fed into the steel works companies in the country or exported for foreign exchange.

Figure 2.4: Scavengers collecting items (Mostly plastic containers) at the Kpone Dumpsite.

A visit to the Kpone dumpsite as well as interviews with some officials of the TMA revealed that, there are organized groups of scavengers who comb through the dump to recover mostly plastics, metals and glass. Waste pickers are involved in a small-scale recovery and reuse operation (Palczynski, 2002).

Johannessen and Boyer (1999) also noticed that while there is potential for productive uses of landfill gas for instance, most landfills in Africa do not practice gas recovery except one landfill in South Africa where active pumping and flaring of landfill gas is practiced. These observations are no different from observations in Ghana, in that, the few landfills in operation are poorly managed and gas recovery is not practiced.

2.4.6 Disposal

It is estimated that throughout Ghana only about 10% of solid wastes generated are properly disposed off.

Open refuse dumps are most commonly located at the perimeter of major urban centers in open lots, wetland areas, or next to surface water sources. (WELL Fact Sheet-Nov 2005).

At the national and municipal levels, Ghana had not taken steps to construct, operate, or maintain sanitary landfills until very recently.

Johannessen and Boyer (1999) as at the time of their study, observed that in the major cities of Ghana (Accra, Kumasi, and Takoradi) open dumps were the means of solid waste disposal; as is the case in Tema as well.

Though not one of the three major cities in the country; a landfill site which is currently nearing completion is being constructed at Kpone near Tema in the greater Accra Region for the waste management department of the Tema Metropolitan Assembly. That which was constructed in Kumasi materialized about 8 years ago.

Though the engineered mechanisms are in place to ensure efficient waste management, the set-up has been poorly managed.

The single excavator for use on the site broke down a couple of years ago and is yet to be fixed. It can therefore be projected that in a few years to come the Kumasi landfill may lose its capacity to accommodate and assimilate waste efficiently.

The inadequate information on quantification and characterization of waste; health, social, economic and environmental impact of municipal solid waste management is a common occurrence in Ghana.

2.5 Policies Affecting Solid Waste Management

All over the country solid waste is ultimately disposed off in both authorized and unauthorized waste dumps. All kinds of wastes, regardless of their nature, are being dumped indiscriminately into depressions, sand pits, old quarries, beaches, drains and even in certain areas, along streets, without due regard to the nuisance and harm caused to the environment (GEPA, 2002).

In 1999, the Ministry of Local Government and Rural Development produced an Environmental Sanitation Policy document which sought to reform the solid waste management sector and allow private sector participation in solid waste collection, transport and disposal in the major cities of the country.

The involvement of the service recipients especially households (who are the primary producers and generators of significant proportion of solid waste) may not only allow them (households) determine the most appropriate service required but also participate in making of sound policy decisions including designing of effective joint solutions in SWM.

Sustainable solid waste management was affirmed by the United Nations Millennium Development Goals (MDGs), adopted by 189 countries and signed by 147 heads of state and governments during the UN Millennium Summit in September 2000 (UNDP, 2007).

The eight MDGs to be achieved by 2015, address the world's main development challenges and also recognize the interdependence between growth, poverty reduction and sustainable development.

Sustainable solid waste management, though not so clearly stated in Agenda 21, is indirectly advocated by the seventh goal which addresses environmental sustainability, and also aims to integrate the principles of sustainable development into country policies and programs, and subsequently reverse the loss of environmental resources.

The key question is: What sound policy recommendations, if any, can be suggested to ensure efficient delivery of SWM services particularly to the fast developing residential estates including the poorest households in society.

A look at the 2010 revised draft of the Ghana National Environmental Policy (NEP) highlights, objectives and strategic goals, all aimed at a more conscientious effort to safeguarding the environment. Policies are made as a guide to decision making to achieve rational outcomes. This Policy was based on a broad vision founded on and directed by respect for all relevant principles and themes of environment and sustainable development. The 1995 Policy identified a restructured lead agency (The Environmental Protection Agency, EPA) to drive the process towards sustainable development while ensuring least damage to the environment.

The Ghana NEP document is divided into two main sections; A and B, where section A gives an introduction and general overview of the major environmental challenges and current management activities and issues arising, whereas section B covers the National Environmental Policy proper. Section B which talks about the National Environmental Policy in detail comprises a brief introduction; the vision, mission and policy statement, the operational principles, strategic goals and objectives, sectoral and cross-sectoral environmental policies and the policy implementation arrangements.

Considering the environmental issues discussed in Section A it is apparent that the entire Ghanaian community should be responsible for the implementation of the necessary management activities to ensure that Ghanaians have the health environment they are entitled to, to further ensure their wellbeing.

Nevertheless based on the 1992 constitution which was adopted just before the 1995 Environmental Policy was formulated, the government of Ghana is responsible for spearheading the objective of living in harmony with our environment. The new Constitution identifies the Legislature, the Executive and the Judiciary as the different arms of government within the framework of cooperative governance which oversees the development of the new environmental policy for Ghana.

The Waste Management Policy which is most relevant to the study aims at reducing and managing urban waste generated both from residential and economical activity by introducing effective policies and incentives to encourage waste producers to adopt cleaner production processes and minimize waste generation.

The last section of the Ghana NEP borders on Policy Implementation Arrangements as listed below:

1 -Institutional Framework and Responsibilities

2 -Legislative Frameworks

3 -National Environmental Action Plan (NEAP)

4 -Financing Arrangements

5 -Monitoring, Evaluation and Policy Review

In all efforts being made to sustainably conserve the environment as presented in the five (5) basic implementation arrangements enumerated above, one principal challenge remains, and that is the ineffective enforcement of the policies and laws that exist to achieve the desired goals.

2.6 Cost of Solid Waste Management

As is the case in many developing countries, water and sanitation service quality and coverage remain inadequate, and subsidies directed at public services have often benefited the middle classes rather than the poor, who remain unconnected to the public network. This has led to a search for alternative subsidies that would guarantee access to basic services for the poorest.

Cost recovery is one of the major problems plaguing Solid Waste Management Services.

This is because, traditionally, solid waste services are financed by general revenues from city taxes and levies. Consequently, many municipalities in developing countries spend a large proportion of their budgets on the collection, transport and disposal of solid waste. Solid waste management is a costly service that consumes between 20 and 50 percent of available operational budgets for municipal services, yet serves no more than 70 percent of the urban inhabitants (Bartone and Bernstein, 1993).

A typical example is seen in the case of Tamale in the northern region of Ghana, where it was reported that the Tamale Metropolitan Assembly spends GH¢1,000,000 every year on waste management, which is just about 40% of the GH¢2,500,000 required annually. Meanwhile, about 80% of the vehicles at the disposal of the assembly break down frequently, with some being as old as 25 years.

It was also reported that only 5% of the over 700,000 people living in Tamale pay their sanitation levy, and attributed it to lack of education, non-enforcement of by-laws, and bad attitudes (Gyebi, 2010).

Data available at the Tema Metropolitan Assembly's (TMA) waste management department indicated that though close to 2,000 tonnes of waste is generated per day only about 300 to 500 tonnes of waste reaches the final dumpsite daily. Meanwhile the average TMA fee for organized solid waste collection is about 5 cedis/ household/ month as against the TMA's waste collection operational cost of over 50 gallons worth of diesel each day.

Those who do not receive services are the low-income populations concentrated in the peri-urban areas; who either do not prioritize the importance of clean environment or are caught in the abyss of poverty and therefore have more pressing issues.

Even some residents in decent housing facilities are living next to huge heaps of uncontrolled or poorly controlled garbage. The municipal authorities have not made sufficient efforts in the area of education.

Gradually, it is becoming critical for municipal assemblies to take up the role of actively protecting the environment and public health by accomplishing effective solid waste management. Recently, however, more attention is being paid to enhancing institutional arrangements for service delivery, with a special emphasis on privatization (Cointreau, 1994).

In Kampala city for instance and indeed many major towns in Uganda, the standards of solid waste management (SWM) have always been gauged and evaluated on the role and performance of service providers such as local authorities and other alternative players.

The policies and legal framework governing SWM have also been directed at these providers completely ignoring the demand side. This leaves the solid waste management service providers not fully appreciated by service recipients – households, institutions, industries and commercial premises.

In view of this, various stakeholders have directed less effort at investigating the demand side to solid waste management. This has nonetheless, circumvented the proper improvement of the service delivery in the past.

2.7 Factors affecting willingness to pay

A willingness to pay study in the area of water and waste water investment during the past two decades demonstrated that nonmarket valuation methods contribute to effective planning of water and wastewater investments. Nonmarket methods, especially contingent valuation, were readily adapted to estimating water and wastewater benefits.

Research showed that benefits, measured by willingness to pay, are significant under a wide range of cultural and demographic conditions (Altaf, 1994a, 1994b; Altaf and Hughes, 1994; Briscoe *et al.*, 1990; Whittington *et al.*, 1990; Whittington et al., 1989). However, households' willingness to pay was not uniform. Nonmarket valuation was an effective and flexible tool for assessing economic demands, project efficiency, and financial viability (Altaf *et al*., 1993).

Several factors were linked to variations in the size of willingness to pay. One factor was the quality of water service. A second factor was the availability of alternative supplies. A third factor was household characteristics such as income, number of family members, age, and gender. Differences among household characteristics led to differences in willingness to pay (Briscoe *et al*., 1990; McPhail 1993; Whittington *et al.*, 1992).

In general, the variation in willingness to pay has an important implication for financial viability: Investment revenues collected through voluntary charges might not be sufficient to generate revenues in excess of costs, even if benefits exceed costs. This is especially true for the lump sum tariffs or fees that agencies often charge.

Households with willingness to pay less than the tariff will not voluntarily sign up for the service, and no revenue is collected from this portion of the population (McPhail, 1994). Households with willingness to pay greater than the tariff sign up for service, but the tariff they pay is less than their willingness to pay. The net result is that revenues are certain to be less than total willingness to pay and may be less than total costs.

The processes of field survey of willingness to pay for better solid waste management in various cities, the kind of data collected through administration of questionnaires and data analysis done are presented in various forms.

Based on the findings in a town called Gboko in Nigeria for instance, the following conclusions were drawn:

Demographic variables like occupancy rate, socio-economic class and education affect solid waste management. The greater the size of the household the greater the tendency to generate more wastes.

Many people believe that it is the responsibility of the government to manage solid waste and hence have care free attitude towards the management of the environment.

Government's management of solid waste is inadequate. This manifests in delays in collection of wastes for disposal and near absence of service in some areas. Also, public enlightenment campaigns have not been satisfactory.

The study of willingness to pay for better SWM service involves data collection and statistical analyses. The idea behind the data collected is to help develop a statistical model upon which solid waste management challenges can be controlled and possible related future events predicted (Akpen *et al.*, 2009).

CHAPTER THREE

METHODOLOGY

3.0 The Study Area

The study was conducted in the Tema Metropolitan area in the Greater Accra region of Ghana. Fig. 3.1 shows the map of the study area, with the central Tema indicated in the dotted bracket.

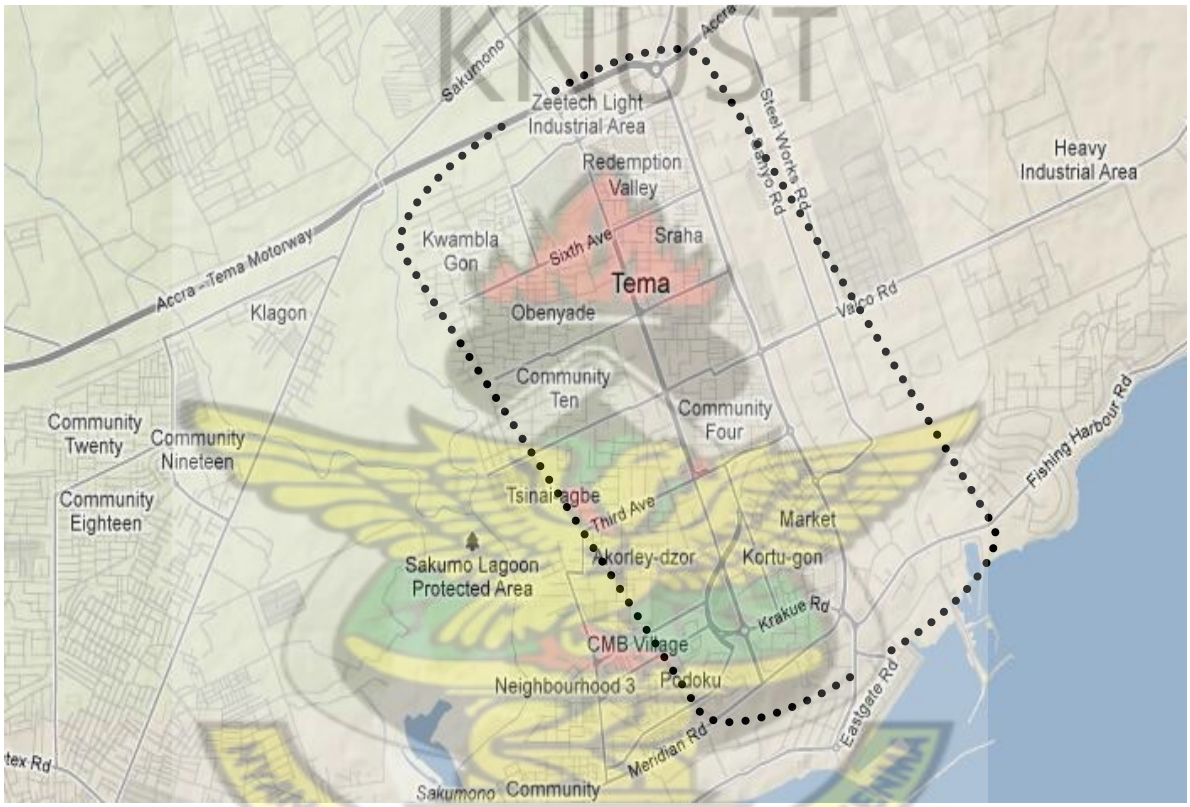

Figure 3.1 Map of the Tema metropolis (Study Area is shown in dotted bracket)

Tema is a coastal city located at latitude 5.66698 and longitude -0.01657 in decimal degrees.

It is the administrative capital of the Tema metropolitan area. The metropolis is currently composed of five (5) towns and twenty-five (25) communities. As at May 2012, the total population of Tema stood at 160,939, (Ghana Statistical Service, 2012).

The metropolis is the industrial hub of the country and was serviced with good infrastructure until recently where consistent use over the years and overburdening of these infrastructure by increasing population have adversely affected these infrastructure. There are 220 kilometres of roads in the municipality, excluding Lashibi and Sakumono. Over 80% of the settlements in the municipality enjoy electricity supply, and a similar proportion has access to potable water by means of pipe-borne water system. Some sanitation facilities are available in the Tema city and other urban areas, with the privatization of refuse collection in some parts of the municipality, intended to improve sanitation (http://www.ghanadistricts.com).

The Tema Port, which opened to maritime traffic in 1962, is Ghana's largest and indeed one of the most important Maritime ports on the west coast of Africa. A fishing harbour also adjoins the Main Harbour. Tema handles over 70% of all shipments to Ghana and to some landlocked countries in the West African Sub-Region.

Tema is home to over 200 light and heavy industries including the Tema Oil Refinery, Food Processing Plants such as Nestle Ghana Limited and Cocoa Processing Company and many others. Hence several factory workers can be found in the communities. Nevertheless, other common occupations observed in the metropolis include; retail and whole sale trade of varied goods and services, building construction and fishing (Mba, 2002).

The metropolis is also serviced by hundreds of basic schools, at least 15 second cycle institutions and one main tertiary institution as well as several other tertiary institutions that have learning centres located within the metropolis.

Aside the Tema General Hospital and the Tema Polyclinic, there are several private health institutions in the municipality.

3.1 Sources of Data

To support the survey, primary data was obtained mainly from the Waste Department of the TMA and Zoomlion Ghana Limited, Tema branch as well as individuals in the communities. Secondary data was also collected and mostly included books, published articles both on the internet and in journals and government publications.

The socio-economic survey utilized a stratified sampling approach. Three types of households were identified.

The stratified sampling involved grouping households into three main categories of affluence. Furthermore, three main social gathering points were indentified for questionnaire administration in conjunction with the house-to-house mode of administration of questionnaires. These locations notwithstanding, several of the questionnaires were administered from door-to door in most parts of the communities. Logistic regression model and similar complementary models were used to identify the determinants of households' willingness to pay for improved solid waste management service and to analyze the mean WTP of households.

3.2 Instruments (Modes of Data Collection)

3.2.1 Primary Data Collection

Primary data for the study was collected through field study, questionnaire survey and face- to-face interviews. Questionnaire was developed to take into account all the important variables of public willingness to pay for better solid waste collection. Questionnaire was discussed with experts and was pre-tested before finalizing it. By using systematic random sampling, 150 questionnaires were administered from door to door in some areas and more conveniently at three central gathering points; a church and two Senior High Schools.

The questionnaire was put into two categories: part one was aimed at collecting demographic data (age, sex, academic level, marital, and employment status), and the second part looked at the important variables of the willingness of the public to pay for a better solid waste collection.

3.2.2 Secondary Data Collection

Secondary data regarding the level of collection, sources of operational funds, status of logistics and the problems confronting their operations were collected from the Waste management authorities (TMA and Zoomlion Waste Management Service).

Data collection from the Waste Management Department (WMD) of TMA was done through personal interviews and few extracts from their records. The data collected here was on waste stream information including waste type and composition, waste collection, supposed volume generated versus volume collected. The data also include the existing methods of waste disposal and the ground work on the proposed Kpone landfill.

3.2.3 Contingent Valuation Method (CVM)

In order to achieve the objectives of the study, CVM was used in the data collection. It shows the valuation that an individual attaches to a service. The approach involves asking people questions, as opposed to observing their actual behaviour (Mitchel & Carson, 1989).

3.2.4 Field Study in Selected Areas (Communities)

A general field study involved combing through the twelve communities under study to do a visual examination and categorization of the communities into three main groups of affluence.

The process involved looking at houses which Zoomlion had marked for its collection services as well as areas where only TMA collection services were available through to areas where skips were the dominant receptacle for waste collection or areas where open dumps were seen.

3.2.5 Landfill Site

Study visits were made to the TMA's waste management department offices, especially for face-to-face interviews at the office facility in Community 1 in Tema.

Afterwards, the old and the new sanitary land fill site at Kpone managed by the TMA waste department were also visited to ascertain the following among other things:

- The treatment plants at the site if any
- The possibility of recycle
- The leachate collecting system
- Gas recovery
- Weigh bridge
- Internal access
- Maintenance of the site

While carrying out this activity, a couple of pictures were taken of heaps of solid waste at the dump sites, solid waste skips overflowing with solid waste as well as scattered solid waste in between houses.

This process gave a general overview of the current waste management situation in the Tema Metropolis and this guided the formulation of questionnaire survey and interview schedule.

Face-to-face interviews were conducted to collect data from the following key stakeholders as far as solid waste management is concerned in the study area.

• TMA Waste Management Department (Director) and

• TMA Waste Management Department (Landfill Officer) and

• Zoomlion Company Limited (Tema Manager)

3.2.6 Convenience samples

This method though regarded as a non-random sampling method was employed in the selected schools where questionnaires were administered. An equal number of students, living in one of the communities under study from different classes were selected at random to respond to the questionnaires on behalf of their parents or send it to their parents for a response.

The idea behind this method of sampling is to get respondents who are easier to select or who are most likely to respond.

One advantage with this method for this study was to meet a large group of respondents in a short period of time while saving funds and expending little energy. The diversity of parents of these students therefore makes the convenience sampling random to a large extent.

3.3 Data Processing and Analysis

Data collected from the questionnaire were examined to check completeness, accuracy and consistency of responses. Statistical analysis was performed using statistical software, SPSS version 16 analysis. Statistical tables and charts were constructed for easier interpretation and discussion.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter discusses the results of the survey used to collect information about waste generation of some selected communities in Tema and their willingness to pay for the collection of these wastes by the appropriate authorities. Questionnaires were administered to a random sample of 140 respondents and a total of 131 responses were obtained indicating a 93.5% response. An extract of the summary of some questions and responses included in the survey can be found in Table 4.1 and 4.3.

4.1 Demographic characteristic of respondents

The demographic summary statistics of the respondents are presented in Table 4.1. Approximately 55% of the respondents were females; about 4% less than the ratio represented in the Ghana Census profile of 2010. 58.8% of respondents were people who own or live in their own houses. Owning a house in this case could mean living in a house without paying rent not necessarily having one's own estate. Compared to the Ghanaian general population, more married respondents answered the questionnaires than single individuals.

The greatest number of responses came from Community 11 and Community 12.

The age categories from 51 to 60 were over represented in our sample and the household size between 6 to 10 people representing about 5% of the Ghanaian population, accounted for the majority of the respondents (47%) in the study.

At least 45% of the respondents had a tertiary education (compared to 3.5% of the Ghanaian population as at 2007), and only 26% of the respondents had less than Senior High School education, which is 6% greater than the average population of Ghana (20%).

Table 4.1: Frequency distribution of the demographic characteristics of survey respondents

Characteristics(n=131)		Number of Respondents	Percentage of Respondents
Type of Residency	Own	77	58.8
	Rented	50	38.2
	Unknown	4	3.1
Geographical Region	COM1	13	9.9
	COM2	16	12.2
	COM3	3	2.3
	COM4	12	9.2
	COM5	4	3.1
	COM6	5	3.8
	COM7	7	5.3
	COM8	5	3.8
	COM9	12	9.2
	COM10	2	1.5
	COM11	27	20.6
	COM12	20	15.3
	Unknown	5	3.8
Gender	Male	59	45
	Female	72	55
Marital status	Married	75	57.3
	Single	53	40.5
	Unknown	3	2.3
Current Occupation	Administrative staff	36	27.5
	Traders, businessmen, SE	36	27.5
	Health Workers	5	3.8
	Artisan, Fashion	22	16.8
	Caterer	9	6.9
	Security Service	3	2.3
	Retiree	7	5.3
	Education	3	2.3
	Unemployed or student	5	3.8
	Unknown	5	3.8
Educational level	Junior High School	34	26
	Senior High School	38	29
	Tertiary	59	45
Household Size	1-5	40	30.5
	6-10	62	47.3

	11-15	6	4.6
	16-20	6	4.6
Own a Waste bin	Yes	58	44.3
	No	71	54.2
	Unknown	2	1.5
Current Salary Range	<200	22	16.8
	201-600	51	38.9
	601-950	22	16.8
	951-1500	7	5.3
	>1500	14	10.7
	Unknown	15	11.4
Age Category	between 20-30 years	29	22.1
	from 31-40	27	20.6
	from 41-50	31	23.7
	from 51-60	33	25.2
	above 61	10	7.6
	Unknown	1	0.7

SE- Self-employed, COM 1-12: Communities 1, 2, 3 …12.

In this study, however, household income was expressed as current salary range. This value represents a respondent's salary rather than that of the household where a respondent comes from. Of the 131 respondents, 38.9% earn between 200 to 600 cedis. About 16.8% had a monthly income of less than 200 cedis while 32.8% earn above 600 cedis.

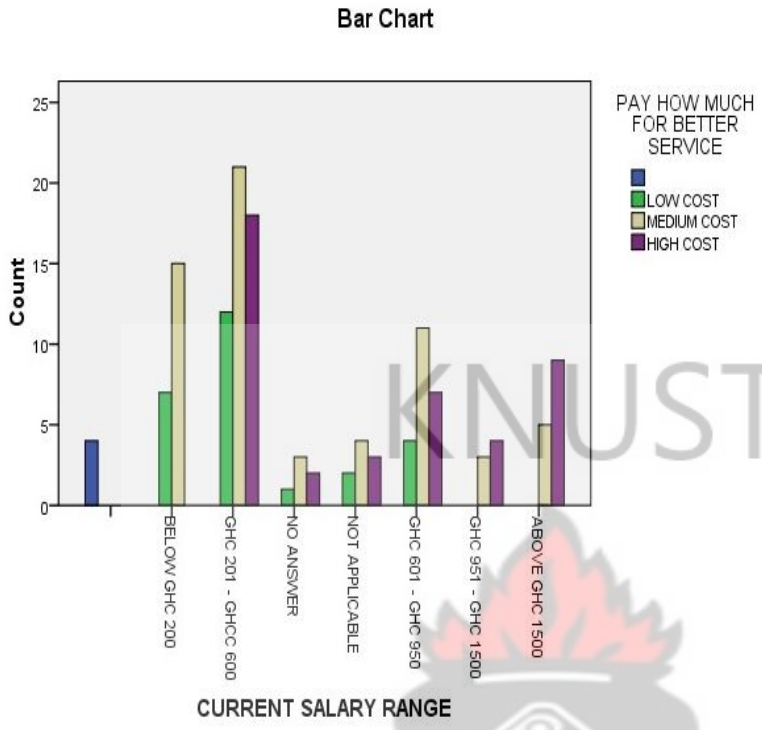

Figure 4.1 Respondents response to the question current salary and preferred choice (hypothetical cost) of waste management.

The basic graph shown above (Figure 4.1) indicated that income is an important determinant of households demand for the service. This variable was however not significant as per the regression model used in the study. With the increase in households' income people can spare money for improvement in their living standards. Although the contrast was not so clear, it was observed that income does affect willingness to pay to some extent.

An observation of the lowest income quintile of below 200 cedis indicated a 'zero' Willingness to Pay for a high cost of solid waste collection service whiles at the right end of the graph;

the fourth and fifth income quintiles, which were between 950 cedis and 1500 cedis as well as above 1500 cedis showed that households were more willing to pay the high cost for solid waste management rather than the medium cost of solid waste management. Furthermore, these households within the two highest income quintiles did not at all consider the low cost of solid waste management service as an option.

4.2 Respondents Knowledge of Waste Management

Table 4.2: Respondents response to the objective questions.

Question	Correct	Incorrect	Number of Observation
1) Improper waste management causes outbreak of diseases	89.63	10.37	131
2) Zoomlion manages all waste in Ghana.	90.54	9.55	131
3) Waste management is only an act of collecting and dumping refuse	89.21	10.79	131

In this study, objective knowledge of waste management and its health implications were measured using three items. Evaluating objective knowledge implies measuring what an individual actually knows and this "textbook" knowledge may be weighed as a set of true/false items or giving specific answers. The descriptive statistics of the three items are summarized in figures 4.2-4. Eighty nine percent (89%) of the respondents answered all true/false questions correctly and only 10.2 answered all the questions wrong. Eighty nine percent of the respondents knew the correct definition of waste management.

90.5% knew that there are other companies involved in waste management apart from Zoom Lion; 89% knew that improper disposal of waste is a congenital factor of a disease outbreak.

The average score of the answers to the true/false questions (0 = Incorrect and 1= Correct) was used as the summated scale (used in further analysis) for the objective knowledge of solid waste management. According to Hair *et al.* (1998), summated scales may be formed by summing up the separate variables and then their total or average score is used in the analysis.

Subjective knowledge of waste management was measured using seven items found in Table 4.3. It required respondents to answer or select from a set of response options. The available choices also included a "not sure" option to allow for the possibility of lack of an opinion where applicable. Subjective knowledge is the individual's perception of how much she or he knows (House *et al.*, 2004).

Figure 4.2 Respondents response to the objective question 'improper waste management causes outbreak of disease''.

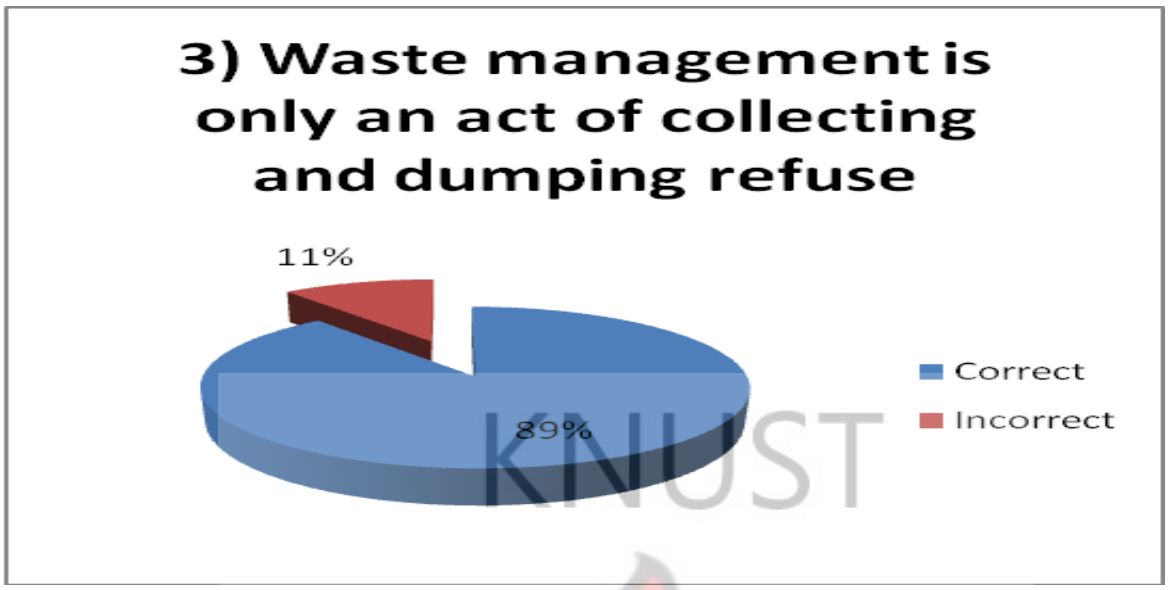

Figure 4.3 Respondents response to the objective question ‘’Waste management is only an act of collecting and dumping of refuse.

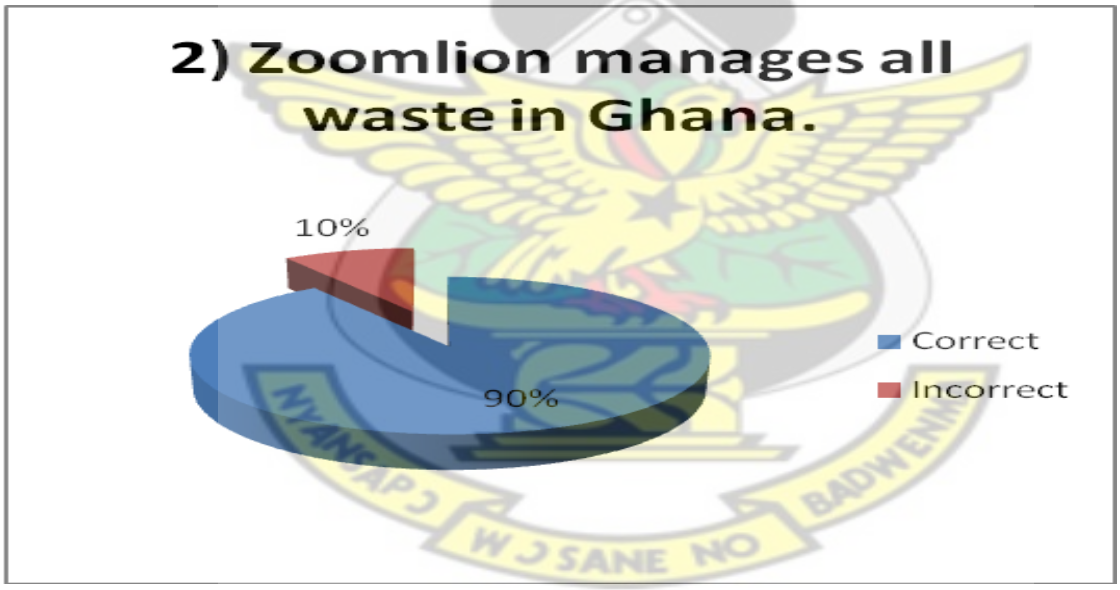

Figure 4.4 Respondents response to the objective question ‘’Zoomlion manages all waste in Ghana.

Table 4.3: The frequency distribution of respondent's knowledge of waste management

Question		Number of Respondents	Percentage
Which body should handle street waste	Municipal	36	27.5
	Private Company	8	6.1
	Both	23	17.6
	Communal Labour	64	48.9
How are electronic waste disposed	Burning	5	3.8
	Waste bin	39	29.8
	Scrap dealers	70	53.4
	dump site	14	10.7
	No answer	3	2.3
Willingness to use reusable shopping bag	Yes	101	77.1
	No	21	16
	No answer	9	6.9
How hazardous material are disposed	Burning	16	12.2
	dumping in nearby bush	9	6.9
	dumping in gutter	5	3.8
	Burning in backyard	14	10.7
	Waste bins	79	60.3
	Recycling	6	4.6
	No answer	2	1.5
Companies involved in waste management	Truck pushers	15	11.5
	Zoomlion	88	67.2
	private trucks	10	7.6
	Others	2	1.5
	no answer	9	6.9
	Missing	7	5.3
Waste generated most	Plastic	18	13.7
	Paper	28	21.4
	food waste	66	50.4
	Diposable/ yard waste	18	13.7
	Missing	1	0.8
Measures taken to reduce waste generation	Reuse and recycle	48	36.6
	Burning	60	45.8
	No Answer	9	6.9
	Pouring into gutters and drains	4	3.1
	Throwing into nearby bushes	8	6.1
	Dumpsite	2	1.5

The frequency distribution and descriptive statistics of the 7 items are shown in Table 4.3. Quite interestingly, the results indicated that 48.9% of the respondents specified that the streets in the neighborhoods be cleaned on communal basis and not necessarily by the waste management department of the municipal assembly, yet this is not the reality on the ground. Hardly is it observed that communities organize themselves to clean up their environment. However, about 27.5% of the respondents revealed that the Municipal Assembly was supposed to take an active role in the management of solid waste generated on the streets.

In consonance with the four-tier solid waste management hierarchy (US EPA, 2000), which ranks source reduction or waste prevention, which includes reuse as the best approach to solid waste management, 77.1% of respondents were willing to reuse reusable shopping bags in an effort to prevent waste generation. According to the hierarchy, recycling, the second tier is the next in rank followed by the third tier, combustion with energy recovery and landfilling or incineration without energy generation as the fourth tier. Although incineration was the last resort according to the hierarchy, incineration was rather the popular waste management practice as shown in the Figure 4.5.

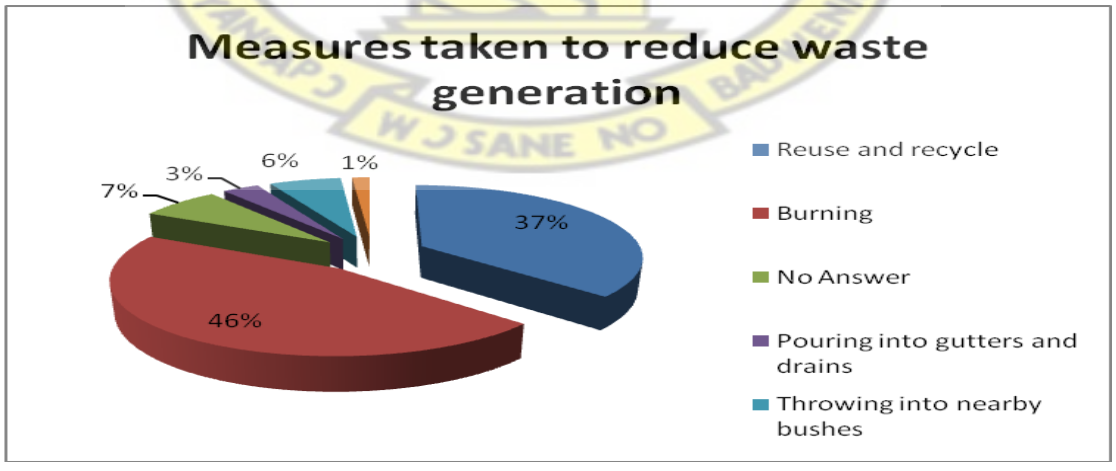

Figure 4.5: Measures taken to reduce or dispose off waste.

In a study conducted by Akpen *et al.* (2005), no significant variation was recorded in the waste generated by the various households segments.

Some studies have indicated that one important variable in the regression is the household size and that there is a statistically significant relationship between household size and household willingness to pay for solid waste management services (Richardson & Havlicek, 1974). Among the other variables, awareness regarding the need for solid waste management is also considered and included in the regression. However, these variables have failed to establish statistically significant relationship with the dependent variable in this study.

At best it was observed that irrespective of the household size, medium to high cost of better solid waste management service was preferred to the low cost of solid waste management service.

Although household sizes influences the amount of waste generated in this study, there were little or no difference in the kind of wastes generated in the various household segments.

4.3 Deductions on Willingness To Pay

The study elicited the willingness of households to pay for improved solid waste collection services. Approximately 51.6% of the respondents expressed willingness to pay for improved solid waste collection. On the average, majority of the respondents indicated a response to pay a premium reflecting the current service charges of the Tema municipal Assembly, between (3-5) cedis monthly. Of the 41 respondents who preferred to pay a premium of (6-10) cedis, 56% expressed a willingness to pay more for solid waste collection.

As it was expected, respondents' WTP was skewed towards high income earners such as the individuals earning between 950-1500 cedis and higher.

Surprisingly, only 64.3% of respondents in the highest income level were willing to pay as opposed to 85.7% in the 950-1500 earners category. Furthermore, households who indicated a satisfactory response to the current frequency of waste collection, were all willing to pay and vice versa.

Education is also seen as a variable which can affect people's WTP. Consequently, people in the highest quartile of the education category were more (58.1%) predisposed to paying for waste management than their counterparts who are less educated.

However, respondents who have had Senior Secondary School level of education were also willing to pay (51%).

Some of the reasons given by respondents that expressed lack of willingness to pay were: dissatisfaction with the current rate of collection, the cost of current rate of collection being too expensive compared to the service provided. Some respondents asserted that it is the responsibility of the municipal assembly to provide services consistently and determine appropriate charges per collection.

4.4 Binomial Logistic Regression

Logistic regression model is one of the important econometric techniques that is used for regression analysis when the dependent variable appears to be a categorical variable. It helps in calculating the elasticties of different independent variables upon a dependent variable. As WTP is treated as dependent variable in this study therefore, the binomial logistic regression is the appropriate econometric technique to find out the determinants of WTP.

In order to estimate the determinants of individual's WTP for solid waste collection, the contingent valuation model was used to note down public stated perception. The binomial logistic regression is utilized to estimate the impact of households' socio- economic attributes on their valuation of waste collection services. The SPSS software was used for all the statistical analysis in this study. Among the set of independent variables used in this study, different variables including education level, income, awareness, owning a bin, etc were identified. Some of these variables were seen to have some effect on household's demand and consequently their WTP for better solid waste management services.

Table 4.4 shows the estimated coefficients of all independent variables associated with the dependent WTP for solid waste collection.

The logistic regression analysis conducted to predict WTP of 131 households for improved waste collection using age, frequency of present collection (pfc), current cost of waste collection (phm), current salary, educational level, and owning a waste bin as predictors of the full model against a constant only model was statistically significant. This indicates that the predictors as a set, reliably distinguished between acceptors and decliners of the scenario. (chi square = 11.484, df=8 with $p < .176$ indicates the model fits the data)

Nagelkerke's R^2 of 0 .544 indicated a moderately strong relationship between prediction and grouping. Prediction success overall was 86% (84.9% for decline and 87.0% for accept). The Wald Criterion demonstrated that current frequency of collection, preferred frequency, age, and educational level made significant contributions to the prediction ($p = 0.02, 0.00, 0.03$, and 0.01) respectively. The dummy variables, gender, current cost of collection; how much one pays (phm), income and whether one owned a waste bin were not significant predictors.

For educational level, no main statistical effect was recorded. However, households with educational level at the senior high School level recorded significance (p=0.01).

EXP(B) value indicates that with raising the frequency of present collection one degree higher; say from weekly to biweekly, the odds ratio is 11.98 times as large and therefore households in weekly waste collection category are 11.98 times more willing to pay than the households in the baseline category of monthly.

Although preferred frequency of collection as a dummy variable recorded a statistically significant main effect, none of its sub categories recorded a significant effect. On the other hand, age, another dummy variable which recorded a statistically significant main effect, recorded significance for age categories '51-60' and '31-40' years.

Raising the age category by a step higher, households in the age categories of '51-60' and '31-40' are 22.67 and 41.48 times more likely to pay than the baseline category (above 60 years) respectively.

Table 4.4: Marginal effects of binomial logistic regression

Variables in the Equation				
	B	Wald	Sig.	Exp(B)
Pfc		8.16	0.02*	
pfc(1)	24.67	0.00	1.00	$5.15X10^{10}$
pfc(2)	2.48	8.16	0.00*	11.98
FREQUENCY PREFERRED		14.26	0.00*	
FREQUENCY PREFERRED(1)	-1.37	0.57	0.45	0.25
FREQUENCY PREFERRED(2)	1.21	0.47	0.50	3.36
FREQUENCY PREFERRED(3)	23.17	0.00	1.00	$1.15X10^{10}$
AGE		10.37	0.03*	
AGE(1)	1.37	0.88	0.35	3.93
AGE(2)	3.73	6.38	0.01*	41.48
AGE(3)	2.94	3.95	0.05	19.00
AGE(4)	3.12	4.49	0.03*	22.67
SEX(1)	0.16	0.07	0.79	1.17
Phm		0.04	0.98	
phm(1)	-0.05	0.00	0.95	0.95
phm(2)	-0.14	0.04	0.84	0.87
OWNWASTE BIN(1)	-0.19	0.10	0.75	0.83
EDUCATIONAL LEVEL		3.33	0.19	
EDUCATIONAL LEVEL(1)	-0.85	1.32	0.25	0.43
EDUCATIONAL LEVEL(2)	-1.30	3.10	0.01*	0.27
SALARY		4.73	0.32	
SALARY(1)	-0.21	0.07	0.80	0.81
SALARY(2)	-0.55	0.32	0.57	0.58
SALARY(3)	2.50	2.58	0.11	12.18
SALARY(4)	0.82	0.52	0.47	2.27
Constant	-4.48	2.97	0.08	0.01
No. of Observation	131			
Loglikelihood	-92.23			
Prob>Chi				0.00
a. Variable(s) entered on step 1: pfc(willingness to pay for), FREQUENCYPREFERRED, AGE, SEX, phm(how much is paid currently), OWNWASTEBINITSPROVIDER, EDUCATIONALLEVEL, SALARY. *significance				

$$Prob\ of\ a\ case = \frac{e\{2.48wpf(2) + 3.73age(2) + 3.12age(4) - 1.30edu(2) - 4.48\}}{1 + e\{\{2.48wpf(2) + 3.73age(2) + 3.12age(4) - 1.30edu(2) - 4.48\}}$$

Pfc = current frequency of waste collection- biweekly

Edu (2) = SHS -Educational level

Age (2) = ’51-60’ years

Age (3)= ‘31-40’years.

Prob. = probability of a case.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 Conclusion

The study sought to analyze the dynamics involved in waste generation and its collection and the willingness of households to pay more for the collection of waste they generate in some selected communities in the Tema Metropolis. The analysis revealed that

1. Of the 12 communities selected, community 12 had the highest response rate with an overall percentage WTP of 60%. In addition, slightly more females were willing to pay than their male counterparts.
2. Considering the respondents knowledge on waste management, approximately 90% of them responded correctly. On the whole, respondents' awareness of waste and its management may be said to be very high.
3. Although several variables were included in the dummy only the current frequency of collection, preferred frequency of collection (should the service be improved), age, and educational level made significant contributions to the prediction with p values of p = 0.02, 0.00, 0.03, and 0.01 respectively.
4. Income which is an important determinant in most households' willingness to pay was rather not significant in this study. Nevertheless, from observation of the results it was clear that low income earners (200 cedis or less) showed no interest in paying the highest cost for waste collection whereas high income earners (950 cedis to 1500 cedis and above) also showed no interest in the low cost category for the hypothetical values set for WTP(Figure 1). This is a good indication that high income earners are more capable and likely to afford better SWC services.

Though the communities of Tema were categorized into three classes of affluence, results from the studies showed no clear distinction in the affluence of the communities. This was probably due to the fact that several people of various socioeconomic backgrounds move into the township and get accommodation based on availability and not choice; hence relatively affluent individuals may have ended up in the seemingly least affluent communities and vice versa respectively.

Results from the study indicate that, if waste collection is consistently and efficiently carried out twice a week, residents will be willing to pay more for the service. Hence there's the need for the TMA to make more advanced and medium to high cost waste management service available to all communities without essentially considering the affluence classification as done in the past. In the meantime communities can be conscientized on the better forms of SWC and management and convinced to patronize for the good of all.

5.1 Recommendation

Waste reduction is said to be a logical starting point for sustainable solid waste management, by reducing the amounts of waste that must be managed, by collection and disposal (UNEP, 1996).

Source waste which is mostly organic is essential to note. Composting this putrescible part of the wastes will reduce the waste being disposed off and the compost becomes fertilizer to be used in backyard gardens or serve as raw material in organic fertilizer blending factories or plants.

Revenue collection is a major problem facing the TMA waste department. A franchise system would be more suitable whereby a contractor in assigned a particular community or zone.

An efficient rezoning with clear contractor agreement will enhance revenue collection and this financial resource can be used to improve the TMA waste departments' activities.

In this case the contractor may meet with the service recipients and come to an agreement on the services required and the most appropriate charge for the service. The contractor may then send minutes of the meeting to the TMA which oversees waste collection for gazetting. This kind of agreement will be more binding and make revenue collection more efficient since both parties were involved in the decision making.

Based on the lack of a clear distinction in affluence among the communities, there's the need for the TMA to make more advanced and medium to high cost waste management service available to all communities without considering the affluence classification as done in the past. In the meantime communities can be introduced to better forms of waste management and convinced to patronize them for the good of all.

The system has also not delivered the optimum economic and environmental result for now and has not provided enough room to adapt to future pressures (increases in volumes of waste and diversity in composition). Therefore, cost recovery could also be considered on a large basis.

Most household attempt to dispose of all kinds of generated waste through the use of waste bins, hence, it is advisable that the TMA develops and enforces an efficient system of collecting the garbage as scheduled weekly for now, and also attempt a waste segregation and recycle program.

It is therefore recommended that Government's effort be intensified through the metropolitan assembly in the field of awareness creation campaigns, provision of appropriate equipment and efficiently trained personnel in removing solid wastes from the municipality as well as ensuring compliance with existing environmental laws.

REFERENCES

Abankwa V., Grimard A., Somer K. and Kuria F. (2009). United Nations Human Settlements Programme (UN-HABITAT). www.unhabitat.org/pmss/getElectronicVersion.aspx?nr=2929& Accessed; December, 2011

Akpen, G.D, Tyagher, S.T and Ogori, P.O. (2005). Solid Waste Management in Urban Areas of Benue State, Nigeria. Int. Journal of Environ. Issues. 3 (2): pp 54-59.

Altaf, Mir Anjum. (1994a). The economics of household response to inadequate water supplies. Third Worm Planning Review 16:14-53.

Altaf, Mir Anjum, and Jeffrey A. Hughes. (1994). Measuring the demand for improved urban sanitation services: Results of a contingent valuation study in Ouagadougou, Birkina Faso. Urban Studies 31:1763-76.

Altaf, Mir Anjum, Dale Whittington, Haroon Jamal, and V. Kerry Smith. (1993). Rethinking rural water supply policy in the Punjab, Pakistan. Water Resources Research 29:1943-54.

Anomanyo E .D (2004). Integration of Municipal Solid Waste Management in Accra (Ghana) Bioreactor Treatment Technology as an Integral Part of the Management Process. Presented to Lund University, Sweden.

Bartone, C.L & Bernstein, J.D (1993). "*Improving Municipal Solid Waste Management in Third World Countries*", Resources, Conservation and Recycling; 8; 43-45.

Bateman I. J. and Turner R. (1992). Evaluation of the Environment: The Contingent Valuation Method: The Centre for Social and Economic Research on the Global Environment (CSERGE) Working Paper GEC 92-18

Baud, I.S.A., & Post, J. (Eds.). (2002). Realigning actors in an urbanizing world: Governance and institutions from a development perspective. VT: Ashgate.

Bertrand, M. and Mullainathan, S. (2001). "Do People Mean What They Say? Implications for Subjective Survey Data." The American Economic Review, Vol. 91, No. 2, 67-72.

Boadi, K. O., & Kuitunen, M. (2002). Urban waste pollution in the Korle Lagoon, Accra, Ghana. The Environmentalist, 22 (4). 301-309.

Boadi, K. O., & Kuitunen, M. (2003). Municipal solid waste management in the Accra metropolitan area, Ghana. The Environmentalist, 23 (3), 211-218.

Boadi, K. O. and Kuitunen, M. (2005): Childhood diarrhoea, morbidity in the Accra Metropolitan Area, Ghana: Socio-economic, environmental and behavioural risk determinants. Journal of health and population in Developing Countries/URL, March: 31-44

Briscoe J, Paulo Furtado de Castro, Charles Griffin, James North 1990. Toward equitable and sustainable rural water supplies: A contingent valuation study in Brazil. The Worm Bank Economic Review 4:115-34.

Castanino P.J. (2011). Trash & Recycling Definitions. Department of Public Works. Belmont, MA 02478.

Cointreau-Levine, S. (1994). Private Sector Participation in Municipal Solid Waste Services in Developing Countries. Volume 1. The Formal Sector.

http://wwwwds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1994/04/01/000009265_3970128111924/Rendered/PD

Accessed; 2nd February, 2011.

Cointreau-levine S. and Coad A. (2000). Guidance Pack Private Sector Participation in Municipal Solid Waste Management. Executive Overview. http://rru.worldbank.org/Documents/Tookits/waste-fulltoolkit.pdf

(Accessed: 10th March, 2012)

Dayton C. M. (1992). LOGISTIC REGRESSION ANALYSIS, University of Maryland.

Dijkema, G.P.J., Reuter, M.A., Verhoef, E.V. (2000) *A new paradigm for waste management*. Waste Management Vol. 20, pp 633-638

(http://www.elsevier.nl/locate/wasman Accessed 20/08/2004)

Downmore M., Shepherd M., Andrew M., Barbara N. and Daniel J. (2011). Municipality Solid waste (MSW) Management Challenges of Chinhoyi Town in Zimbabwe: Opportunities of Waste Reduction and Recycling.

EGSSAA, (2009). Environmental Guidelines for Small-Scale Activities in Africa http://www.encapafrica.org/EGSSAA/solidwaste.pdf Accessed; March, 2011.

Environmental Protection Agency, (2002) Ghana State of the Environment Report EPA, MES, MLGRD.

Ghana landfill guidelines: Best Practice Environmental Guidelines.

European Recovery and Recycling Association, (1991): *Resource*. Report of European Recovery and Recycling Association, Autumn, 1991. ERRA, Brussels – cited in Adam D. Read (2003) *What is integrated waste management (IWM)?* Energy from Waste Foundation Project.

Eykhoff,P. (1974). System Identification-Parameter and State Estimation. Wiley, New York

Foo, T.S., (1997). Recycling of domestic waste: early experience in Singapore. Habitat International 21, 277-289.

Ghana Export Promotion Authority, (2002) Ghana landfill guidelines. Environmental Protection Agency of Ghana. Ministry of Environment Science and Ministry Of Local Government and Rural Development

Ghana Statistical Service, (May, 2012). Population & Housing Census Summary Report Of Final Results

Griffin C., Bhanwar Singh,; Radhika Ramasubban and; Ramesh Bhatia. (1995). Contingent valuation and actual behavior: predicting connections to new water systems in the state of Kerala, India. The World Bank Economic Review 1995;9:373–95.

Gwatkin DR, Guillot M, (1999). The Burden of Disease among the Global Poor: Current Situation, Future Trends, and Implications for Strategy. Geneva: Global Forum for Health Research Publications.

Gyebi E. (2010). The chronicle Ghana: Tamale Assembly makes breakthrough in waste management. 19th March 2010 Edition of the Chronicle.

Hair, F.J., R.E. Anderson, R.L. Tatham and W.C. Black. (1998). "Multivariate Data Analysis." Upper Saddle River, N.J., Prentice Hall

House et al. (2004). "Objective and Subjective Knowledge: Impacts on Consumer Demand for genetically Modified Foods in the United States and the European Union." AgBioForum, 7(3):113-123

Johannessen, L. M., and Boyer, G. (1999). *Observations of Solid Waste Landfills in Developing Countries: Africa, Asia, and Latin America*. Urban Development Division, Waste Management Anchor Team, The World Bank.

KEEA, (2006). Komenda/Edina/Eguafo/Abirem About Komenda/Edina/Eguafo/Abirem Muncipal Environmental Situation. http://ww.ghanadistricts.com/districts1on1/keea/?arrow=atd&=57&sa=2826 Assessed: February, 2012

Martin, O. A. (2011). Governance Crisis or Attitudinal Challenges? Generation, Collection, Storage and Transportation of Solid Waste in Ghana. Integrated Waste Management. In Tech 1, (978- 953-307-469-6)

Mba E A, (2002) Privatization of Solid Waste Collection, The Tema Experience. Regional Workshop on Shared Management Responsibility of Waste in African Towns.

McPhail, Alexander A. (1993). The 5-percent rule for improved water service-can households afford more. World Development 21:963-73.

McPhail, Alexander A. (1994). Why don't households connect to the piped water system? Observations from Tunis, Tunisia. Land Economics 70:189-96.

Medina, M. (2002). Globalization, Development, and Municipal Solid Waste Management in Third World Cities. El Colegio de la Frontera Norte [College of the northern border], Tijuana, Mexico. Unpublished paper.

Mensah, A. and Larbi E. (2005). Fact Sheet Solid Waste Disposal (SWD) in Ghana. www.trend.watsan.net Accessed on 10th February, 2012.

Miller, C. (2004). Wastage. Food Waste http:// wastage.com/mag/waste-food-waste-2/ Accessed in January, 2012.

Ministry of Environment and Forestry Notification. (2000), New Delhi. http://envfor.nic.in/legis/hsm/mswmhr.html Accessed on 3rd June, 2012.

Misra, V. and S.D. Pandey. (2005). Hazardous waste, impact on health and environment for development of better waste management strategies in future in India. Envir. Int'l. 31(3): 417-431.

Mitchell, R.C., Carson, R.T. (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Johns Hopkins University Press, Baltimore, MD.

NEHA (2005). Environmental and Health Impacts of Household Solid Waste Handling and Disposal Practices in Third World Cities: The Case of the Accra Metropolitan Area, Ghana. http://depts.washington.edu/envhlth/acad_programs/eh/ (Accessed; February, 2012).

Othman J. and Noor Fazni Harun. (2002). Economic Instruments and Willingness to Pay for Solid Waste Management Services. Chapter in Chamhuri Siwar, et. al. (ed.), Policies to Improve Municipal Solid Waste Management. LESTARI Publisher. Universiti Kebangsaan Malaysia, Bangi.

Palczynski R. J. (2002). Study on Solid Waste Management Options for Africa Project Report Final Draft Version.

http://www.bscw.ihe.nl/pub/bscw.cgi/d1354356/SOLID%2520WASTE%2520MANAGEMENT%2520STUDY.pdf Assessed: 19th January, 2012.

Post, J., Broekema, J., & Obirih-Opareh, N. (2003). Trial and error in privatisation: Experiences in urban solid waste collection in Accra (Ghana) and Hyderabad (India). Urban Studies, 40 (4), 835-852

Puopiel F. (2010), Solid Waste Management in Ghana: The Case of Tamale Metropolitan Area. Thesis Presented to the Department of Planning, Kwame Nkrumah University of Science and Technology.

Richardson, R.A. & J. Havlicek. (1974). An analysis of seasonal household waste generation. Southern Journal of Agricultural Economics. 06(02): 143-153

Röhrs, L.H., Fourie, A.B., and Blight G.E. (1999). *Landfill Bioreactors in developing Countries: A Balance between climate and waste composition* – Barriers, Waste mechanics and landfill Design; Volume III; Proceedings Sardinia 1999, Seventh International Waste Management and Landfill Symposium; Pg 647 - 653

Snigdha, C., 2003.Economics of Solid Waste Management: ASurvey of Existing Literature. Available from: http://www.isical.ac.in/eru/2003-11pdf (accessed 01.08.2012.)

Tamale Metropolitan Assembly (2007). Medium-Term Development Plan (2006-2009) under the Growth and Poverty Reduction Strategy. Tamale, Northern Region.

Tema Municipal Assembly (2010). Policy document on waste management

Tuani M. E. (2011). Oblogo, a case of societal failure? http://www.modernghana.com/news/330874/1/oblogo-a-case-of-societal-failure.html Accessed; 18th March, 2012.

UNEP. (1996). International Source Book on Environmentally Sound Technologies (ESTs) for Municipal Solid Waste Management (Msolid waste management). Division of Technology, Industry and Economics, United Nations Environment Program.

(Available online at http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/index.asp)

UNEP (2005) Selection, Design and Implementation of Economic Instruments in the Solid Waste Management Sector in Kenya: The Case of Plastic Bags, UNEP-ETB, Geneva.

UN Summit on the Millennium Development Goals, (2010). World leaders gather to boost progress against poverty in New York.

US EPA (1999). State and Local Solutions to Solid Management Problems. http://www.epa.gov.

Accessed; December, 2012.

US EPA (2010). Waste-Resource Conservation-Common Waste & Materials-Organic-Organic Materials. http://www.epa.gov/osw/conserve/materials/organic/food/

(Accessed; May, 2011).

US EPA (2011). Waste-Resource Conservation-Reduce/ Reuse Recycle http://www.epa.gov/epawaste/conserve/rrr/reduce.htm Accessed; April, 2011.

US EPA, (2012). Municipal Solid Waste. Electricity from Municipal Solid Waste.

Accessed; January, 2012.

WELL Fact Sheet-Nov 2005: Solid Waste Disposal in Ghana

file:///C|/Webpage/LRA/LOGISTIC REGRESSION ANALYSIS.htm (1 of 9) [4/23/2001 11:31:29 AM]

Whittington, D., Laura, D.T., Wrght, A.M., Choe, K., Hughes, J.A and swarna, V., (1992): "Household Demand for Improved sanitation Services in Kumasi, Ghana: A Contingent Valuation Study." *Water Resources and Research,* Vol.29 (6) 1539-1560.

Whittington et al., (1993): "Household Sanitation in Kumasi Ghana-A Description of current practices, attitudes and Perceptions, World Development report 1992.

Whittington et al., (1993) Economic values and the Environment in the developing World: A Report Prepared for United Nations Environment Programme, Nairobi, Kenya.

Whitworth, A. P. (2005). Part I. Thermal Breakdown Characteristics of Municipal Solid Waste Components in Varying Oxygen Environments and Part II. Municipal Solid Waste Management in China. http://www.seas.columbia.edu/earth/wtert/sofos/Whitworth-thesis.pdf Assessed: January, 2012.

Yadav Ishwar Chandra and N.Linthoingambi Devi, (2009) Studies on Municipal Solid Waste Management in Mysore City- A case study in Mysore, India.

Zerbock, O. (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations www.cee.mtu.edu. 13th April, 2011.

APPENDICES

Appendix 1. Description of online sample size calculator

The sample size for the survey was calculated using an online sample size calculator. The calculator is available at www.surveysystem.com/sscalc.htm, as a public service of Creative Research Systems, providing software for market researchers, political pollsters, human resource professionals, social scientists and others who use questionnaires.

This particular online resource was utilized to determine the number of respondents required to attain survey results that will reflect the larger Parish and national populations. And as the website states, "you can use it [the sample size calculator] to determine how many people you need to interview in order to get results that reflect the target population as precisely as needed."

In order to calculate the sample size, the website requires the researcher to input values for two variables: the confidence level and confidence interval. The website defines the variables as follows:

Confidence interval: the plus-or-minus figure usually reported in newspaper or television opinion poll results. For example, if the confidence interval of 4 is used, and 47% of the sample picks an answer, then you can be 'sure' that if you had asked the question of the entire relevant population between 43% (47-4) and 51% (47+4) would have picked that answer.

Confidence level: indicates how sure you can be. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval.For the present research, a confidence level of 95% and a confidence interval of ±10 were chosen for use in the sample size calculator. The confidence level was chosen based on the statement made in the website that, "most researchers use the 95% confidence level."

Given the limited personnel and financial resources available for implementing the survey, the confidence interval of ±10 was chosen based on the respective sample size, so as to minimize the sample size and maximize the confidence interval.

Appendix 2: Service Recipients Questionnaire

Willingness to Pay For Solid Waste Management within the Tema Central Metropolis.

This questionnaire is administered as part of a study into people's Willingness to Pay for Solid Waste Management within central Tema in partial fulfillment of the requirements for the degree of Master of Science in Environmental Science, Kwame Nkrumah University of Science and Technology, 2011.

Please read and answer the following questions accurately and honestly. Tick (✓), circle or fill in the blanks where applicable.

Date: / /2012

dd /mm /yy

1. Age

20-30 ☐ 30-40 ☐ 40-50 ☐ 50-60 ☐ above 60 ☐

2. Gender

Male ☐ Female ☐

3. Highest level of education attained

Junior High School ☐ Senior High School ☐ Tertiary ☐ Other ☐

4. Current Occupation (Job)

……

5. Current Salary Range

Below GHC200 ☐ GHC200-GHC600 ☐ GHC600-GHC950 ☐ GHC950- GHC1500 ☐

Above GHC1500 ☐

6. Are you in a rented apartment? Yes ☐ No ☐

7. In which community do you live? (Circle the number)

1 2 3 4 5 6 7 8 9 10 11 12

8. How many people live in the same house with you? ☐

Number of adults ☐ Number of children ☐

9. What kind of waste do you usually generate? (Tick at least 1 item or at most 3 items)

Plastic ☐ Paper ☐ Food waste (fruit, vegetable peels and tins) ☐

Disposables (eg. Diapers) Yard waste ☐

10. Which of the above mentioned waste types is generated most?

Plastic ☐ Paper ☐ Food waste (fruit, vegetable peels and tins)

Disposables (eg. Diapers) Yard waste ☐

11. Improper waste management causes outbreak of diseases. True ☐ False ☐

12. Zoomlion manages all waste in Ghana . True ☐ False ☐

13. Waste management is only an act of collecting and dumping refuse True ☐ False ☐

14. What measures, if any, do you take to reduce the amount of solid waste your household produces?

Reuse and recycle (e.g.water and beverage bottles) ☐ Using only required amount of items to reduce excesses ☐ Burning ☐ Pouring into gutters / drains ☐

15. Is there any waste collection service or mechanism provided by the Municipality or Private Business holders? Yes ☐ No ☐

16. If private, which company or mechanism is employed?

Truck pushers ☐ Zoomlion Gh Ltd ☐ Private Trucks ☐

Other……

17. If you have no collection service at all, how do you dispose of your waste?

A Common Community Waste Bin ☐ Burning ☐ Gutters ☐ Dumpsite ☐

18. Does your household (or establishment) have a durable metal or plastic container for storing solid waste? Yes, we have metal or plastic container ☐ basket or carton container ☐

No, we do not have a container ☐

19. Do you own a waste bin that was provided by your municipality or by a private company?

Yes ☐ No ☐ If Yes which one? Municipal ☐ Private ☐ Both ☐

20. Who do you think should clean the streets, community waste bins and drains in your area?

Municipal Authority ☐ Private Company ☐ Both ☐ Communal Labour ☐

21. How often are there waste pickups in your neighborhood?

Biweekly ☐ Weekly ☐ Monthly ☐

22. Do you find this adequate? Yes ☐ No ☐

23. a) How often would you like household waste to be collected in your area?

Biweekly ☐ Weekly ☐ Monthly ☐

b) Will you be willing to pay a higher proce for this preference than what you pay now?
Yes ☐ No ☐

24. If this collection does not come on, what do you do with your household waste?
Burning ☐ Dumping in nearby bush ☐ Gutter ☐ Burying in backyard ☐
Other ……..……

25. How do you dispose of hazardous materials (batteries, paint, solvents, home and garden chemicals, fluorescent tubes and bulbs) in your home?
Burning ☐ Dumping in nearby bush ☐ Gutter ☐ Burying in backyard ☐

26. How do you dispose of yard waste (leaves, grass clippings, and tree trimmings)?
Burning ☐ Dumping in nearby bush ☐ Waste bins ☐ Use as mulch/manure ☐

27. How do you dispose of electronic waste in your home (computers, TV's, cell phones)?
Burning ☐ Waste bins ☐ Scrap collectors ☐ Dumpsite ☐

28. Are you willing to use reusable shopping bags every time you shop? Yes ☐ No ☐

29. How do you dispose of items that are not collected by your waste management company, if any, e.g. broken tiles, broken blocks or caked cement.
Fill street potholes ☐ Recycle ☐ Dumpsite ☐

30. a) Do you pay for waste disposal, Yes ☐ No ☐ How much, GHC……..….
and does this cost affect your choices of waste disposal? Yes ☐ No ☐
b) Are you willing to pay more than this current fee if the service is improved?
Yes ☐ No ☐

31. Are you satisfied with the service provided? Yes, very satisfied ☐ Quite satisfied ☐
No, not satisfied ☐

32. What new or expanded solid waste services would you like to have made available to you in the future?

More regular collection ☐ Segregated waste collection ☐ Collection of recyclable items

33. Segregated waste: waste items separated into groups, e.g.; plastics, glass, metals, food and yard waste, etc.

How much will you be willing to pay for better waste management service?

Low cost (Carrying you waste to a large communal container in the neighbourhoood)

Medium cost (Keeping your waste in-house until a collection truck comes to a location in the neighbourhood periodically for a few minutes to pick up)

High cost (Waste collecting authority providing you with a bin and picking up your waste from door-to-door periodically).

34. Do you have any illegal dumping site in your neighborhood or at any specific known location? Yes ☐ No

If you do, please identify these locations.

……

35. Please share any additional comments, concerns or suggestions you may have regarding solid waste management in your municipality.

....……

……...