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KUMASI
COLLEGE OF ENGINEERING
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ECONOMIC VALUATION OF IMPROVED SOLID WASTE MANAGEMENT IN THE GA EAST MUNICIPALITY

BY
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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 acknowledgment has been made in the context.

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ABSTRACT

Similar to settlements worldwide, the Ga East municipality faces as one of its main challenges effective solid waste management. This is attributable to the high rates of population growth coupled with lack of the financial resources and institutional capacity to provide needed municipal infrastructure. This study analysed the economic value of an improved solid waste management system in the Ga East municipality based on 150 sampled household respondents, 50 from each community level. Communities in the municipality, based on their life standards, income levels, housing and other facilities, were categorized into three levels in the first stage. Employing the contingent valuation method (CVM) and the logit linear regression model, values for willingness to pay (WTP) were determined. Additionally, factors which influence WTP were identified. The study revealed that most (74%) of the respondents were willing to pay for improved SWM in the Ga East Municipality. It was discovered that the annual mean total willingness to pay for improved Solid Waste Management was GH¢ 595,571.16. Residents' WTP for improved solid waste management were significantly related to monthly income, educational level and number of years lived in the community. There was an indication that residents desire change in the currently operating waste management system and also a viable business venture for investors. The WTP estimates determined could be used as an essential tool to further estimate taxable revenues by urban planners and administrators to determine the socially optimal charges for solid waste services where all households in a particular community would receive planned and properly scheduled collection services, proper disposal of waste with additional recycling and composting features.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

In spite of the merits of urbanization, rapid population growth have rendered urbanization a 'nightmare' for governments of developing countries. The problems associated with urbanization have social, economic and environmental dimensions. Solid waste management is one major environmental challenge that continues to confront municipal authorities (Hardoy *et al*., 2000). According to Hoornweg and Bhada-Tata (2012), 2.9 billion urban residents who generated 0.64 kg of Municipal Solid Waste (MSW) per person per day a decade ago have increased to about 3 billion residents generating 1.2 kg per person per day.

Municipal Solid Waste (MSW) management constitutes one of the most crucial health and environmental problems facing governments of African cities (Achankang, 2003). Senkoro (2003) indicates that for many African countries, only less than 30% of the urban populations have access to proper and regular garbage removal. Despite the high level of expenditure on solid waste management (over 20% of municipal budgets), collection and disposal services levels are low, that is, only 70% of urban residents receive service and most disposal is by unsafe open dumping. Cointreau-Levine (2000) suggests that solid waste services in the developing nations do not satisfy the full demand existing in urban areas.

Like similar developing countries, Ghana, due to rapid population growth and urbanization is challenged with increase in waste generation. It is estimated that three million tonnes of waste is generated annually, with daily generation rate of 0.45kg per capita (Mensah and Larbi, 2005). Over three thousand tonnes of Solid Waste is generated daily in Accra (the capital). The ever-increasing volumes of SW generated, associated with lack of existing systems to adequately handle them has resulted in indiscriminate disposal and huge piles of solid waste in many urban centres. The concept of the novel solid waste management approach; Integrated Solid Waste

Management (ISWM) which has yielded good results with regard to solid waste management in most developed nations must be exploited by municipal authorities seeking to improve their solid waste management system (UNEP, 2010). The approach differs from conventional approaches by seeking stakeholder participation, including waste prevention and resource recovery and encouraging the analysis of interactions with other urban systems. ISWM can be achieved with high standards if sound management practices are combined with a high level of public awareness. If the regulatory institutional set-up is efficient, top management is committed and public participation is maintained. Again a key tenet of this concept is the "polluter pays" principle which intimates that those responsible for pollution should pay for this pollution. However, a service is considered affordable when society perceives it as valuable. To determine the price society places on improved waste management, its value has to be measured. Valuation reveals people's preferences by gauging how much they are willing to pay (WTP) for given benefits. Valuation gauges how much worse off individuals would consider themselves to be, as a result of changes in the state of the environment (Bird, 2001).

Waste collection and disposal, however, is a public good which cannot be provided under perfect market conditions. This is because the non-exclusion principle applies to public goods and they are not rival consumption products (Sumukwo *et al*., 2012). It therefore requires a different market situation to achieve optimal resource allocation, as environmental services are often under-priced and hence to maximize social welfare levels, resources must be allocated in a way to bring about the most beneficial changes. Stated preference techniques are the basic means of valuing non-market benefits and the commonly used technique is the contingent valuation method (CVM). CVM has been used to estimate the value people place on environmental commodities by creating hypothetical market scenarios to elicit their willingness to pay for them (Sumukwo *et al*., 2012).

1.2 PROBLEM STATEMENT

The rapid economic activity in the Ga East municipality in the Greater Accra region has resulted in an increase in rural-urban migration, increased output levels, changes in consumption patterns and an improved life style. This has given rise to an increase in the volume and composition of waste generated throughout the municipality, the management of which has confounded the municipal assembly (MESSAP-GEMA, 2013).

It is estimated that about 1400 metric tonnes of solid waste is generated monthly out of which 900 metric tonnes are collected (MESSAP-GEMA, 2013). A substantial amount of backlog that creates various kinds of inconveniences including health hazards to people in the municipality. The municipal authorities spend a hefty sum of GHC420,000 annually combating waste in the district (MESSAP-GEMA, 2013).

Despite efforts made so far, the situation of solid waste management in the municipality can be described as poor (MESSAP-GEMA, 2013). The vast quantities of waste generated are generally sluggish and inorganic, and, worse of all, are dumped together at unauthorized locations in the municipality including drains, uncompleted buildings and along the streets. The Assembly currently has only five approved public refuse dumps with as much as over twenty unapproved sites. The landfill site at Abokobi serves as a final disposal site not only for the Ga East Municipal Assembly but also receives waste from Adentan, Ga West and even Accra Metropolitan Assembly (AMA). The constant burning of the waste at the site creates serious air pollution and threatens the life of people in the surrounding communities. In addition, the management of this un-engineered final disposal site is another major environmental concern to the Assembly (MESSAP-GEMA, 2013).

According to Obiri-Opareh and Post (2002) several surveys performed in the region report of the considerable efforts being made by private waste management companies in the collection and disposal of waste. Glaring within the reports is the problem of inadequate service delivery

by private companies due to technical and financial constraints. Private entrepreneurs possess the potential and can play a tremendous role in waste management of the municipality but find access to funds a major hindrance. Generally, banks from whom they can borrow money lend at high interest rates. Even funds for government funded projects take a long time to materialize hence, often stalling the project, sometimes indefinitely. For these reasons some form of financial commitment from private households to enable the sustainability of such projects is a pre-requisite.

Commercial clients and especially households who are the primary producers of solid waste as well as the direct victims of the effects of uncollected solid waste, should be able to participate in municipal discussions on improving Solid Waste Management (SWM) and structuring effective public-private partnerships to deliver such services. The service provider needs to better understand households' demands and motivation. Therefore, the key question here is how much citizens are willing to pay for efficient and cost-effective delivery of solid waste services to residential areas. Solid waste management in the city has always been gauged and evaluated by the performance of the service provider (the supply side), while the demand side has been ignored.

Unfortunately, there is very scanty information on the economic value of waste in Ghana, despite the vast volumes of research in this field, for which reason questions concerning for example, the value private and communal households place on improved waste collection and disposal, how much they are willing to pay for the service, among others, remain unanswered. Further, there are also uncertainties in consumer awareness and attitude towards a number of waste management issues that hinder the implementation of effective sustainable solid waste management options in the district.

1.3 AIM

The study aims at doing an economic valuation of improved solid waste management in the Ga East municipal assembly.

1.4 SPECIFIC OBJECTIVES

- To identify the current waste management practices in the GEMA
- To determine households' willingness to pay for an improved solid waste management system
- To identify factors which influence households' willingness to pay for an improved solid waste management system

1.5 RESEARCH QUESTIONS

The research questions set to guide the study were as follows:

- What is the nature of waste collection and management in the Ga East Municipal Assembly?
- How much are the households willing to pay for an improved SWM?
- What factors determine their motivation to pay for the amount of money they are willing to pay?

1.6 JUSTIFICATION

The Ministry of Local Government and Rural Development (MLGRD) introduced a number of measures that would contribute to improving environmental sanitation services (NESSAP, 2010). They include Metropolitan, Municipal and District Assemblies (MMDAs) improving revenue mobilization and increasing the proportion of house-to-house (door-to-door) services for improving paid-for refuse collection. The Composite budget of the Ga East Municipal Assembly for the year 2012 captures the prioritised development interventions in the Assembly's Medium Term Development Plan 2010-2013 under the Ghana Shared Growth and Development Agenda 2010-2013. It has Waste reduction and pollution control as the first of the objectives to be achieved (MESSAP-GEMA, 2013). Also, the mission of the Waste Management Department is to function in collaboration with agencies, the private sector and the general public to keep the municipality environmentally healthy through effective and efficient waste management. The Assembly seeks to promote the separation of the waste at the source (MESSAP-GEMA, 2013). This in in conformity with the ISWM concept. Furthermore, the value the public places on the improved solid waste management system in the municipality needs to be determined to aid in the achievement of the system and hence requires the extraction of their willingness to pay for an improved SWM.

To economically justify the need for better SWM services in the Ga East municipality, good valuation studies on the potential benefits of such services are necessary. This information can be used in negotiating an appropriate tariff rate with the current private service providers as well as in the designing of future concession agreements and/or consideration of proposals by new private entities for new residential service areas. Reduction in disparities regarding services that can be supplied by service providers and what the public really wants and is willing to pay for is also an important contribution of this study. There are no adequate data currently on the pricing of solid waste disposal and collection services as a normal economic commodity in the Ga East municipality. This study therefore attempts to bridge the existing

knowledge gap and provides two important insights for public and private policy makers in terms of incorporation of demand-side information into the design of MSW management services and fee schedules as it seeks to derive estimates of the value of changes in individual attributes as well as changes in the aggregate level of service attributes.

Economic valuation of municipal solid waste (MSW) can assist link economic policies to environmental outcomes; give decision makers a summary of urban environmental problems; and assist in formulation of policies on solid waste management. This study will also be of special interest to regulators of private concessions of MSW management as well as to the private waste collectors. This research will offer substantial contribution to current trends in scholarship on waste management not only in Ghana but elsewhere around the globe and it will provide an avenue for further research to be conducted in this area.

1.7 SCOPE OF THE STUDY

The scope of this research was the Ga East Municipal Assembly in the Greater Accra Region of Ghana. The focus was much on the households in the municipality and their willingness to pay for an improved solid waste management.

1.8 LIMITATION OF THE STUDY

The study is limited to solid waste management in the Ga East municipality, thus, other types of waste such as liquid, health care and radioactive waste and their management will not be investigated in this study. This is a deliberate effort on the researcher's part to make the study manageable given the time and resources available to complete the study.

1.9 ORGANIZATION OF THE STUDY

The study has been presented in five chapters. The first chapter which looks at the background of the study, statement of the problem, objectives of the study, research questions, justification, scope, limitation and organization of the study. The second chapter deals with relevant literature review. Chapter three looks at research working definitions and hypothesis, research design, population and sampling procedure, and the method of analysis of the data. Chapter four deals with data analysis and discussion. The fifth and final chapter focuses on summary of the findings, conclusion and recommendations for government, stakeholder, municipality and private investors.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 DEFINITION OF WASTE

Waste is defined in the Basel Convention of 1997 as "substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by provision of national law'' (Veenstra, 2000). Waste can be classified by a multitude of schemes: by physical state (solid, liquid, gaseous), and then within solid waste by: original use (packaging waste, food waste etc.), by material (glass, paper, etc.), physical properties (combustible, compostable, recyclable etc.), by origin (domestic, commercial, agricultural, industrial, etc.) or by safety level (hazardous, non-hazardous) (McDougall *et al*., 2001). UNEP (2005) refer to Municipal Solid Waste as the term usually applied to a heterogeneous collection of wastes produced in urban areas. According to Guerro *et al*. (2013), municipal solid waste is generally composed of electrical and electronic equipment, construction and demolition waste, health-care waste, waste from households, offices, shops, schools, industries and agricultural residues.

2.2 CHARACTERISTICS OF SOLID WASTES

According to Beede and Bloom (1995), physical properties of MSW help to determine the processing and disposal needs and costs.

2.2.1 Solid Waste Composition

This is the term used to describe the individual elements that make up the solid waste stream and their relative distribution, usually based on percent by weight (Mensah, 2010). Municipal solid waste includes degradable, partially degradable and non-degradable materials (Jha *et al*., 2011). Information about the nature of waste is critical for assessing the effects on the environment if specific composition is found in Municipal Solid Waste (Mensah, 2010). An overview of the global characteristics of Solid Waste is presented in Table 2.1 below.

Table 2.1 Global Characteristics of Solid Waste (Asase, 2011)

Characteristic	Low Income Country	Middle Income Country	High Income Country
Generation Rate, Kg/capita/day	0.4-0.6	0.5-0.9	0.7-1.8
Composition, %			
Putrescibles	40 - 85	20 - 65	20 - 50
Paper	1 - 10	15 - 40	15 - 40
Plastic	1 - 5	2 - 6	2 - 10
Metal	1 - 5	1 - 5	3 - 13
Glass	1 - 10	1- 10	4 - 10
Rubber, Miscellaneous	1 - 5	1 - 5	2 - 10
Fines, %	15 - 60	15 - 50	5 - 20
Moisture Content, %	40 - 80	40 -60	20 - 30
Density kg/m^3	250 - 500	170 - 330	100 - 170
Calorific Value kcal / kg	800 - 1100	1000 - 1300	1500 - 2700

Note: Categorization by income is based on 1992 gross national product data from the 1994 World Bank Report. Waste data on a wet, "as received" condition. For self-sustained incineration, a year-round minimum of 1300kcal/kg lower calorific value (as received) is needed. For waste-to-energy plants, 2200kcal/kg is the minimum calorific value desired.

2.2.2 Bulk Density of Solid Waste

Density is an important determinant of the capacity of storage containers and frequency of collection based on duration of storage. It is also important in determining the capacity of sanitary landfill sites (Mensah, 2010).

2.3 SOLID WASTE MANAGEMENT

According to Mensah (2010), Solid Waste Management is that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes. Waste management in Ghana is recognised to be the responsibility of the Ministry of Local Government and Rural Development, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). However, the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science is in charge of monitoring. The MMDAs are responsible for the collection and final disposal of solid waste through their Waste Management Departments and their Environmental Health and Sanitation Departments. However, there is a growing perception that inadequate education about the importance of proper sanitation account for poor waste management practices in Ghana. The policy framework guiding the management of hazardous, solid and radioactive waste includes: the Local Government Act (1994), Act 462; the Environmental Protection Agency Act (1994), Act 490; the Pesticides Control and Management Act (1996), Act 528; the Environmental Assessment Regulations 1999, (LI 1652); the Environmental Sanitation Policy of Ghana (2010); the Guidelines for the Development and Management of Landfills in Ghana; and the Guidelines for Bio-medical Waste (2000). All these Acts and Regulations emanate from the National Environmental Action Plan (Asase, 2011).

2.3.1 SOLID WASTE GENERATION

Waste generation encompasses activities in which materials are identified as no longer valuable and are either thrown away or gathered together for disposal (Momoh and Oladebeye, 2010). The knowledge of how much solid waste is generated in a community informs largely the waste

management plan and approach. The composition of waste generated by African urban centres is mainly decomposable organic materials based on the urban community consumption that generates much kitchen waste, compound waste and floor sweepings. In Ghana, based on the estimated population of eighteen million as of the year 2005, it is estimated that three million tonnes of waste is generated annually with a daily generation rate of 0.45kg per capita (Mensah and Larbi, 2005). The ever-increasing volumes of Solid Waste generated associated with rapid urbanization and lack of existing systems to adequately handle them has resulted in indiscriminate disposal of wastes.

Important issues related with MSW generation are-

Attitude

Waste generation is mostly related with attitude of the society towards it. In developed countries, people are often aware of the importance of the minimization of waste generated as compared to developing countries (Clapp, 2010). When people have little understanding of where their post-consumptive waste actually go and have even less understanding of where the waste associated with the production of their purchases end up, they tend to make decisions that perpetuate the generation of waste. Once waste is out of sight, people tend to forget about it, assuming that it is someone else's responsibility. This 'someone else' may be firms, the federal government or municipalities (Clapp, 2010).

According to Clapp (2010), Economic inequality has led to situations where some disadvantaged communities have little choice but to accept others' waste despite the associating environmental and social problems. The Not in My Backyard (NIMBY) Syndrome with respect to the siting of waste dumps has meant that some communities keep dumpsites out of their neighbourhoods while others, who often are unable to resist jobs and revenues, are paid to take them.

Impacts

When the waste is dumped, because of its composition it does not decompose very quickly, making space unavailable for other waste. Given below are some examples to understand how much time it takes for various materials to decompose.

Type of litter	**Approximate time it takes to degenerate the litter**
Organic waste such as vegetable and fruit peels, leftover foodstuff, etc.	A week or two
Paper	10 to 30 days
Cotton Cloth	2 to 5 months
Wood	10 to 15 years
Woollen Items	1 year
Tin, aluminium and other metal items such as cans	100 to 500 years
Plastic bags	One million years?
Glass bottles	Undetermined

Source: Mensah, 2010

Institutional mechanism

Governing bodies in most developing countries often pay more attention to the provision of basic services like water and health to communities. Waste management, particularly waste generation, becomes the least priority issue (Jha *et al*., 2011). Local bodies often lack budgetary support to handle waste generation in better manner. Manpower dealing with waste generation is also often not equipped enough. The area of jurisdiction becomes important when many governing agencies are associated with development works. Responsibility of waste generated during this development works is always an issue. Solid waste management in areas outside Municipal Corporation Limits is also an issue of contention (Jha *et al*., 2011).

2.3.2 SOLID WASTE COLLECTION

Waste collection is an element of waste management which embraces lifting and removal /passage of a waste material from the source of production to either the point of treatment or final disposal (Mensah, 2010). Efficiency in collecting solid waste and segregating it decides how well solid waste is managed. Waste collection is currently one of the most important issues in municipal administration, particularly in metro cities. Collection rates range from a low of 41% in low-income countries to a high of 98% in high-income countries and collection costs represent 80 to 90% of the municipal solid waste management budget (Hoornweg and Bhada-Tata, 2012). According to Okot-Okumu and Nyenje (2011), waste collection in African urban centres is not based on the total amount of waste generated but rather on the level of income of the service area. Adebuason (2010) submitted that there are various forms of waste collection practiced in developing countries.

Communal collection: Under this system, householders discharge their wastes at pre-determined sites containing some form of communal storage facility and refuse collection vehicles collect the wastes at frequent intervals. The frequency of communal storage distribution depends on the degree of community willingness to cooperate in its proper utilisation. This method prefers the use of portable containers for realisation of high labour and vehicle productivity and is relevant since it reduces considerably the number of waste collection sources. It must be added, however that, it is rare for communal storage containers to be lifted daily.

Block collection: Under this system, a collection vehicle travels a pre-determined route scheduled by an urban authority at certain scheduled intervals and stops at selected sites. Upon hearing the signal, the house holders bring their refuse to the crew. Under this method, no refuse containers are left outside household premise or on communal land. However, vehicle and labour productivity often lies between low and medium.

Kerbside collection: In this system, the collection crew collects refuse containers which are situated at the kerbside (entrance) at fixed and specific intervals, usually twice a week. This system requires a regular and well organised collection service in order to enable householders leave their wastes out at appropriate times. This system is often applicable in high income areas of developing countries due to the relatively high collection cost associated with it.

Door-to door-collection: In this system, the collection crew enters each premise, takes out the container and sets it back after the waste is emptied into collection vehicles. This system offsets the non-involvement of householders by increased labour costs in accessing all premises. This method is only productive when collection is infrequent, especially once a week. This method is common in developed countries.

2.3.3 WASTE DISPOSAL

Disposal is the most important element amongst all the functional elements involved in Solid waste management, as it includes planning, administrative set up, financing, technology support and their interdisciplinary relationships.

Disposal is referred to as 'the different treatments which are given to waste for avoiding environmental and health hazards'. Waste disposal methods include biological, thermal landfilling and recycling. There is, however, no single technique which is suitable in all situations. Landfill is still the primary method of disposal used by most high-income countries, because it is relatively cheap compared to other disposal options (UNEP, 2011).

2.3.4 CHALLENGES OF SOLID WASTE MANAGEMENT

The NESSAP (2010) lists the following as obstacles and challenges in the environmental sanitation sector in Ghana. They include: Inadequate waste collection vehicles; Revenue generated insufficient to meet waste collection; Inadequate Government financial support on sanitation. The shift of attention has gone to curative instead of the preventive aspect of

sanitation; Lack of public awareness on the need to pay for sanitation services; Indifference of the public towards good sanitary practices; Lack of intense and sustained public education on sanitation; Problem of land acquisition for public waste disposal; Not in my backyard syndrome (NIMBY syndrome); Inadequacy of law enforcement; Need to put in place recycling plants e.g. plastic waste;

An estimation of the proportion of solid waste from a major source of generation is shown in Table 2.2 below.

Table 2.2 Municipal Solid Waste Data for Accra, 2010.

CHARACTERISTICS	**ACCRA**
Population, 1000	2,340
MSW generated, kg/capita/day	0.80
MSW generated, tons/day	1872
MSW collected, tons/day	1498
Percent collected	75%
Collection cost, US$/ton	10.0
Disposal cost, US$/ton	3.0
Total cost, US$/ton	13.0

Source: Project Appraisal Document– World Bank Urban Environmental Sanitation Project (Phase 2), Nov. 2010

2.3.5. BIOLOGICAL WASTE TREATMENT

Composting

Composting is the process of decomposition and stabilization of organic matter under controlled condition. It is a biological process in which micro-organisms convert degradable organic waste into humus like substance which is then recycled as mulch or compost for agricultural or landscaping purposes. Composting with windrows is intended to be an aerobic

operation that avoids the formation of methane associated with anaerobic conditions. There is a large variety of composting and digestion methods and technologies varying in complexity from simple home compost heaps, to industrial-scale enclosed-vessel digestion of mixed domestic waste (EGSSAA, 2009).

Large central composting efforts, designed to separate the organic component from the mixed waste, have almost always failed in Africa for reasons including poor feasibility studies and failure to meet cost recovery expectations.

Small composting enterprises have fared somewhat better. Higher urban demand or subsidies may be necessary if composting is to become a part of integrated waste management. For example, a city could pay small composting operations for each ton of material that is diverted from landfills and base that payment on the disposal costs the city can avoid (EGSSAA, 2009).

In Ghana, according to NESSAP (2010), the installation of windrow composting plants as part of Material Recovering Facilities (MRF) is to reduce the transport cost of input-material to stand-alone plants. The target is to compost 50% of biodegradable organic fraction (BOF) of the proportion of municipal refuse that will be source separated (i.e. 15% by 2015).

The Accra Composting and Recycling Plant (ACARP), built by ZoomLion in partnership with the Government of Ghana and the United Nations Framework Convention on Climate Change (UNFCCC) is designed to handle 600 TPD of mixed waste. As of January 9th, 2013, the plant is receiving 300 TPD of mixed waste. The plant is a project of ZoomLion and has started operations in September, 2012. Since then, the plant has been accepting small quantities of waste in an attempt to optimize its operations (Annepu and Themelis, 2013).

Anaerobic Digestion

Anaerobic digestion is considered to be one of the most viable options for recycling the organic fraction of solid waste with substantial amounts of methane also known as biogas (Khalid *et al*., 2011). The technique involves microorganisms in an enclosed vessel that break down biodegradable material in the absence of oxygen. Biogas produced can be used to generate electricity and heat, and can be used as a substitute for natural gas and transportation fuel. The digested slurry can be further processed into compost and liquid fertilizer (Khalid *et al*., 2011). The technique has been recognised as suitable for processing organic wet waste in developing countries (UNEP, 2011).

Composting is rarely undertaken formally even though the waste stream in Africa has a high percentage of organic material (~70 percent on average). Markets for, and awareness of, compost is lacking. If this part of the waste stream could be used for compost or methane production, many adverse impacts of open dumps and landfills would be reduced. Landfills would require less space, last longer, and produce less leachate (EGSSAA, 2009).

2.3.6 THERMAL TREATMENT

This refers to processes that involve the use of heat to treat waste. Listed below are descriptions of some commonly utilized thermal treatment processes.

Incineration

Incineration is the thermal treatment of waste during which chemically fixed energy of combusted matter is transformed into thermal energy (UNEP, 2005). It is the controlled combustion of waste with or without energy recovery.

Incineration involves burning waste in large furnaces and converting the waste material into heat, gas, steam, and ash. Incineration of waste (with energy recovery) can reduce the volume of disposed waste by up to 90% especially with very high amounts of packaging materials,

paper, cardboard and horticultural waste (World Bank, 2012). It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Recovering the energy value embedded in waste prior to final disposal is considered preferable to direct landfilling, assuming pollution control requirements and costs are adequately addressed. Burning the relatively moist waste found in Africa and subsequently Ghana often requires the addition of supplemental fuel thus making incineration rarely economically feasible. Without proper controls, incinerators can be highly polluting; generating dioxins and depositing toxic heavy metals into water bodies (EGSSAA, 2009).

Pyrolysis and Gasification

Pyrolysis is the thermal decomposition of rubber in the absence of oxygen, chemically breaking it down into oil, gas and char (UNEP, 2005). Gasification is a form of pyrolysis with the presence of limited oxygen. Pyrolysis and gasification are similar processes as they both decompose organic waste by exposing it to high temperatures and low amounts of oxygen. Gasification uses a low oxygen environment while pyrolysis allows no oxygen. These techniques use heat and an oxygen-starved environment to convert biomass into other forms. A mixture of combustible and non-combustible gases as well as pyroligenous liquid is produced by these processes. All of these products have a high heat value and can be utilised. Gasification is advantageous since it allows for the incineration of waste with energy recovery and without the air pollution that is characteristic of other incineration methods (Sewerage and Solid Waste Project Unit. 2000).

However, the technologies are technically difficult, relatively unproven at commercial scale, and some of the generated energy is used to power the process and hence reduces the overall benefits, hence rarely feasible in Ghana.

Open Burning

This refers to burning of unwanted materials in a manner that releases smoke and other emissions directly into the air without passing through a chimney such as burning of outdoor piles, burning in a burn barrel and the use of incinerators which have no pollution control devices. Open burning has been practiced by a number of urban centres because of its ease and convenience and because it reduces the volume of refuse received at dumpsites hence extending their lifespan (Sewerage and Solid Waste Project Unit, 2000).

Open burning releases pollutants into the atmosphere which pose serious risks to human health. The process also releases acidic gases, oxides of nitrogen and carbon. Nitrogen oxides contribute to acid rain, ozone depletion, smog and global warming. In addition to being a greenhouse gas, carbon monoxide reacts with sunlight to produce ozone which can be harmful. The particulate matter released creates smoke and haze which contribute to air pollution (Sewerage and Solid Waste Project Unit, 2000).

2.3.7 LAND FILLING

Landfills

Disposing of waste in a landfill involves dumping the waste in a pit dug in the ground in a controlled or uncontrolled manner. Landfills are often established in abandoned or unused quarries, mining voids and pits, and are generally located in urban areas where large amounts of waste generated have to be dumped in a common place. The dumped waste is often covered with debris/ soil and spread evenly in layers and some mechanism, usually earthmoving equipment is used to compress the garbage, which now forms a cell (Mensah, 2010). Thus, every day, garbage is dumped and becomes a cell. The organic waste undergoes natural decomposition and generates a fluid, known a leachate, which is very harmful to the ecosystem. Serious threat to community health presented by open dumping or burning is avoided in this method (Mensah, 2010).

Open Dumping

The cheapest and the oldest method of MSW disposal is open dumping where the waste is dumped in low - lying areas on the city outskirts and levelled by bulldozers from time to time. Open dumping is not a scientific way of waste disposal (Hoornweg and Bhada Tata, 2012). The waste is untreated, uncovered and not segregated. In spite of its simplicity in execution, the financial involvement for this traditional method of waste management has been quite high particularly for the big metropolis. Open dumps are exposed to flies and rodents, generates foul smell and blight the environment. Loose waste is dispersed by the action of wind. Leachate from dumps contributes to pollution of surface and ground water and also the rainwater run-off from these dumps contaminates nearby land and water thereby spreading diseases (Hoornweg and Bhada Tata, 2012).

2.3.8 RECYCLING

According to Momoh and Oladebeye (2010) recycling has been viewed as a veritable tool in minimizing the amount of household solid wastes that enter the dump sites. Recycling makes use of materials that otherwise would become waste by turning them into valuable resources. However, increased scarcity of natural resources and the consequent rise in commodity prices have influenced the demand for recycled products. The resource value of waste has become an important driver in many developing countries today and provides a livelihood for the urban poor (UN-HABITAT, 2010). The world market for municipal waste, from collection to recycling, is worth an estimated US $410 billion a year (Chalmin and Gaillochet, 2009). In Ghana, the only recycling is conducted by the informal recycling sector. A material recovery facility (MRF) called the Accra Composting and Recycling Plant (ACARP) separates recyclables from mixed waste that arrives at the tipping floor. Waste pickers involved in the informal recycling sector collect recyclables by sorting through mixed waste on the streets or at the dumpsites (Plate 3). The number of plastic manufacturing and recycling companies has

increased over the years. Current discussions with the chairman (personal communication; Mr. Ken Kuranhyie) of the Ghana Plastic Manufacturers Association suggest that over 50 registered plastic manufacturing companies exist in Accra with a number of small scale plastic recycling companies springing all over the city of Accra (Asase, 2011). The major challenge to recycling of plastic waste in Ghana is the inability to collect enough quantities of plastics due the lack of adequate logistics and low storage capacity. Much of the plastic waste still remains unrecovered mainly attributed to the insufficient number of companies available to recycle the different types of the plastic waste and the difficulty of retrieving and recycling plastics from the mixed waste stream (Asase, 2011).

2.4 THEORETICAL PRINCIPLES OF INTEGRATED SOLID WASTE MANAGEMENT (ISWM)

The ISWM refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximising resource use efficiency (UNEP, 2005). SWM is an approach tailored to reach better, more sustainable solutions to solid waste problems, especially in developing nations (Adebuason, 2010). Sustainable Solid Waste Management (SSWM) means that the model is appropriate to local conditions and feasible from a technical, environmental, social, economic, financial, institutional and political perspective. It can maintain itself over time without exhausting the resources on which it depends meaning that the generators of waste (polluters) bear the whole costs of the service (Adebuason, 2010). SSWM can be realised by using the technical, organisational, and financial resources available in a particular country. ISSWM differs from conventional approaches towards solid waste management by seeking stakeholder participation, by including waste prevention and resource recovery explicitly, by encouraging

the analysis of interactions with other urban systems and by promoting an integration of different habitat scales (Adebuason, 2010).

The ISSWM concept takes as a point of departure four basic principles:

- Equity: all beneficiaries are entitled to an appropriate waste management system and this should go beyond ethical considerations.
- Effectiveness: The waste management model adopted should be capable of removing all the waste generated.
- Efficiency: waste management should entail benefit maximization, cost minimization and resource optimization.
- Sustainability: the waste management system is tagged to the local conditions and should be technically, environmentally, socially, economically, institutionally and politically feasible. The system should also have self-maintenance mechanism overtime while optimizing the resources on which it depends (Adebuason, 2010).

Assessment of the degree of 'integrated sustainability' needs an analysis that uses a range of criteria, both quantitative and qualitative indicators. They include technical, environmental, financial, socio-economic and institutional.

Effectiveness

Effectiveness in this context means providing effective SWM services for an entire population which is measured by determining the extent to which the required quality of services is being provided (Adebuason, 2010). In this respect, the notion of equity is closely related to the notion of effectiveness. In principle, solid waste services have to be rendered in a satisfactory manner irrespective of the socio-economic situation of a given district as poor SW waste management affects not only those who cannot afford the services in question. However, rapidly growing, informal settlements of low-income residential areas present a particular challenge to this principle in developing countries (Adebuason, 2010). While the fees charged to beneficiaries

of the service for waste collection services may cover primary collection costs, it seldom covers full transfer, treatment and disposal costs, especially in low-income districts. To render effective waste service access, some cross-subsidisation and/or financing out of general revenues will be required.

Efficiency

Efficiency in terms of solid waste management refers to the provision of specified quantity and quality of services at minimum cost, thereby maximising the benefits and optimising the use of resources (Adebuason, 2010). In order to improve efficiency, public authorities are turning to the private sector. The provision of waste collection and disposal services are among those often outsourced. One of the largest problems faced by municipal waste management in developing countries is the difficulty in keeping expensive capital equipment operational. The problems include a lack of maintenance technicians, a shortage of spare parts, and insufficiently sound management (Adebuason, 2010).

2.4.1 Hierarchy Principle

In sum, the hierarchy principle is about sound resource management. Based on the hierarchy principle, all waste recovery and treatment options have priority whereas controlled disposal and landfilling are at the bottom of the pyramid (Adebuason, 2010). The hierarchy principle promotes the so called "4Rs": reduce, reuse, recycle, and recover waste. The last option of the pyramid regarding the hierarchy principle is sanitary landfilling. The hierarchy should be applied in a flexible manner and should take account of the fact that, for many developing countries, the first priorities are to improve the collection service for a large part of the population, and to enhance the quality of landfills.

2.4.2 Polluter Pays Principle

The polluter pays principle which is also mentioned in the Ghana Environmental Sanitation Policy (2010) has enjoyed quite a long history of acceptance in the USA and in the EU (Bird, 2001). It states that those responsible for pollution should pay for the costs of this pollution. This principle is an economic policy which allocates the costs of pollution and environmental damage. Pongrácz (2002) discovered that the polluter pays principle raises awareness and encourages householders to segregate their waste when a separate recyclables collection is available. Simply put, user charges promote economic efficiency and a well-designed tariff system is essential to achieve this objective. According to Anku (2000), in order to make user charges effective, there is the need to tailor such charges to the level of environmental consciousness of residents, and their ability to pay. Bird (2001) stated that the economically efficient price for any service is the price that would be charged in a perfectly competitive market. Sound SWM provides not only "private" benefits to direct beneficiaries, but also "public" benefit in the form of an externality.

According to the NESSAP (2010), direct cost recovery from users should be applied where it is possible to charge a full commercial price covering all operating and capital costs, for solid waste collection services. Also, sanctions against polluters shall follow the "polluter pays" principle. Such payments should correspond to the costs of restoring any damage done to the environment. The mechanisms adopted must ensure that the cost of pollution increases progressively with the amount of pollution emitted.

To develop a strategy and financing plan with clear allocation of resources (and costs) for households, communities, MMDAs and central government, the "polluter- pays" mechanism must be adopted in determining levels of charges and fees for environmental sanitation services (NESSAP, 2010).

2.5 SOLID WASTE MANAGEMENT COSTS

Table 1 shows how general cost ranges for solid waste collection, transport and sanitary landfill, vary as a function of average Gross Net Product (GNP) income. In developing countries, while the per capita quantities of wastes and labour costs are low, the costs of providing solid waste management are not proportionately low (Cointreau, 2006). Equipment capital costs and fuel costs in low-income countries are comparable to those in high-income countries. Solid waste management cost is higher in low-income countries, when viewed as a percentage of personal income. Given the proportionately high cost of operating a full service in developing countries and competing urban infrastructure needs, the prevailing low levels of solid waste services are likely to continue for several more years (Cointreau, 2006).

Table 2.3: Global perspective of cost of solid waste management

	LIC	MIC	HIC
Average waste generation	0.2 t/capita/y	0.3 t/capita/y	0.6 t/capita/y
Average income from GNP	370 $/capita/y	2,400 $/capita/y	22,000 $/capita/y
Collection cost	10-30 $/t.	30-70 $/m.	70-120 $/t.
Transfer cost	3-8 $/t.	5-15 $/t.	15-20 $/t.
Sanitary landfill cost	3-10 $/t.	8-15 $/t.	15-50 $/t.
Total cost without transfer	13-40 $/m.t.	38-85 $/t.	90-170 $/t.
Total cost with transfer	16-48 $/t.	43-100 $/t.	105-190 $/t.
Total cost per capita	3-10 $/capita/y	12-30 $/capita/y	60-114 $/capita/y
Cost as % of income	0.7-2.6%	0.5-1.3%	0.2-0.5%

LIC-Low Income Countries, MIC-Middle Income, Countries HIC-High Income Countries

Source: Cointreau, 2006

Considering the actual gap between MSW costs and the funding of these, and the forthcoming growth of the waste sector, local authorities must enhance their service efficiency and access other sources of funding if they wish to lower the burden on their finances. In some middle-income and developed countries, financial schemes are established by public authorities to internalise the cost of waste externalities, through a direct fee to the waste generator or a tax on the product used. However, residential user fees are largely untapped, in low income countries, with low collection fees. Very often, the issue is not unwillingness to pay, but improper price setting relative to the low quality of service (Hoornweg and Bhada-Tata, 2012). The private sector participation may be a way of assisting the public sector to address the huge financial shortfall. The private sector is more likely to provide a high-quality service at a lower price, as it seeks to reduce financial losses and improve service effectiveness, whereas due to a lack of incentive, the public sector often fails to achieve this (Kessides, 2004).

2.6 PUBLIC PARTICIPATION

Environmental sanitation is a public good. Improper waste disposal by one individual affects all community members. Ensuring good sanitation is therefore the responsibility of all citizens. Public participation in solid waste management in developed countries greatly differs from that in developing countries. In developed countries, public participation may go as far as sorting of the waste generated. The private firms then collect the already sorted waste at a fee which covers up for the processes in which the public should have participated in the waste management line. In other words, the burden is passed on to the private waste collectors at a fee.

In developing countries, however, the people often believe it is completely the concern of the local administration to ensure proper waste management at no extra charge on the public. The culture of the separation of waste to ensure proper disposal and management in the Ga East municipality in Accra, Ghana is a critical challenge confronting the Assembly. There is the need to do more than just creating awareness and disseminating knowledge (Oteng-Ababio,

2011). According to Tsai (2007), a society that is willing to work together presents an opportunity for "creativity and innovation" in dealing with the waste problem. The social and economic status of the people also has a connotation on whether or, and how the people will participate in solid waste management. Tsai (2007) gives evidence that higher incomes and higher education levels elicit the will to participate in waste management programmes like recycling in order to protect the environment. The user charges also work as a stimulus for item reuse thus reducing the rate of waste generation at the source (Chung and Poon, 2001). This can be a step in involving the public in solid waste management and also forms an impetus for innovative thinking to devise cheaper and more convenient ways of managing solid waste.

2.7 SOLID WASTE SERVICE-A PUBLIC OR PRIVATE GOOD

Public goods are resources which exhibit non-rivalry in consumption and are fully accessible to all (non-excludability). Non-rivalry in consumption refers to a person's consumption of a good not diminishing the amount available to others. Beautiful landscapes, clean air, global climate, biological diversity and solid waste management are examples of public goods. The broad principles underlying Ghana's Environmental Sanitation Policy (2010) recognises solid waste management services as a public good (NESSAP, 2010).

2.8 DEFINITION OF ECONOMIC VALUATION AND ITS IMPORTANCE

Economic valuation can be defined as the attempt to assign quantitative and monetary values to environmental goods and services when market prices are not available (Naidoo, 2008). It is a key exercise in economic analysis and the results provide important information that is used to influence decisions about wise use and conservation of environmental resources. The basic aim of valuation is to determine people's preferences by gauging how much they are willing to pay (WTP) for given benefits or certain environmental attributes. In other words, valuation estimates how much worse off they would consider themselves to be as a result of

changes in the state of the environment. The power of valuation lies in translating "hidden" benefits of the environment into a monetary measure, which is a currency that policy makers and the general public can obviously and easily relate to (Naidoo, 2008).

Economic valuation never refers to a stock, but only the changes in the stock, comparing them with their alternatives. If one speaks of the economic value of solid waste management, then one always mean the economic value of a change in solid waste management.

Valuation has an important role to play in environmental planning and management activities because it helps to answer many questions including the following about any given natural resource: What is the value of conserving the environment? Who gains and who loses when the environment is conserved or degraded? How can the environmental resource be efficiently and equitably financed? How can people be motivated to take into account the environmental resource benefits and costs of its loss in the course of their economic activities? How can policy, planning and decision making with regard to environmental resources be better influenced?

2.9 CONTINGENT VALUATION METHOD (CVM) AS A TOOL FOR ASSESSING INDIVIDUAL'S WILLINGNESS TO PAY (WTP)

The contingent valuation method (CVM) involves asking respondents for their WTP for an environmental improvement or willingness to accept compensation for a loss or degradation of environmental quality (Spash, 2008). The resulting stated preference is commonly used as a mean value of the change, aggregated across the relevant population and then discounted for time. The original justification was the need to include the resulting monetary value as part of a cost-benefit analysis to aid project appraisal (Spash, 2008). The respondents are presented with a hypothetical market which may include pictures, photos, and information maps, to improve the description of the good or service. CVM has proven to be the most popular of the

available methods for monetary valuation of the environment because of the air of simplicity the technique has as well as the unlimited range of its applications (Spash, 2008).

Today, the CVM is widely used by academic institutions as well as governmental agencies as a crucial tool in cost-benefit analysis and damage cost assessment. CVM has advantages over other valuation methods. CVM method gives immediately a monetary assessment of respondents' preferences. It is the only valuation technique that is capable of shedding light on the monetary valuation of non-use values, i.e., the benefit value component of the environmental commodity that is not directly associated with its direct use or consumption. CVM brings with it the advantage that environmental quality changes may be valued even if they have not yet occurred (ex-ante valuation). This implies that the CVM is a useful advisory tool for policy decision-making (Spash, 2008).

2.9.1 REVIEW OF HOUSEHOLDS' DEMAND FOR IMPROVED ENVIRONMENTAL QUALITY

Altaf and Deshazo (1996), in a study of households in Gujranwala city, Pakistan, surveyed the existing SW disposal system, WTP for improvements, and the priority that households attach to improvements in SWM, relative to improvements in water supply and sanitation. Their study verified the use of demand-side information in improving solid waste management in the city. Their results challenged the conventional presumptions that households accord low priority to SWM, compared to other urban services and are unwilling to pay for it. Chuen-Khee and Othman (2010) estimated the economic values of household preference for enhanced SW disposal services in Malaysia, employing the CVM. They estimated and compared the mean WTP for two alternative disposal methods, which represented improved options with better levels of service characteristics versus the current disposal method. Their study further revealed a higher WTP for sanitary landfill, compared to incineration, which suggested that sanitary landfill was a preferred alternative. Their logistic regression estimation of a household's

concern about where their rubbish was disposed showed that age, ownership of house, household income, and format of the CV question were important factors that significantly influenced WTP.

Wang *et al*. (2011) conducted economic analysis of MSWM in Eryuan, China. They estimated the WTP of residents for an improved SWM system and compared it with the project cost. Their study revealed that the total WTP could basically cover the total cost of the project. Again it was revealed that the poorest households in Eryuan were not only willing to pay more than the rich households, but were willing to pay not less than the rich, in absolute terms, particularly where no SW services were available. They argued that the poorest households had stronger demand for public SW management services, while the rich had the capability to substitute private measures when public services were not available.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 INTRODUCTION

The study assessed residents, Willingness to Pay (WTP), with household heads as the main focus, for an improved solid waste management in the Ga East Municipal Assembly (GEMA). A cross-sectional survey data of randomly drawn households in the municipality was conducted at a single point in time for each household head. Cross-sectional research design, according to Bryman (2004), aims at getting data from multiple cases at a given point in time so as to analyse relationships across a number of variables of interest. An environmental valuation technique known as the Contingency Valuation Method (CVM) was employed in the study. From an economic perspective, the goal was to determine the value, to the communities, of having an improved solid waste management system and use this value in the decision-making process so that the full cost of managing waste is paid for. Consumers' preference for environmental quality was inferred by exploring the use of structured questionnaires and asking directly for their maximum WTP for specified improvements in the environmental quality.
This chapter describes the study area, sampling and design of survey questionnaire, contingent market scenario and data collected and method of data analysis.

3.2 STUDY AREA

The Ga East Municipal Assembly, created in 2004, is located at the northern part of Greater Accra Region (Figure 1). It is one of the ten Districts in the Greater Accra region and covers a land area of 166 square km. There are about 65 settlements in the district with Abokobi, a well-known Presbyterian community as the district capital. It is bordered on the west by the Ga West Municipal Assembly, on the east by the Adentan Municipal Assembly, the south by Accra Metropolitan Assembly (AMA) and the north by the Akwapim South District Assembly (Figure 1). The 2010 National Population and Housing Census put the District's population at

259,668 with an intercensal growth rate of about 2.3%. The growth of the population is mainly attributable to the influence of migration inflows. The structure of the population has about 51% males and 49% female with an average household size of 4.6. There are 66, 286 households in the municipal. The urban/peri-urban population constitutes 82% of the district total population with the remaining 18% residing in the rural portion towards the Akwapim Hills. The district can therefore be described as predominantly urban with the population concentrated mainly along the urban and peri-urban areas of the district particularly along the border with AMA to the south (GEMA, 2013).

Indeed the level of urbanization is above the national average of 43.4% with the urban population residing in about 65% of the total land area of the district. This indicates a densely populated urban area with its associated pressure on social infrastructure and land. Land litigation, encroachment on the few open spaces, rapid waste generation, indiscriminate refuse disposal, and construction of illegal structures are some of the development challenges the Assembly has. Malaria continues to be the major cause of Out-Patients Department (OPD) attendance in the Ga East Municipal accounting for approximately 40.8% of morbidity. Frequent outbreaks of cholera in the district are also of great concern and poor environmental sanitation is a known and major contributory factor (GEMA, 2013). Below is the map of the Ga East Municipality.

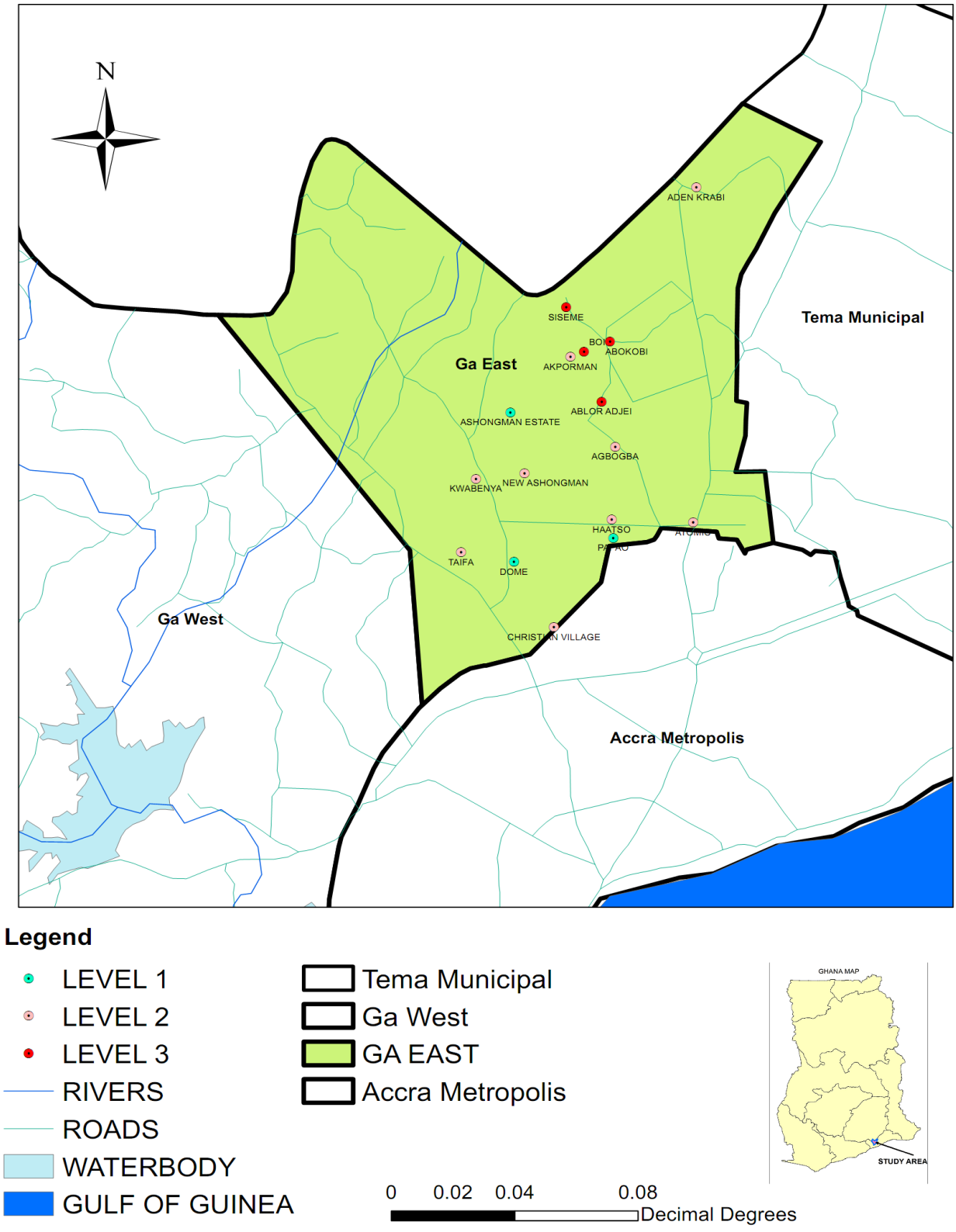

FIGURE 1 - MAP OF GA EAST MUNICIPAL ASSEMBLY

3.3 RESEARCH HYPOTHESIS, SAMPLING AND DESIGN OF SURVEY QUESTIONNAIRE

One of the purposes of the study was to assess the residents' WTP for improved solid waste management. In this regard, the main objectives were to calculate the mean WTP and estimate a parametric model that includes respondents' socioeconomic factors in the WTP function. WTP for an improved solid waste management in the Ga East Municipality was defined as a function of gender, age, level of education, number of years lived in the community, family size and monthly income, as indicated in the following table.

Table 3.1: Description of explanatory variables used in the model

VARIABLE	DESCRIPTION	UNIT OF MEASURE
Gender	HM1(Gender of Respondents)	Binary=1 if male, 0= otherwise
Age	HM2 (Age of Respondents)	Years
Level of education	HM3 (Educational Level of Respondents)	Years
Number of years lived in community	HM4 (Respondents' number of years lived in the community)	Years
Family size	HM5 (Size of Respondent's family)	Number of Individuals
Monthly Income	HM6(Monthly income of Respondent)	Ghana Cedis (GH₵)
Responsibility of SWM	HM7 (Responsibility of SWM)	Binary 1= if they think GEMA is responsible, 0= otherwise

The variables are explained below:

HM1(Gender of Respondents) – Female respondents had a general tendency to be willing to pay more than the male respondents since culturally women had the responsibility of ensuring clean environment in the society (Ichoku *et al*., 2009).

HM2 (Age of Respondents) – The age of respondents was expected *a priori* to negatively affect WTP as the elderly usually perceived waste management as a responsibility of the government. The younger generation on the other hand would positively influence WTP as they are more abreast with the status quo of waste in the country as well as the necessity for multi- stakeholder participation.

HM3 (Educational level of respondents) - WTP for environmental quality was expected to have a positive relation with the level of education since the latter would increase the awareness of the benefits from a cleaner environment.

HM4 (Respondents' number of years lived in the community) - The respondents' number of years lived in the community was expected *a priori* to negatively affect WTP. This is because the more the number of years lived in the community the more familiar the people become with the existing system and hence more reluctant to accept innovations relating to the environment.

HM5 (Size of Respondent's family) – The family size of respondents was expected *a priori* to positively affect WTP due to the fact that the more children in the household, the more willingness to maintain a clean environment in the future in which children will grow with lesser risk due to cleaner environment. Also having children in the household should increase WTP because of an altruistic attitude towards future generations.

HM6 (Monthly income of Respondent) - A higher wealth was expected to increase WTP since a larger wealth would allow individuals spend more on all goods, the environment among them.

HM7 (Responsibility of SWM) - Environmental ethics should be positively related to WTP; it tells us about the coherence between their thoughts and actions. This variable was taken as proxy to examine the attitude of the respondent towards cost sharing in solid waste management.

Responsibility of Solid Waste Management is a dummy variable taking 1 if the respondent believed households have responsibility to the improvement of solid waste management (including cost sharing) with the government; 0 otherwise, that is, if the respondent felt it was entirely government's responsibility. This study expected positive attitude towards cost sharing to influence willingness to pay in the positive direction.

Questionnaire Design

A questionnaire was the main instrument for the collection of household data in this study. The first section, which included information on the household socio-economic characteristics, was used to generate data that may influence the household WTP. The second section which revolved around the status quo of solid waste management in the municipality had questions seeking information on forms of solid waste generated by households, waste disposal methods and perceptions of challenges regarding solid waste collection in the municipality among others. The third and fourth sections dealt with waste management services households received from private waste management companies as well as the GEMA. The contingent valuation survey was the fifth section of the questionnaire design. The purpose of this section was to obtain an estimate of the value of improvements in solid waste management in the municipality.

Sampling

In order to get sample representative of the population, a two stage sampling technique was used to select households for the study. Based on their life standards, income levels, housing and other facilities, communities within the area of study were categorized into three levels in the first stage. Level 1 communities included high income groups, Level 2 and 3 communities included the middle and low income groups respectively (figure 1). Communities which constituted level 1 included-: Dome, Ashongman Estates and Papao. Level 2 communities

included New Ashongman, Taifa, Haatso, Agbogba, Adenkrabi, Kwabenya, Christian village, Atomic and Akporman. Abloradjei, Boi, Siseme and Abokobi fell under the level 3 settlements.

In the second stage, the sample size was selected out of the stratified samples. In determining the sample size, the formula $\frac{n=N}{(1+N(\alpha)2)}$ by Coffie (2010) was used where n is the sample size, N is the Population size and α is the confident level at 95 percent. The Ga East municipal has a population of 259,668 according to 2010 Population and Housing Census (Ghana Statistical Service, 2010). Fifty households were randomly selected from each of the stratified segments. In all 150 households were selected for the study.

3.4 CONTINGENT MARKET SCENARIO AND DATA COLLECTION

In order to elicit willingness to pay values for improved management of solid waste in the CVM survey, a hypothetical market scenario was described. A description of the commodity, which is 'improved solid waste management', was made to the household respondent and the impacts of the project explained to the interviewee.

After understanding the contingent market respondents were first asked if they would be willing to pay anything for the improvement scenario presented. If the interviewees said 'yes' to the participating question, how much they were willing to pay was elicited by calling out the amount in an ascending order. But those unwilling to participate were asked to give a reason for their response. Each response was probed to understand the reasons behind each preference category. The validity of WTP bids were assessed by incorporating validation questions into the questionnaire, apart from socio-economic data, that can be used to examine the effects of the theoretical determinants of the explanatory variables in the commodity demand function and the WTP valuation (Alfroz *et al*., 2011). For example, "How much more money are you willing to pay if you were sure of the success of the project or involved in decision-making process?"

The survey which occurred between 5th and 30th May, 2014 commenced with a pilot test of 20 respondents. The findings of this survey assisted in the fine-tuning of a questionnaire that was used in the main survey. This pre-test was conducted in order to uncover any challenges in interpretation of the questions and results were used in identifying the bid vector that was included in the final development of the contingent valuation questionnaires.

A mixed methodological approach and specific techniques were employed to address the objectives of the research. Primary data for the study were gathered using detailed structured questionnaires, face-to-face interviews, preliminary field investigation and direct observation. The preliminary field investigation involved scouting through the study area to assess solid waste dump sites, waste collection receptacles and a landfill site.

During this process, pictures were taken of the landfill site, heaps of solid waste in dump sites, both authorised and unauthorised and skips overflowing with solid waste. This process gave a general overview of the current waste management situation within the study area.

3.5 METHOD OF DATA ANALYSIS

The socioeconomic characteristics of the respondents were analysed with descriptive statistics such as frequency distribution tables, mean and standard deviation. To determine the mean willingness to pay for improved solid waste management by households, the logit model was employed.

Logistic regression, also called a logit model, is used to model dichotomous outcome variables. The logistic regression model describes the relationship between a dichotomous response variable Y, coded to take the values 1 or 0 for `yes' and `no', respectively, and explanatory variables X_1, X_2…….X_k. The explanatory variables can be quantitative or indicator variables referring to the levels of categorical variables. Since Y is a binary variable, it has a Bernoulli distribution with parameter p = P(Y = 1), that is, P is the probability of success for given values X_1, X_2…….X_k of the explanatory variables. For a Bernoulli variable, the mean is given by

E[Y] = P(Y = 1) = p The logistic regression model is defined as follows. Suppose that Y_1,…..,Yn are independent Bernoulli variables, and let Pi denote the mean value of Yi, that is, Pi = E[Yi] = P(Yi = 1) = p. The mean value Pi can be expressed in terms of the explanatory variables Xi, 1, X_2,.., Xi, k as $$\rho_i = \frac{1}{1+\exp(-\beta_0 - \sum_{j=1}^{k} \beta_j x_{i,j})}$$

In the logit model the log odds of the outcome is modelled as a linear combination of the predictor variables. The explanatory variables can be quantitative or indicator variables referring to the levels of categorical variables. The respondents were asked the bid amounts to state whether they were willing or not willing to pay by responding "yes" or "no". The responses were treated as a binary variable taking the value of 0 or 1. Then logistic regression function package was used to estimate the parameters of the function. The non-linear binary Logit model takes the following form

WTPi = α + βBid + β1HM1 + β2HM2 + β3HM3 + β4HM4 + β5X5 + β6X6+ β7X7+ β8X8 + ε

Where WTP = the dependent variable or response obtained from respondents in the form of "yes" or "no" answer; WTP=1 if the respondent answers yes and 0 otherwise, ε= random disturbance term; "α" is the constant term and "β" is the bid coefficient; HM_1 = (Sex of Respondents), HM_2 = (Age of Respondents), HM_3 = (Education of Respondent), HM_4 = (Marital Status of Respondent), HM_5 = (Monthly Income of the Household), HM_5 = (Number of Children in the Household), HM_7 = (Responsibility of Solid Waste Management), HM_8 = (Time Spent in the Area).

Mean willingness to pay for improved Solid waste management by households was calculated using the formula derived and given as:

MeanWTP =1*In(1+$esp\beta_0$)(β_1)

Where $ß_0$ and $ß_1$ are absolute coefficient estimates from the logistic regression and the Mean WTP is the mean for the improved Solid waste management by households.

The chi-square test is a statistical test that can be used to determine whether observed frequencies are significantly different from expected frequencies. Chi-square tests enable us to compare observed and expected frequencies objectively, since it is not always possible to tell just by looking at them whether they are "different enough" to be considered statistically significant. Statistical significance in this case implies that the differences are not due to chance alone, but instead may be indicative of other processes at work.

The pseudo-R square and the chi-square were parameters used to measure the aptness of fit of the model and the significance of the model used.

Coefficient of determination ($\mathbf{R^2}$) is statistical method that explains how much of the variability of a factor can be caused or explained by its relationship to another factor. It is used in trend analysis. It is computed as a value between 0 (0 percent) and 1 (100 percent); the higher the value, the better the fit. Coefficient of determination is symbolized by R^2 because it is square of the coefficient of correlation symbolized by R. The coefficient of determination is an important tool in determining the degree of linear-correlation of variables ('aptness of fit') in regression analysis.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Status Quo of Solid Waste Management in the GEMA

The current waste management practice in the municipality is discussed below.

4.1.1 Perception of Solid Waste Collection and Methods of Waste Disposal in GEMA

The responses to the questions concerning current situation of solid waste collection in the Ga East municipality show that people are not ignorant of the waste menace in the municipality (Table 4.1).

Table 4.1 Problem of Solid Waste Collection and Waste Disposal Methods

			Waste Disposal Methods				
			Private collectors	**Communal containers**	**bury/burn**	**Dump in bushes**	**Total**
Perception of Solid Waste Collection	**Yes**	Count	63	39	15	6	123
		%	42.0%	26.0%	10.0%	4.0%	82.0%
	No	Count	18	5	3	1	27
		%	12.0%	3.3%	2.0%	7%	18.0%
	Total	Count	81	44	18	7	150
		%	54.0%	29.3%	12.0%	4.7%	100.0%

Source: Author's Survey, 2014

Majority (82%) of respondents admit that solid waste collection is a problem in the municipality and have done something about it. A total of 83.3% receive waste collection services. Of this total 54% are rendered services by private waste collectors and the rest (29.3%) by communal container services. Respondents attribute the poor solid waste collection to the irregular and low door-to-door collection activities. The poor waste collection situation observed agrees with MESSAP-GEMA (2013) which documents that as of the year 2012, only 900 metric tonnes out of the 1400 metric tonnes of solid waste generated monthly in the

municipal is collected. As a result of which 10% of the respondents bury or burn their waste in holes dug in their houses while four percent (4%) dump their waste in nearby bushes due to lack of trust for private waste collection services. Others dispose their waste into drainage channels, road verges and open lots which destroy the municipality's environmental aesthetics (Plate 1).

There is indiscriminate disposal of waste within the municipality. In their research about solid waste management in East African cities, Okot-Okumu and Nyenje (2011) noted that communities in Kenya, Tanzania and Uganda without access to adequate waste collection activities resort to burning, burying and indiscriminate disposal. Perhaps the phenomenon is not restricted to communities in East Africa. There has been progress in the activities of the municipality aimed at promoting and encouraging registration for house-to-house collection by the private companies. This is confirmed by 54% of respondents who receive door-to-door services from private waste collection firms. The registration and deployment of private waste collectors is part of an agreed strategy to discourage and finally eliminate indiscriminate dumping of waste in the Ga East municipality (MESSAP-GEMA, 2013).

Although the introduction of private operators has increased solid waste collection activities compared to the era when the responsibility was entirely dependent on municipal assemblies (MESSAP-GEMA, 2013), most of these reported collection efforts only apply to waste that reaches community collection points (popularly referred to as transfer points). This means a larger quantity of the solid waste ends up in the environment and not legal disposal points.

Plate 1: (a) Road shoulders in Agbogba littered with refuse. (b) A drain in Taifa.

4.1.2 Availability of Storage Receptacles in Households and Measures to Reduce Waste Generated

From Table 4.2 it is observed that 19.6% of the respondents recycle their waste while 26.4% actively prevent excesses.

Table 4.2 Availability of Storage Receptacle in Household and Measures to Reduce Waste Generated

			Measures to Reduce Waste Generated				
			Reuse and recycle	Burn	Disposal into gutters	Usage of required amount	Total
Availability of Storage Receptacle in Household	**Yes**	Count	25	60	0	28	113
		%	16.9%	40.5%	0.0%	18.9%	76.4%
	No	Count	4	17	3	11	35
		%	2.7%	11.5%	2.0%	7.4%	23.6%
	Total	Count	29	77	3	39	148
		%	19.6%	52.0%	2.0%	26.4%	100.0%

Source: Author's Survey, 2014

Majority (54%) of respondents practice bad waste disposal methods of either burn (52%) or disposal into gutters (2%). This practically supports an earlier observation; that a large amount of solid waste within the communities of the municipality does not reach the disposal point but end up in the environment. It is interesting to note that high percentages of respondents in these categories have available spaces in their homes designated for interim storage of waste. 76.4% of the respondents have storage receptacles on and in close proximity to their compounds, the rest (23.6%) had none. Household wastes are stored in bins by the affluent and in sacks, plastic bags, cut jerry cans, cardboard boxes by the low-income households. Out of the 23.6% who have no storage receptacles, 11.5% burn their waste while 2% dump into gutters.

Some households separated components of waste such as plastic bags, bottles (plastic/glass), tins and scrap metal (Plate 2). A few reutilised at the waste source. Most of the respondents, however, sold to itinerant buyers who also sold to middlemen who supplied to recycling industries. The nature of activities of the Ga East Municipal households such as using efficiently to reduce excesses (prevention), reuse and recycling, conform to the elements which UNEP (2010) considers integral parts of systematic ISWM approach and also confirm the fact that recycling in developing countries is mainly through the unorganized sector. In 2013, the Ga East Assembly sought to promote the separation of waste at the source through public education and sensitization programs. Additionally, it also intended to make stakeholders appreciate and adopt the practice to improve waste management, the ultimate, recycling of waste. This seems to be yielding some results demonstrated in numbers of households involved in reduction of excesses, reuse and recycling, though progress seems slow. However, with the Assembly's plans of establishing a recycling plant in the municipality, it is important that sensitization programs are prioritized and intensified to enhance awareness and further educate the people. This will help facilitate sorting of waste at the source and enhance households' cooperation with the recycling program.

Plate 2: A pan containing sorted plastic bags and bottles. (Photo by author, 2014).

4.2 Assessment of Private Waste Collectors' Services Offered To Households in GEMA

Information on amount paid to service providers and households' satisfaction are discussed in this section.

4.2.1 Amount Paid Monthly To Private Service Providers for Waste Collection Services

Licensed private operators mostly collect waste directly from generating sources (door-to-door) at negotiated fees with the individual clients (Figure 4.1).

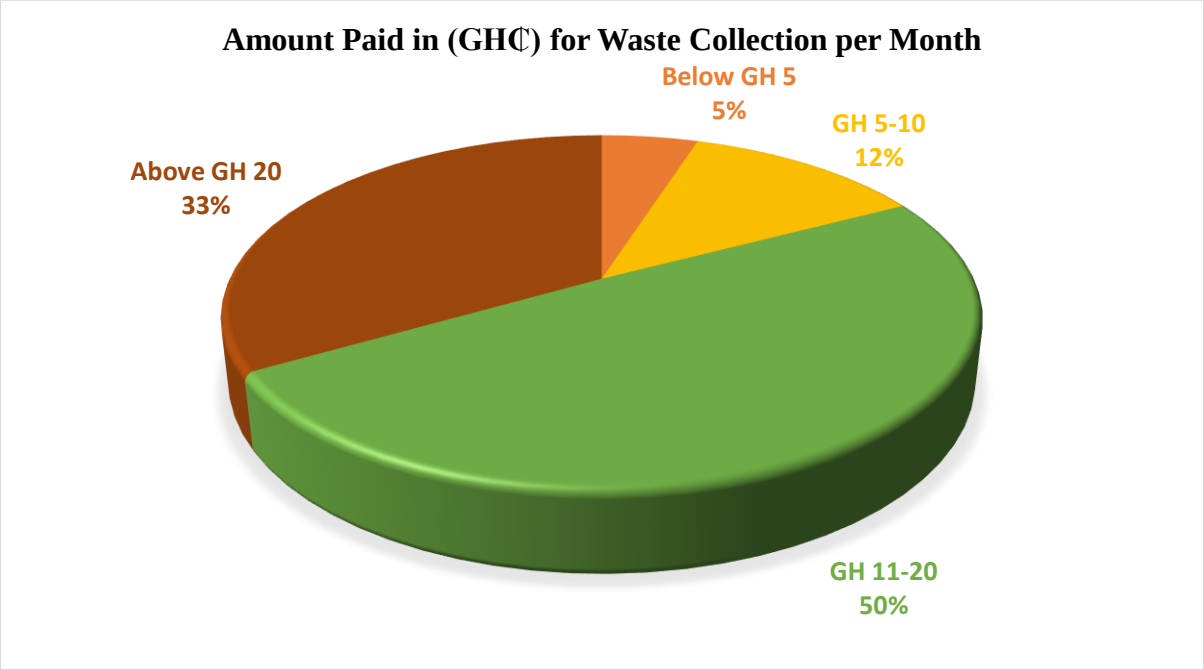

Figure 4.1 Assessment of Private Waste Collectors' Fees Charged

Source: Author's Survey, 2014

Private waste collection operators contracted by the municipal assembly include Asadu Waste Ltd, Zoomlion Domestic Waste Services Ltd, Jamoky 'B' Ventures, Amanee Farms Ltd, Premko Waste Management Services Ltd and Honest Waste Services Ltd. Forty nine percent (49.4%) consisting of the majority of the respondents pay on a monthly basis over GH₵ 20 to these companies for waste collection services (Figure 4.1).

There were also a few households (17.2%) who employed the services of individual waste collectors. These individual self-employed waste collectors take their wages on the spot depending on the quantity of waste. These category of waste collectors utilize wheelbarrows, large head pans, cardboard boxes and sacks for waste collection. The respondents are unaware of the places these collectors dispose off the waste or the environmental soundness of the place. They are only satisfied with the availability of these individuals compared to private firms.

4.2.2 Household's Satisfaction with Private Collection Services and Collection Frequency.

Table 4.3 Household's satisfaction with Private collection firms' services and Number of collections per week

			Number of collections per week					
			Once	**Two times**	**Three times**	**Everyday of the week**	**less frequently**	Total
Household's satisfaction with service	**Yes**	Count	19	8	3	2	1	33
		%	23.5%	9.9%	3.7%	2.5%	1.2%	40.7%
	No	Count	40	6	1	0	1	48
		%	49.4%	7.4%	1.2%	0.0%	1.2%	59.3%
	Total	Count	59	14	4	2	2	81
		%	72.8%	17.3%	4.9%	2.5%	2.5%	100.0%

There is a marked dissatisfaction with collection services rendered by private waste collectors within the municipality independent of the time frame within which waste is collected from the households (Table 4.3). 72.8% of the respondents have their waste collected once per week. 17.3% have theirs collected twice every week. 4.9% of them are serviced thrice weekly and 2.5% mentioned their waste is collected every day of the week (Table 4.3). Of the 59.3% who were displeased with the collection services, the majority (49.4%) had their waste collected once per week. This denotes the displeasure of households whose waste are collected once per week. This suggests there are irregularities with the scheduled times of collection which the

respondents admitted to. The private waste collection firms conceded to the reported inconsistencies in the agreed and scheduled collection days. They attributed it to three main challenges: inconsistencies in payment of revenue by clients, inadequate waste collection vehicles and increased distance between the new dumpsite.

Most of the clients or households believe that the private operators do not render services to their satisfaction and therefore hesitate paying.

Private operators mentioned lack of adequate waste collection trucks resulted in their frequent breakdown. This is due to the strain put on them to meet the high service demand, poor dusty road network systems in the region and inexperienced truck drivers. They added it is often difficult meeting the agreed time scheduled due to the high cost and length of time required for maintenance. Majority (50%) of private operators interviewed mentioned they spend up to 50% of the total operation cost on vehicle and equipment maintenance alone (Table 3, Appendix 1).

They also reported that the Abokobi dumpsite in the Ga East Municipality is almost full for which reason they have to send waste to the new dumpsite at Kpone in the Tema Metropolitan Assembly. They suggested that the new arrangement has increased distance between collection points and dumpsite and often makes it difficult for them to complete their workload beyond one trip taking into consideration the large number of clients and huge quantities of waste generated. They consider the requirements to meet the documented schedules a rather tall order.

4.3 Respondents' Awareness to Waste Disposal Activities

Information on respondents' knowledge on waste disposal activities in the municipality is discussed in this section.

4.3.1 Respondent's Knowledge and Concern of the Environmental Soundness of Final Disposal Site

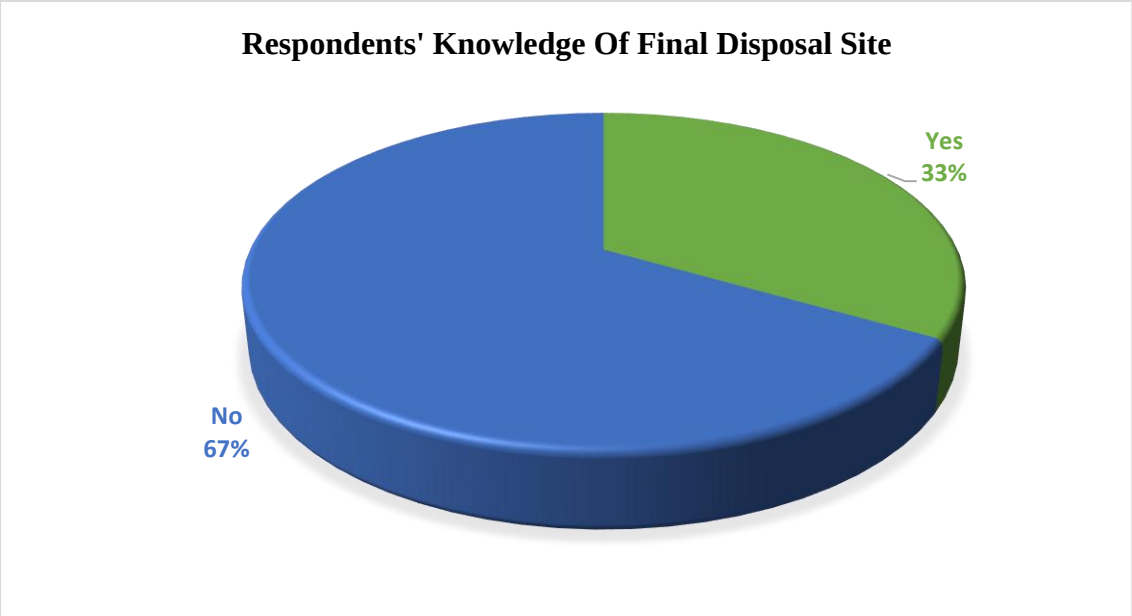

Figure 4.2 Respondents' Knowledge of Final Disposal Site. Source: Author's Survey, 2014

Table 4.4Respondents' Concern for Environmental Soundness of Final disposal site

	Frequency	Percent
Yes	131	87.3
No	19	12.7
Total	**150**	**100.0**

Source: Author's Survey, 2014

The results in Figure 4.2 show that majority (67%) of the respondents are unaware of the final destination of their waste, with a considerable number, (12.7%) who do not care about the environmental soundness of the final disposal site of their collected waste (Table 4.4).

Again majority (67%) of respondents perceive that information about the final destination is inessential adding that it is exclusively the concern and responsibility of the private collection systems. This suggests that an understanding gap defined by Clapp (2010) as a gulf of

information, awareness and responsibility between consumers and waste exists among the respondents. Further, it is evident that the gap is not only geographical but also psychological. For the respondents once waste was out of sight, they usually forget about it and assume it to be someone else's responsibility. The government, private waste systems and municipal assemblies are often tagged as the 'someone else'. When people have little understanding of where their post-consumptive waste ends up, they often make bad decisions that perpetuate their waste generation. Clapp (2010) noted that the understanding gap between consumers and their waste severed ecological feedback loops and perpetuated otherwise undesirable consumption choices of people. It is good to note that the observation consistent with Clapp's (2010) finding is found among few of the respondents.

Although a large number (67%) are oblivious of the dumpsite, majority (87.3%) of the respondents were concerned about the environmental soundness of the site (Figure 4.2 and Table 4.4). This suggests the people are actually concerned about the ecological impacts of the landfill on human health and the environment. This is a favourable avenue for simple and accessible awareness programmes to be implemented to change the mind-set of the people in order for them to perceive waste as resources (goods) rather than something without value.

4.4 Demand for Improved Solid Waste Management Service

Table 4.5 gives demand estimates for improved solid waste management services. From Table 4.5, 111 out of a total of 150 respondents are willing to pay for an improvement in solid waste management in the municipality.

Table 4.5 Estimated Demand for Improved Solid Waste Management Service

WTP Interval (GH₵/Month)	Frequency	% of Households	Total No. of Households	Total WTP (Gh₵)
2	1	0.9	44.19495	88.38991
4	1	0.9	44.19495	176.7798
5	17	15.3	751.3142	3756.571
8	34	30.6	1502.628	12021.03
10	37	33.3	1635.213	16352.13
15	6	5.4	265.1697	3977.546
20	15	13.5	662.9243	13258.49
Total	**111**	**100**	**4905.64**	**49,630.93**

Source: Author's Survey, 2014

Fifteen respondents are willing to pay the highest bid of GH¢ 20 while one person, the lowest bid of GH¢ 2. According to the Ga East Municipality, it is projected that the current estimated households amount to 66,286 with an average family size of 4.6 per household. The monthly Willingness to Pay (WTP) for the municipal is calculated by multiplying the mean number of households by the respective amount they are willing to contribute. This gives an anticipated amount of GH¢ 49630.93 to be collected for improved Solid Waste Management for the Ga East Municipal per month. The municipal's annual mean total WTP would therefore be GH¢ 595,571.16 indicating that solid waste collection service is an economic good and is highly demanded by the households. In reference to the estimated amount of GH₵ 420,000.00 being the cost the municipal assembly incurred in the management of the Municipal's waste, it can be deduced that, private entities with stake in improving the municipal's waste management and providing better services stood the chance of meeting the minimum requirements of

investment into the area. With this also, sustainable financing of environmental sanitation services is ensured.

This conforms to the basic principles of sustainable financing and cost recovery of environmental sanitation services according to NESSAP (2010). It mentions the application of direct cost recovery from all users as far as possible covering all operating and capital costs, for solid waste collection services and also MMDAs setting tariffs with full participation of private sector service providers and users.

4.5 Determinants of Willingness to pay

The regression results (Table 4.6) show the factors influencing willingness to pay for improved solid waste management in the Ga East Municipality.

Table 4.6 Binary Logistic Regression Results

Variables	Coefficient	S.E	p-Values
Constant	-0.296	1.490	.843
Gender	0.011	.619	.857
Age	0.054	.855	.950
Educational level	0.007	1.452	.003*
Employment Status	0.337	.794	.671
Time spent in the Area	-0.217	1.160	.001*
Family size	-0.614	.696	.378
Monthly Income	0.446	.863	.004*
Responsibility of SWM	0.435	.558	.436

* represents significant at $p<0.05$

Source: Author's Survey, 2014.

Hence, **WTPi = 0.007HM3-0.217HM5+0.446HM7** (Logit model)

The results from the table show that respondents' income, educational level and longevity in the area are the factors that affect willingness to pay for improved waste management.

Respondents' household income variable ($p<0.004$) was positive and significant at 95% confident interval indicating that improved solid waste management is a normal good since its demand increases with income according to Table 4.6. This is because as the household income increases people are able to afford the fees that are charged for solid waste management. The marginal effect reveals that an additional income would increase the likelihood of person's willingness to pay for improved waste management services by about 44.6%.

Educational Level of the respondents ($p<0.003$) was positive and significantly influenced willingness to pay for improved SWM indicating that as the educational level of the respondents increases, they become more concern with their environment and are more willing to contributes financially to improve on management of their waste. The marginal effect of the coefficient showed that an additional level of education would increase the likelihood of households' willingness to pay by 7%.

Lastly, Time spent in the area ($p<0.001$) is significant and negatively influences willingness to pay for an improved SWM. This means when households settle in any new area, they are willing to pay any levy that is sent to them for a service. However, as the number of years lived in the community increases, experiences and familiarity with previous and existing unsatisfactory services cause them to explore and access other options. They become reluctant to contribute for any new services. The marginal effect of the coefficient showed that an additional year spent in the area will decrease the households' willingness to pay by 21.7%. These results agrees with Ichoku *et al*. (2009), who notes that the value of WTP increases in general with household income, respondent's education level, conscience about the seriousness

of solid-waste-related pollution problems, past positive experience in receiving the SWM services and trust in the proposed project. Thus the logit model becomes

On the other hand, Gender of respondents' (p=0.857), respondents' Age (p=0.950), Employment Status (p=0.671), Family size (p=0.378), and Responsibility of SWM (p=0.436) did not significantly influence the willingness to pay for improved waste management.

4.6 Model Summary-Coefficient of Determination

The results according to table 4.7 gave Nagelkerke coefficient of determination, R^2, of about 0.546 and Cox and Snell coefficient of determination, R^2, of about 0.372.

Table 4.7 Model Summary-Coefficient of Determination

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
97.067[a]	.372	.546

Source: Author's Survey, 2014

The validity of the regression model in estimating willingness to pay for improved solid waste management is consistent with related studies (Altaf *et al.*, 1996). The R^2 value for the regression model is considered acceptable, because O'Garra (2009) mention that regressions on Contingent Valuation data usually yield R^2 values between 10% and 40%.

4.7 Reasons for Respondents' Non-Willingness to Pay

Respondents were asked for reasons they are unwilling to pay for solid waste management services (Figure 4.3). Responses received include lack of trust for private companies, dislike for private companies, poverty, satisfaction with the existing systems, perception that it is government's responsibility and perception of unreliable services (Figure 4.3).

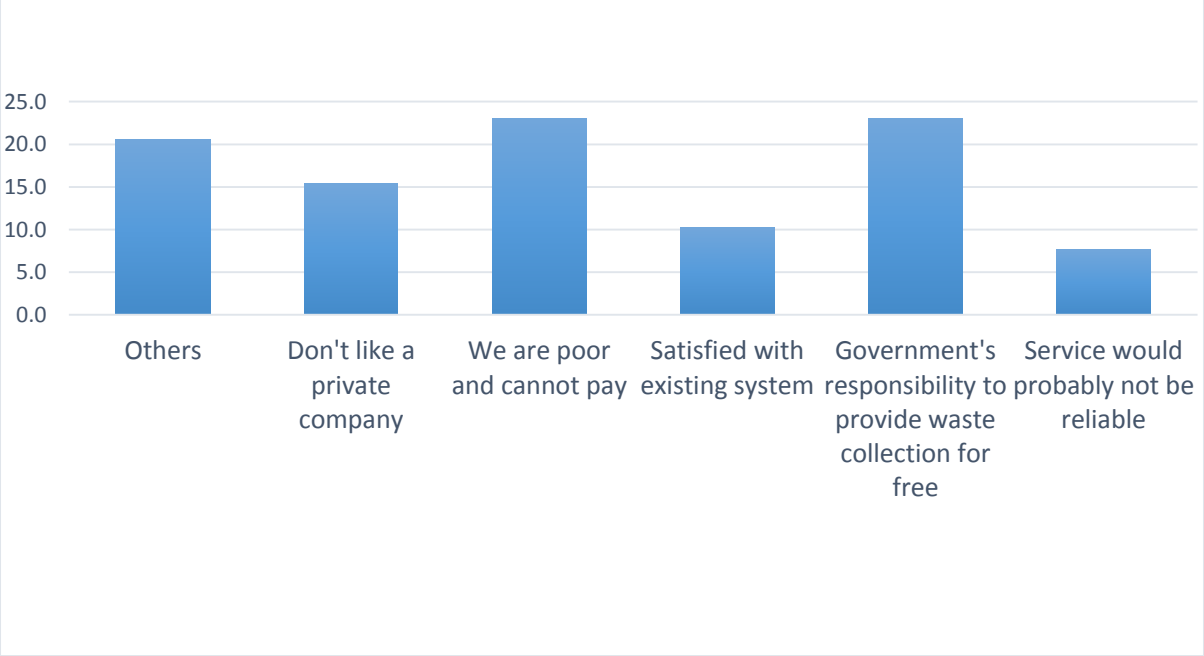

Figure 4.3 Respondents' Reasons for Non-Willingness to Pay. Source: Author's Survey, 2014

Two groups of respondents with equal and the highest percentages (23.1%), stated they are unwilling to pay for improvement in SWM. The first attributed to their financial instability and the second group perceived it as the responsibility of the government to provide it free of charge. The least percentage (7.7%) had mistrust for the private companies' reliability. Some (10.3%) were reluctant because they were comfortable with the existing systems. Others (20.4%) had no trust in the private companies and 15.4% of the respondents simply did not like the private companies. Ichoku *et al*. (2009) notes that increase in trust for private companies by households' increases their willingness to pay.

4.8 Assessing Willingness to Pay at the Community levels

WTP at the three categories in which communities in the study area were grouped into, based on their life standards, income levels, housing and other facilities, was assessed.

Table 4.8 Willingness to Pay at the Community Level

		Community Level		
		1	**2**	**3**
Willingness to Pay	Yes	90.0%	54.0%	78.0%
	No	10.0%	46.0%	22.0%
Total		**100**	**100**	**100**

Source: Author's Survey, 2014

As iterated in chapter 3, communities which constitute level 1 (high income) include; Dome, Ashongman Estates and Papao. Constituting communities in level 2 (middle income) include New Ashongman, Taifa, Haatso, Agbogba, Adenkrabi, Kwabenya, Christian village, Atomic and Akporman. Abloradjei, Boi, Siseme and Abokobi fall under the level 3 (low income) settlements (MESSAP-GEMA, 2013).

Out of 111 respondents who are willing to pay for improved SWM in the municipality, the majority (90%) are from level 1 communities. These are the households with relatively high income levels and greater awareness of environmental quality due to their relatively high educational status. They understand the relevance and impacts of an improved SWM system and because they are often engaged with their jobs, they rely solely on the private operators to handle their waste. This corresponds with Hagos *et al*. (2012) who mentioned that a consumer with higher income has a greater demand for waste management and is more willing to pay for it.

The second largest group (78%) is from level 3 communities who are relatively low income earners. They are also desperate for an improved SWM system as they are discontent with the

filth and blighted environments, especially inhabitants of Abokobi. The landfill site at Abokobi which serves as a final disposal site not only for the Ga East Municipal Assembly but receives waste from Adentan, Ga West and even Accra Metropolitan Assembly (AMA) is also a key contributing factor to the inhabitants' willingness to pay for an improved SWM system. They complain bitterly of the stench and constant burning of waste at the site which creates serious air pollution, invisibility that was a threat to their health.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The findings show that the people of the Ga East municipality are aware of the waste menace and employ some measures to manage their waste. It was observed that though 83.3% of the respondents received waste collection services from private collectors, majority (82%) consider solid waste collection a problem in the municipality. Again, households apply the 3R (reduce, reuse and recycle) concept of ISWM which depicts their willingness to participate as stakeholders in combatting the menace in the municipal. Close to half of the respondents (46%) reuse and recycle their waste as well as use only required amount of items to reduce excesses. Majority (87.3%) of the respondents are concerned about the environmental soundness of the final disposal site of their collected waste.

The study reveals that most (74%) of the respondents are willing to pay for improved SWM in the municipality. It was discovered that the mean monthly WTP for improved SWM is GH¢ 49,630.93. Calculating with an estimated household number of 66,286, the annual mean total WTP would be GH¢ 595,571.16. It can be inferred, though unconsciously, that residents of the municipality consider improvements in SWM an economic commodity and an indication of their desire for change in SWM methods. Educational level, monthly income and number of years lived in the community are factors which have a positive and significant influence on demand for better environmental quality. The annual mean total WTP of households was discovered to be higher than the current estimated sum of 420,000 cedis which the municipal authorities spend annually on combating waste in the district. Hence, there is a potential of viable business opportunities in the municipal for private waste operators who can make efficient and effective investments to improve the solid waste management situation and enhance the utility of the people in the Ga East Municipality.

5.2 RECOMMENDATIONS

From the stated conclusions the following recommendations are suggested.

Increased education, awareness and sensitization: The GEMA is commended for tremendous efforts in managing solid waste and keeping the environs clean and healthy. It must intensify efforts through more environmental sanitation education, close contact interaction/ effective communication and dissemination of information and implementation of by-laws to punish indiscriminate waste disposal as a deterrent and reward employment of the 3Rs, as attitudinal and behavioural change is central to achieving sustainable progress in environmental sanitation. When households practice waste sorting at the source and active waste reduction methods, it will enable them to appreciate the recycling plant to be constructed at Danfa (Sackey, 2014). Further, households should also be made aware of the final destination of their waste because when people have understanding of where their post-consumptive waste ends up, they often make optimum decisions that will moderate their waste generation.

Provision of Incentives to private waste collectors: Efforts must be made by the Government to provide incentives such as Tax/Duty wavers, accessible landfill sites to the private waste collectors to enable them enhance their operation as well as improve services rendered to the public.

Provision of waste storage receptacles: Some of the reasons that contributed to the upsurge of crude disposal activities according to the results reveal that not all households have waste storage receptacles. It is recommended that the Municipal Assembly and private investors should make available enough waste bins to the households. This conforms to an objective of NESSAP (2010) that notes the Provision of primary storage containers to gradually improve house-to-house service coverage and thus increase the number of direct-paying customers.

Also in effective response to the increasing waste volumes and changing waste streams due to growing economy and varying life-styles, provision of services and facilities for primary separation of solid wastes at household, community and public levels must be available.

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APPENDICES

APPENDIX 1

Table 3: Cost of vehicle and equipment maintenance as a percentage of total operation cost.

		Frequency	Percent
Valid	21-30%	1	16.7
	31-40%	2	33.3
	41-50%	3	50.0
	Total	**6**	**100.0**

Source: Author's Survey, 2014

The majority (50%) of the waste management service providers mentioned that approximately 50% of the total operation cost is spent on maintaining vehicle and equipment.

APPENDIX II

HOUSEHOLD QUESTIONNAIRE

ECONOMIC VALUATION OF IMPROVED SOLID WASTE MANAGEMENT IN THE GA EAST MUNICIPALITY

Confidentiality statement

This research work aims at gaining insight into the economic valuation of improved solid waste management in the Ga East Municipality. Information gathered during this exercise is solely for academic purposes. Full confidentiality for all disclosures is assured. Please tick[**✖**] appropriately

Name of Community……. Community Level……. Que No...…..

DEMOGRAPHIC INFORMATION OF RESPONDENTS

1. **Gender**: [1] Male [2] Female
2. **Age**: [1] below 35 years [2] 35-60 years [3] Above 60 years
3. **Level of education**: [1] Never been to school [2] Basic education [3] JSS/SSS leaver [4] Training/Vocational [5] Diploma/ Degree [10] Other, please specify ……
4. **Occupation** (please state your exact occupation, e.g. accountant, farmer, etc)
   Main occupation: [1] Government [2] Private [3] Self-employed ……
   Part time occupation: [1] Government [2] Private [3] Self-employed ……
5. **Hometown** ……..
6. **How long have you lived in the community**? [1] below 5 yrs [2] 5-15 yrs [3] 20-30 yrs **[**3] Over 30 yrs
7. **What is the size of your family**? [1] below 10 [2] above 10
8. **What is your monthly household income, in GH₵?** [1] < GH₵ 100 [2] GH₵ 100-300 [3] GH₵ 301–500 [4] GH₵ 501-800 [5] Above GH₵ 1,000 [10] Other, please specify ……

STATUS QUO OF SOLID WASTE MANAGEMENT (please tick[**✖**] appropriately)

9. **What kind of waste do you generate most?** [1]Paper [2] Plastic [3] Food waste [4] Plant debris [10] Other, please specify……
10. Do you have a storage receptacle for solid waste in your house or in your compound? [1]Yes [2]No

11. What measures do you take to reduce the amount of solid waste your household generate?

    [1]Reuse and recycle such as water and beverage bottles [2] Burning [3] Disposal into gutters [4] Use only required amount of items to reduce excesses

12. Is solid waste collection a serious problem in your area? [1]Yes [2] No

13. In your opinion, how serious is the problem of littering and illegal piles of solid waste in your area? [1]Very serious [2]Somewhat serious [3] Not serious [11] Don't know

14. Who in your opinion should clean the streets, community waste bins and drains in the area?

    [1] Municipal authority [2] Private companies [3] Community labour [10] Other, please specify

    ……

15. How do you dispose off your solid waste? [1] Private collectors [2] Take it to the nearby storage receptacle [3] Dig a hole around the house and bury or burn it [4] Dump in nearby bushes [5] Throw it on an open space or on the street [10] Other……

    If private collectors, Go to Q16

16. **ASSESSMENT OF PRIVATE COLLECTORS**

a. How much do you pay for your collection service per month? [1]Below 5GHC [2] 5-10GHC

   [3] 11-20GHC [4] Above 20GHC [5] Other, please specify: ……

   b. How many times is your waste collected per week? [1] Once [2] Two times [3] Three times

      [4] Everyday of the week [5] Other, please specify……

   c. Are you satisfied with their service? [1] Yes [2] No

   d. If the collection is not satisfying how do you dispose of waste generated? [1]Burn [2] Dump in nearby bush and drains [3] Keep it piled till collectors come for it [4] Bury in backyard [10] Other, please specify……

e. What is your opinion of the service that you are receiving for collection of solid waste from your household? [1]Very satisfied [2] reasonably satisfied [3] not satisfied at all ***Go to f***

f. If you are not satisfied with the service, please you state your primary reason?
   [1]The service is not reliable

   [2]Frequency of service – the interval between collections is too long

      [3] The location of the communal container or pick-up point is unsatisfactory

      [4] Lack of clean appearance of the neighbourhood

      [10] Other, please explain

   …….....

ASSESSMENT OF MUNICIPAL ASSEMBLY

17. Is your household getting the services of solid waste collection or disposal from the Municipal?

    [1]Yes [2] No ***[if Yes Go to 18, if No Go to 19]***

    18**.** How frequently is your container usually taken out to be emptied? [1] Once [2] Two times [3] Three times [4] Everyday of the week [10] Other, please specify……

19. What is your opinion of the service that you are receiving for collection of solid waste from your household? [1]Very satisfied ***Go to 21*** [2] reasonably satisfied [3] not satisfied at all ***Go to 20***

20. If you are not satisfied with the service, would you state your primary reason?

    [1]The service is not reliable

    [2]Frequency of service – the interval between collections is too long

    [3]The location of the communal container or pick-up point is unsatisfactory

    [4]Lack of clean appearance of the neighbourhood

    [5] Other, please explain…….....

AWARENESS /ATTITUDE TO WASTE DISPOSAL ACTIVITIES

21. Do you know where the collected waste is taken for final disposal when it leaves your neighbourhood?

    [1]Yes [2] No ***[If Yes, Go to Question 21, If No go to Question 23]***

22. Are you concerned about whether the final disposal is environmentally safe and acceptable? (1) Yes (2) No *[If Yes Go to 22]*

23. Who do you think is responsible to properly manage solid waste (for instance financing it) in the Ga East Municipal? [1] The Municipal only [2] Households only [3] Both

24. Which of the following do you think is the best institute to handle solid waste management in Ga East Municipal? [1] The Assembly [2] Private companies [11] No idea

HOUSEHOLDS' WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE MANAGEMENT

Description of Improved Solid Waste Management

Assuming a decision has been taken to offer a new solid waste collection service to households in your neighbourhood such that someone would pick up the waste from your house each day. The waste from all the houses subscribing to the service would be disposed of properly and would be hauled away from your neighbourhood in trucks to a municipal landfill. This waste collection service would thus address two problems: your waste would be picked up regularly from your house, and your waste would not be left around the neighbourhood to create a

sanitary problem. This kind of service can only be offered if a sufficient number of households agree to purchase it and agree to pay a monthly charge on a regular basis. The service can be offered by the municipal corporation or by a private firm. In either case each household could decide whether it wanted to accept this service or not.

25. Suppose the Municipal Assembly were to offer this improved waste collection and disposal service in this area for a fee which of the following would be affordable for you?
[1] GHC1-5 [2] GHC 6-10 [3] GHC11-15 [4] GHC15 [5] GHC 20 and above

26. What is the maximum monthly bill you would be willing to pay for this new waste collection and disposal service? [1]Maximum bill GH₵…… [2] Don't want service at any price ***If you ticked [2] Go to28***

27. If you are willing to pay for a collection service, to whom would you prefer to pay the fee?
[1]To a government fee collector [2] To a fee collector working for a private company
[3] To a neighbourhood leader [10] Other, please specify……..

28. If you do not want to pay for improved waste collection service(s) what is your main reason?
[1] Don't trust a private company
[2]Don't like a private company
[3] We are poor and cannot pay
[4] Satisfied with existing system
[5] Government's responsibility to provide waste collection for free
[6] Service would probably not be reliable
[10] Other (specify) ……..

QUESTIONNAIRE FOR WASTE COLLECTION AND DISPOSAL SERVICE PROVIDERS

Confidentiality statement

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1. Company Name:
2. Location of company/Contact no(s):
3. Areas of operation within the Ga East municipality: (please tick [**✘**] as many as applies)

[1] Dome	[2] Kwabenya	[2] Adenkrabi
[1] Ashongman Estates	[2] Christian Village	[3] Boi
[1] Papao	[2] Atomic	[3] Aboman
[2] Adenta West	[2] Akporman	[3] Abloradjei
[2] New Ashongman	[2] Haatso	[3] Sisememe
[2] Taifa,	[2] Agbogba	[3] Abokobi

4. Please indicate the staff strength of your institution

Total Number of drivers [1] 1-20 [2] 21-40 [3] 41-60 [4] 61-80 [5] above 80

Total Number of labourers [1] 1-20 [2] 21-40 [3] 41-60 [4] 61-80 [5] above 80

Total Number of supervisors[1] 1-20 [2] 21-40 [3] 41-60 [4] 61-80 [5] above 80

Total Number of Janitors [1] 1-20 [2] 21-40 [3] 41-60 [4] 61-80 [5] above 80

Total Number of Mechanics [1] 1-20 [2] 21-40 [3] 41-60 [4] 61-80 [5] above 80

5. Is there a schedule of collection and cleaning activities such as the time and frequency?
   [1]Yes [2] No

6. How many people are you rendering service to in the various communities?
   Door-to-Door: [1] Below 500 households [2] 500-1000 households [3] 1001-2000 households
   [4] 2001-3000 households [5] above 3000 households [10] Other, please specify:
   Communal: [1] Below 500 households [2] 500-1000 households [3] 1001-2000 households
   [4] 2001-3000 households [5] above 3000 households [10] Other, please specify:

7. If you render door-to-door services, how many are paying for services rendered?

[1] Below 20% [2] 20-40% [3] 41-60% [4] 61-80% [5] above 80%[10] Other, please specify:

8. How much is being charged per month for services rendered?

   Per head load (communal system)……..
   120 L bin (house-to-house)…….
   240 L bin (house-to-house)…….
   Other, please specify……...

9. What is the average quantity of waste collected daily?
   Door-to Door: [1] Below 50 tonnes [2] 50-100 tonnes [3] 101-200 tonnes [4] 201-300 tonnes [10] Other, please specify…….
   Communal: [1] Below 50 tonnes [2] 50-100 tonnes [3] 101-200 tonnes [4] 201-300 tonnes [10] Other, please specify…….

10. What is the current cost of collection and transfer of waste from houses to final disposal site?
    Door-to-door: [1] Below GHC1000 [2] 1000-2000GHC [3]2001-3000GHC [4] 3001-4000GHC [5] Above 4000GHC [10] Other, please specify……..
    Communal: [1] Below GHC1000 [2] 1000-2000GHC [3]2001-3000GHC [4] 3001-4000GHC [5] Above 4000GHC [10] Other, please specify……..

11. What is the average distance from the collection sites to the final disposal sites?

    Door-to-Door: [1] Below 10km [2] 10-20km [3] 21-30km (4) 31-40km [5] above 40km [10] Other, please specify…….
    Communal: [1] Below 10km [2] 10-20km [3] 21-30km (4) 31-40km [5] above 40km [10] Other, please specify…….

12. How long does it take to transport waste from the collection point to the final disposal site in **the absence of/ without** obstacles such as traffic jam?
    [1] Below 30minutes [2] 30-45minutes [3] 45-60minutes [4] 60-90minutes [5] Over 120min [10] Other, please specify:

13. How long does it take to transport waste from the collection point to the final disposal sites **with** obstacles such as traffic jam present?
    [1] Below 30minutes [2] 30-45minutes [3] 45-60minutes [4] 60-90minutes [5] Over 120min [10] Other, please specify:

14. What are the economic implications of traffic jam to the operations of your firm?
    [1] Increased cost of operation
    [2] Ineffective work output
    [10] Other, please
    specify…….

15. What vehicles are available for the service?
16. Are they adequate for the service rendered? (1) Yes [2] No
    If No, why?
    .....

17. Does your firm employ a maintenance/ technical manager for equipment? [1] Yes [2] No

18. What is the nature of training for your workers (including maintenance workers)?
    [1] On the job [2] formal/organised training [3] informal training [4] no training at all
    [10] Other, please specify:

19. What is the cost of equipment and or vehicle maintenance (percentage of total operation cost)?
    [1] 1-10% [2] 11-20% [3] 21-30% [4] 31-40% [5] 41-50%
    [10] Other, please specify:

20. Where is the landfill site you operate with located?
    [1] within the Ga East Municipal [2] Ga West Mumicipal
    [3] Ga South Municipal [4] Adentan Municipal
    [5] Tema Metropolitan Assembly [6] Accra Metropolitan Assembly

    [10] Other, please specify……

APPENDIX III

Plate 3: Refuse piled up beside a skip container at Taifa.

Plate 4: Abokobi final disposal site.

Plate 5: Neighbouring settlements overwhelmed with emanating smoke from the Abokobi dumpsite.

Plate 6: plastic bottles, cans and other items recycled by waste pickers at the Abokobi dumpsite.

(Photos by author, 2014)