APPROPRIATE GOVERNANCE AND FINANCING MODEL FOR HOUSEHOLD SOLID WASTE MANAGEMENT IN GHANA: IMPLICATIONS FOR PUBLIC HEALTH

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BY

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DECLARATION

I hereby declare that apart from references and other sources that, I have cited and duly acknowledged, this work is my own and has not been presented in whole or in part for another degree elsewhere. I also declare that I am solely responsible for any errors and omissions that might appear in this work.

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DEDICATION

This work is dedicated to my, wife and children, Nana Ama, Nana Afia, Nana Yaw and Eliza Annan Pra Boateng.

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ABSTRACT

Waste management is an important developmental issue globally, especially in Lower Middle-income countries like Ghana. In Ghana, it appears the key challenge in household solid waste management is appropriate governance and financing. This study assessed utilization of solid waste management (SWM) services in Ghana, the financing mechanisms, governance structure for managing solid waste and the willingness-to-pay for improved SWM services as an integral attribute of sustainable financing mechanism for SWM services in Ghana. This was a cross-sectional multi-center study and conducted in Ghana from January to August 2017, among 1560 households in four regional capitals in Ghana; Accra, Takoradi, Kumasi and Tamale. Data were collected using a structured questionnaire and an in-depth interview guide for clients, waste management service providers and key informants from the Assemblies. Logistic regression models were used to determine the factors associated with utilization of household solid waste management services and the predictors of willingness-to-pay for household solid waste management services in Ghana. The current governance structure was found to be weak; not inclusive, role conflict among, Municipal and District Assemblies, (MMDAs), staff and other actors, absence of public health dimension, and a single source funding (user charges). The overall level of utilization of SWM services was 55%, with difference across study sites; 53.9%, 53.2%, 70% and 42.9% in Takoradi, Tamale, Accra and Kumasi respectively ($p<0.001$). Other ways of house hold waste disposal methods included drop-off at communal container sites (21.7%) and burning or putting in dug pits (21.8%). Overall, 53.7% of the households were willing to make additional payment of (GHC10- GHC50) for improved services, with difference across study sites; 54.5%, 53.1%, 61.7% and 46.6% in Takoradi, Tamale, Accra and Kumasi respectively. User charge was mainly the available payment system and was fraught by default

payments and inability to collect revenue. Utilization of household SWM services was associated with age, educational level, marital status, occupation, type of accommodation, type of residence, economic status and duration of stay at residence. Compared to those with no formal education, having tertiary education was associated with higher odd of utilization of SWM services (adjusted odds ratio aOR, = 1.60; 95% confidence interval CI, = 1.01-2.60). Urban residency was associated with higher odds of utilizing household SWM services compared to residing in a peri-urban area (aOR, =2.80; 95% CI, and 1.55-6.69). Willingness-to-pay for improved solid waste management was also predicted by educational level, marital status, type of employment and region of residence. Compared to women who had no formal education, having senior high school (aOR, 95%CI; 2.53; 1.48-4.30], post-secondary (aOR, 95% CI=1.97; 1.08, 3.60] and tertiary education (aOR, 95%CI; 3.30, 1.91, 5.69) were associated with higher odds of willingness-to-pay for improved SWM services. This study provides important evidence on important attribute for the establishment of appropriate governance and financing structure that facilitate willingness-to-pay for improved SWM services. Findings would contribute to efforts at finding sustainable ways for solid waste management service delivery in Ghana. It is therefore recommended that the proposed model for SWM is adopted and piloted in one of the metropolis for improved solid waste management.

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LIST OF ABBREVIATIONS/ACRONYMS

AMA	-	Accra Metropolitan Assembly
DEHOs	-	District Environmental Health Officers
ISWM	-	Integrated Solid Waste Management
KMA	-	Kumasi Metropolitan Assembly
MSWM	-	Municipal Solid Waste Management
MMDAs	-	Metropolitan Municipal District Assemblies
MSW	-	Municipal Solid Waste
MEHOS	-	Metro Environmental Health Officers
RBF	-	Results Base Financing
STMA	-	Secondi Takoradi Metropolitan Assembly
SDG's	-	Sustainable Development Goals
TMA	-	Tamale Metropolitan Assembly
UN	-	United Nation
WHO	-	World Health Organization
WTP-		Willingness To Pay

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CHAPTER ONE

INTRODUCTION

1.1 Background

Solid waste management is a standout amongst the most critical elements of a city government, as a key utility administration on which the general wellbeing and the outer 'picture' of a city depend (Wilson *et al.*, 2013). It has been suggested that the effectiveness of a city's solid waste management system can be used as a proxy indicator of good governance (Wilson *et al.*, 2015). Waste management concerns the general handling, generation, treatment and disposal. From one viewpoint, uncollected solid waste is yet a genuine general public health concern in many developing nations, with both direct consequences for child wellbeing, and aberrant impacts through blocked channels causing the spread of water-borne disease and flooding across borders. The procedure of waste administration is critical for both the soundness of people in general and natural reasons. It is important for both the health of the public, aesthetic and environmental reasons (Chuks *et al*, 2013; Rushton 2003). "Municipal solid waste" (MSW) is a term normally connected to a heterogeneous collection of wastes produced in urban areas, the nature of which differs from area to locality.

Management of solid waste is a major challenge in many urban cities globally, especially in developing countries, including Ghana. It is a key utility service that could be linked to 12 out of the 17 UN Sustainable Development Goals (SDGs) (Rodić and Wilson, 2017). However, about 2 billion people are currently lacking access to solid waste management service (Rodić and Wilson, 2017). Solid waste management and disposal remains a huge burden in major towns and cities in West Africa. This is due to increasing solid waste generation, rising cost of its management and their associated environmental health challenges (Adebayo *et al.*, 2016).

The World Bank in its quest to achieve eradication of severe poverty and maximizing shared property has spent around 1.2 million dollars in investments, and over 55 advisory and analytical works on solid waste programmes and portfolios on about 114 sustainable and active projects within 58 countries (World Bank, 2013). Notwithstanding these interventions, solid waste management remains problematic in developing countries as the numerous World Bank and other partners' interventions have suffered from poor or no role shifting especially with respect to cost and competencies. It is estimated that waste management activities have a global financial shortfall of 40 billion dollars annually (World Bank, 2018a). Recent efforts such as Result-Based Financing (RBF) is gaining recognition and being adopted as an antidote in solid waste financing challenges. The RBF emphasizes on measurable outputs with changing human behaviour towards waste management and service delivery.

A World Bank report estimates a rise in the amount of MSW from the current 1.3 billion tons per year to 2.2 billion tons per year by 2025, with much of the increase expected in rapidly growing cities in developing countries (Hoornweg and Bhada, 2012). The annual cost of solid waste management is also projected to rise from the current $205 billion to $375 billion (Hoornweg and Bhada, 2012). This presents huge burden on governments and economies, especially in low and middle-income countries. Ghana currently produces about 13,000 tons of waste daily with over 4,000 tonnes produced in Accra and Kumasi (Anarfi, 2012; Monney, 2014). City authorities and waste management departments are still grappling with how best to deal with this challenge. Privatization of waste collection is suggested as a way to effectively deal with this menace and significantly contribute to improving the environmental sanitation situation in our cities (Anarfi, 2012).

It must be noted that, the involvement of the private sector in solid waste management has brought some relieve to governments, yet there is still much to be done. In most industrialized cities, there is ample evidence on solid waste management service provided by private enterprise for decades. The failure of municipal and metropolitan authorities in low and middle income countries (LMIC) to keep up with rapid growing cities necessitates the involvement of the private sector (Coad, 2005). The Ministry of Local Government in Ghana, has a supervisory role over the Metropolitan, Municipal and District Assemblies (MMDAs) and provides the general policy framework for waste management (Bentil, 2016). Admittedly, there have been some gains because of greater private sector participation in waste management in Ghana. Despite this improvement, challenges such as inadequate funds, lax attitude of officials and residents, lack of clearly defined roles for stakeholders, poor cost recovery, institutional weaknesses and inadequate financing mechanism are not uncommon (Martin, 2011, Baabereyir, 2009). In most business outlets, financing mechanism is one of the pillars on which the growth and health of a business are anchored and MSW management is no exception. Sadly, appropriate financing mechanisms and governance structure for MSW Management seem to elude service providers and government of Ghana, this does not only exacerbate the problem but also rolling back efforts at achieving the SDGs.

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1.2 Problem Statement

Solid waste management is directly related to the realization of the SDGs, especially Goals 1, 3, 11 and 15, and indirectly related to the other remaining goals (Rodić and Wilson, 2017). It follows that addressing MSW management challenges such as inappropriate governance structure and financing mechanisms have ripple effects on the realization of SDGs.

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Governance could be understood as a regulatory practice to solve societal problems, and environmental governance is a cognate concept used when speaking of governance in the niche of environmental issues (de Bie, 2017). Appropriate governance structure and financing is a function of quality service, ability and willingness to pay, it defines a clear policy framework and indicates the role of stakeholders (de Bie, 2017). These factors in turn influence the utilization of household solid waste management services and reduction in the spread of sanitation related diseases. Good governance is more important than investment or technology in creating and maintaining effective SWM system (Bhuiyan, 2010; Wilson *et al*., 2015). A study of the governance structure for urban waste management in Ghana found that the current governance structure is weak, a situation that has allowed elected local government officials to become involved in illegal collection of user charges (Oduro-Kwarteng *et al*., 2017). The existence of weak regulatory practices, non-adherence to contractual obligations, affect service quality and cost recovery. Unsigned contracts delays raising user charges and payment of subsidies; these practices affect investment in SWM resources and serve as a disincentive for private-sector development (Oduro-Kwarteng *et al*., 2017).

However, effective and efficient financing of MSW is a continually growing challenge at global, regional and local levels and one of the most intractable problems for local authorities in urban centers. Due to continuous economic development coupled with improved living standards, the

demand for goods and services is increasing at an unprecedented rate, resulting in a commensurate increase in per capita waste generation (Narayana, 2009). Two main types of SWM services are delivered by city authorities and waste management companies in Ghana; house-to-house and communal collection services (Boateng et al., 2016; Hamdu and Ibrahim, 2009). However, a number of households still resort to disposing of waste in open dumping sites and burning in open pits even with greater private sector participation due to weak enforcement of laws (Boateng *et al.,* 2016). Empirical evidence on the level and predictors of household SWM service utilization is needed to inform policy and implement strategies to expand and increase usage and payment of the services.

Arrangement and financing of waste administration have dependably been seen as the obligation of the local government. This is because of the legitimate and administrative systems directing the arrangement of strong waste administration from the local government (Bentil, 2016). The Ministry of Local Government, which has a supervisory job role over the MMDAs, gives the general approach structure of the administrative procedures. This includes recognizing key partners in the segment, characterizing their jobs, building up the modalities for granting contracts and setting the norms for the service providers. Within the framework provided by the Ministry of Local Government, the MMDAs award contracts for waste collection; determine the levels of service and charges; decide where to provide/who to receive what level of service; acquire equipment; and find land space for waste disposal (Ghana Ministry of Local Government and Rural Development, 2010). With creation of the current Ministry of Sanitation, the governance structure is even more complex due to managerial conflict between the Local Government and the Ministry of Sanitation in terms of who is in charge of waste management services. Thus, the need for appropriate governance structure that include an independent

authority in addition to a public health dimension is eminent. Another compounding challenge is the fact that, there is high costs of operation coupled with the increasing rate of waste generation due to high urban population growth rates; this has made it difficult for collection to keep pace with generation, thus posing serious environmental hazards and huge financial gaps.

The debilitating effects; spanning from health through socio-cultural to economic are enormous. Uncollected waste clogs drains leading to flooding and its deleterious health effects. Six (6) out of the top ten (10) diseases in Ghana are related to poor environmental sanitation, with malaria, diarrhea and typhoid fever jointly constituting 70%- 85% of outpatient cases at health facilities (Ghana Health Service, 2017; MLGRD, 2010a). For instance, malaria remains the number one killer in Ghana, accounting for 17,000 deaths, including 2,000 pregnant women and 15,000 children below the age of five", a quarter of all child mortality cases and 36% of all hospital admissions over the past 10 years" (World Health Organization, 2010). The Ghana Medical Association also stipulates that about five million children die annually from illnesses caused by the environment in which they live (Ghana Health Service, 2017). In Kumasi, a GHS (2010) report states that, "out of the cholera cases reported to health facilities, 50% came from Aboabo and its environs (Subin Sub-Metro) where solid waste management is perceived to be the worst" (Abalo *et al.*, 2017).

The reasons for the inability of most district assemblies to manage solid waste effectively can be attributed to weak governance and financing mechanisms.

Over the years, Municipal Assemblies have initiated a number of interventions towards sustainable solid waste management such as urban projects (KMA, 2015), however, the solid waste problem continues to increase day by day. A good governance and financing framework

brings about equity, effectiveness, efficiency and sustainability. A more appropriate governance and financing approach for solid waste management is therefore needed to address the current solid waste management challenges. In recent past, several studies on sustainable municipal solid waste management have focused on Public Private Partnership (PPP), Capacity building, socio-cultural and policy issue with little emphasis on sustainable financing and the governance structure of the waste management process.

There is also dearth of knowledge on predictors of the utilization of household solid waste services. Again, information on financing and governance for sustainable municipal solid waste management is patchy. Thus, this study assessed the level of utilization of household solid waste management services and socio-economic predictors, experiences, expectations and satisfaction among current users and providers of municipal household waste management services, using data from four regional capitals across Ghana. The study further sought to model appropriate governance and financing framework for effective management of household solid waste.

1.3 Rationale for the Study

Solid waste management has become a major developmental challenge in Ghana in recent time. This deserves not only the attention of the MMDAs and the waste management departments, but it also concerns corporate organizations and individuals to find a lasting solution to the challenge. This is because; vital human resources could be lost, strain on limited resources, money meant for other developmental projects could be lost through huge cost of waste management, diseases and absenteeism at work leading to low productivity in the country. City authorities are confronted with the challenge of ensuring sustainable financing mechanism for municipal solid waste management, especially at the collection, disposal and treatment stages.

There is also inadequate credible data to convince policy makers to introduce appropriate financial and governance structure that seeks to address the current challenge.

There is a potential crisis as challenges of waste management deepen. A high likelihood of perennial flood and its related diseases such as cholera outbreak, loss of property, resources and lives due to poor waste management practices. Waste management service providers are also saddled with huge receivables and high interest on loans to meet their escalating operational cost. Other challenges of waste management are difficulty in financing for the construction and management of engineered landfill sites or composting plant, and low capacity of households to pay realistic price for services. Consequently, a number of solid waste service providers are folding up their businesses because of huge debt owed by the MMDAs and households in lieu of municipal solid waste collection services and management of disposal sites. Provision of efficient waste management services is an integral part for the realization of the SDGs (Bentil, 2016) and thus must be tackled head on. There is therefore an urgent need to adopt an efficient governance and financing mechanism that is sustainable and acceptable by major stakeholders in provision of waste management services. This study seeks to generate empirical data to contribute to knowledge and for evidence that inform policy decision making in Ghana and other developing countries where municipal solid waste management financing and governance remain a challenge.

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1.4 Research Questions

1. What is the level of utilization of household solid waste management services in Accra, Kumasi, Takoradi and Tamale Metropolitan Assemblies in Ghana?
2. What is the current governance and financing options for household solid waste Management?
3. What is the implication of the current household solid waste governance and financing mechanisms for public health in the named Metropolitan areas?
4. What governance structure and financing model can best fit for Municipal household Solid Waste Management?

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1.5 Hypothesis

1. There is sub-optimal (<60%) utilization of household solid waste management services in major metropolitan assemblies in Ghana.
2. The current financing option for household solid waste management in major metropolitan assemblies in Ghana is acceptable for majority (>50%) of households.

1.6 Objectives

1.6.1 Main objective

To determine appropriate governance and financing model for household solid waste management in Accra, Kumasi, Takoradi and Tamale metropolitan assemblies in Ghana.

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1.6.2 Specific objectives

1. To assess the current level of utilization of household Solid Waste Management services.
2. To assess the current governance and financing options for household solid waste management.
3. To evaluate consumers' acceptability, ability and willingness to pay for household solid waste services.
4. To analyze the trends of environmental sanitation related diseases and their relationship with household solid waste management practices.
5. To develop appropriate financing and governance model for household solid waste Management.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Developing countries like Ghana are faced with multiple challenges spanning from corruption, social vices, weak systems, poverty and ailing solid waste management services. Metropolitan, Municipal and District Assemblies (MMDA's) are struggling to provide efficient waste management services. Hence, they resort to entering into public-private partnership to tackle the issue head on. Yet, waste management service related issues present as a huge developmental challenge. Weak capacities and systems to independently regulate waste management services between MMDAs and waste management service providers partly account for absence of appropriate financing mechanisms. This situation has culminated in huge receivables on the part of the waste management services providers, low capacity to pay realistic prices on the part of clients, fixing unrealistic prices by the MMDAs and absence of independent authority to regulate the activities of waste management service providers and other stakeholders. Due to the interconnectedness of waste management services to the realization of the SDGs, the current waste management services situation cannot be left unattended. The need for empirical evidence on appropriate financing and governance structure to facilitate efficient service provision is eminent. This chapter presents a review of literature on financing and governing structure for solid waste management services and their public health implications from different electronic databases such as PUBMED, MEDLINE, EMBASE, Psych INFO, Cochrane, Google Scholar and Web of Science and other published and unpublished documents. The search strategy specified keywords, including 'solid waste management', 'utilization', 'environment', and 'waste management governance' combined with 'Ghana or sub-Saharan

Africa or Low- and middle-income countries'. Electronic search results and all references were imported in Mendeley reference manager.

2.1 Overview of Solid Waste Management

As a results of increasing human population, growing urbanization and infrastructural developments, the amount of waste generation has steadily increased over the years (Kan, 2009). Humans rarely give a thought to the waste they generate and the health and environmental challenges waste poses. We often dump things we do not need after use and we lose track of its existence. Waste is generally referred to as those materials that are discarded, or are intended to be discarded (United States Environmental Protection Agency, 2018). It is also a common knowledge that, waste generation is a necessary and an unavoidable part of human life. Activities in various economic sectors of a nation leads to waste generation, thus waste is generally regarded as an unavoidable by-product of economic activity (European Environment Agency, 2003).

Waste generation has tremendous impact on the environment, resources and human health (Chuks *et al*., 2013). The severity of this impact depends on its quantity and nature (EPA, 1997; European Environment Agency, 2003). Waste materials are generated from manufacturing processes, industries and municipal solid wastes. Waste generation and management leads to air emissions, water and soil emissions, all of which potentially affect human health and the environment. It is therefore important that, the process of waste generation, disposal and treatment are identified in order to determine which important areas need critical attention. Even though waste is an issue in both the developing and the developed world, there has been no

comprehensive assessment of waste related issue (European Environment Agency, 2003) as a result of the lack of information and reliable data for critical assessments.

General management of waste involves the management of solid, liquid, gaseous or radioactive waste. A typical and traditional waste management system consists of collection, transportation, pre-treatment, processing, and final reduction of residues (European Environment Agency, 2003; Kan, 2009; UN-Habitat, 2010).

Measures to enhance waste reduction, recycling, reuse, and recovery should be paramount to countries like Ghana where improper waste disposal periodically leads to cholera, perennial floods and diarrheal diseases. Policy makers should promote waste management practices with financial incentives to strengthen already existing legislation. In the long term, reliable data collection is needed to aid policy decision in achieving sustainable waste management.

2.1.1 Solid waste utilization, management and practices

Waste management methods differ widely between different countries and regions. The management of Municipal Solid Waste (MSW) are often provided by local governments (UN-Habitat, 2010) and authorities (Kan, 2009) or by private industries. Proper disposal and management of solid waste reduce or eliminate negative impacts on the environment and human health. It also supports economic development and improves quality of life (United Nations, 2000, 2011). Factors such as waste monitoring, collection, transport, processing, recycling and disposal are the pillars of waste management in towns and cities (Hoornweg and Bhada-Tata, 2012). Different countries have different waste management arrangements. These arrangements have evolved with time. In Iceland for example, open pit burning was the main method of waste

disposal in the 1970s. This method included the adoption of one pit per municipality, and only three landfills in the country. Iceland's waste management practices changed in the 1990s when the nation joined the European Economic Area in 1994 and ratified the implementation of the EU legislation pertaining to waste management. Open pit burning was eliminated in 2003 and replaced with 29 landfills and seven incineration facilities with environmental permits. Since then, recycling and other ways of waste recovery have become more prominent. Over 58% of waste in Iceland is now recovered by various means such as material recycling, composting and incineration with energy recovery, while 42% are disposed of at landfills (OECD, 2013).

Lately, waste management in the US comprises hazard based basic leadership, and of hazard appraisal approach that was produced by the ecological insurance organization in the course of the last a quarter century. As logical confirmation rises, hazard evaluation strategy is always being checked on. It has as of late been extended to manage natural hazard, and is utilized to evaluate dangers to an extensive variety of wellbeing impacts in people and in addition in plants and creatures (EPA, 2009; Valaoras, 2000).

Solid waste management services in Ghana in the 1990s was the responsibility of the then Municipal Waste Department which was established in 1985 (Owusu Boadi and Kuitunen, 2003). In 1985, the Waste Management Department (WMD) of the Accra Metropolitan Authority (AMA) was established to augment the work of the municipal waste department in Accra. Due to constraints beyond the capacity of the WMD in addressing the issue of waste management in Accra, the WMD privatized 80 percent of waste management in Accra (World Bank, 1996). Presently, government association with a local company Zoomlion, has worked out an open private partnership in which Chinese innovation for recycling of waste has been

introduced (Anarfi, 2012). In Accra, this partnership has led to an estimated daily capacity of disposing 300 tons of wastes between the government and *Zoomlion* Ghana Ltd.

According to Singh and colleagues, (2014), the application of several functional elements such as generation, on-site storage, collection, transfer, transport, characterization and processing, resource recovery and final disposal of waste cannot be overlooked in a purposeful solid waste management system process. It is worthy to note that this multidisciplinary waste management process involves engineering principles, economics, urban and regional planning (European Environment Agency, 2003; Kan, 2009; Singh *et. al.*, 2014; UN-Habitat, 2010).

2.1.2 Classification, sources and types of solid waste

2.1.2.1 Classification of solid waste

This classification of solid waste (UN-Habitat, 2010) consists of the following:

1. *Industrial wastes*: Chemicals, paints, sand and explosives.
2. *Mining wastes*: Tailings, slug ropes, culm piles at mine areas
3. *Agricultural wastes*: Farm animal manure, crop residues and others
4. *Garbage*: putrescible wastes from food, slaughterhouses, canning and freezing industries.
5. *Rubbish*: non-putrescible wastes either combustible or non-combustible. These include wood, paper, rubber, leather and garden wastes as combustible wastes whereas the non-combustible wastes include glass, metal, ceramics, stones and soil.

6 *Ashes*: Residues of combustion, solid products after heating and cooking or incineration by the municipal, industrial, hospital and apartments areas.

7 *Large wastes*: Demolition and construction wastes, automobiles, furniture's, refrigerators and other home appliances, trees, fires etc.

8 *Dead animals*: Households pets, birds, rodents, zoo animals, and anatomical and pathological tissues from hospitals.

9 *Sewage sludge*: These include screening wastes, settled solids and sludges.

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2.1.2.2 Sources of solid waste

Traditionally, sources of solid wastes are categorized (United Nations, 2000) into the following:

1. Commercial: This mainly consists of grocery materials, leftover food, glasses, and metals, ashes generated from stores, hotels, markets, shops and medical facilities.
2. Institutional: The wastes generated from schools, colleges and offices include, paper, plastics, and glasses.
3. Municipal: This includes dust, leaf litter, building debris, and treatment plant sediments. These arise from various activities like demolition, construction, street cleaning, land scraping etc.
4. Agricultural: This mainly includes spoiled food grains, vegetables, grass, litter etc., generated from fields and farms.
5. Residential: It refers to wastes generated mainly from dwelling, apartments, and consisted of leftover food scrapes, vegetables, peeled material, plastics, wood pieces, clothes and ashes.

2.1.3 Solid waste management process

Solid waste management process refers to the process in which solid waste management is achieved (United Nations, 2000; United Nations Environment Programme, 2005). To a large extent, the solid waste management process relates to all the administrative, financial, legal, planning, and engineering functions involved in finding solutions to tackling waste problems. The solutions may involve complex interdisciplinary fields which include political will, city and regional planning, geography, economics, public health, sociology, demography, communications, and conservation, as well as engineering and material science (UN-Habitat, 2010). The key components of solid waste management are;

2.1.3.1 Waste generation

Several tons of solid waste are generated in various capital cities in Ghana. The waste end up in open dumps and wetlands, contaminating surface and ground water and posing major health hazards. This is the stage in which materials become valueless to the owner and hence of no importance use anymore and for which reason they want to get rid of it. Waste generation rates are available only for selected cities and regions where good systems are in place. Determining actual MSW generation rates may be a daunting task. Several studies have reported a wide variation as they use different components. In Africa solid waste may not be collected by municipal collection systems because of poor management, fiscal irresponsibility or malfeasance, equipment failure, or inadequate waste management budgets (United Nations, 2011).

2.1.3.2 Waste collection and transport

Municipal Solid waste collection and transportation involves storage at the generation and pick-up points, waste collection officers, trucks driving around the neighborhood, and truck transport to a transfer stations or disposal sites (Singh *et al.*, 2014). The collection is difficult, complex and costly. Wastes from our homes are general collected by local authorities through regular waste collection, or by special collections for recycling. Waste should be collected regularly to control fly breeding, and the harboring of other pests in the community in hot climates such as Ghana. The following factors should be considered when deciding on frequency of collection: odours caused by decomposition and the accumulated quantities. In Ghana, waste collection is mainly done by the municipal authorities as well as private institutions who partner government for waste management (Anarfi, 2012). The most common waste collection methods in residential areas include curbing or alley, setout-setback, and backyard carry (Singh *et al.*, 2014). In curbing or allaying service, the residents carry the single-use plastic bags and containers to the curb or collection point, and then return the empty container after pickup. For setout service, crew are utilize to carry the containers to the collection point. A separate collection crew empties the containers and residents return the empty containers. In setout-setback service, a third crew returns the empty containers. In backyard carry service, the collection crew transfers the solid waste into a wheeled barrel, and then unloads it into the collection truck. The containers remain in the backyard.

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2.1.3.3 Waste recycling and reuse

Recycling refers to the removal of items from the waste stream to be utilized as raw materials in the manufacture of new products (UN-Habitat, 2010). Recycling occurs in three phases: firstly, the waste is sorted and recyclables collected, the recyclables are used to create raw materials. These raw materials are then used in the production of new products. The major advantages of recycling and recovery are reduced quantities of disposed waste and the return of materials to the economy. In many developing countries, informal waste pickers at collection points and disposal sites recover a significant portion of discards. Related Green House Gas emissions come from the carbon dioxide associated with electricity consumption for the operation of material recovery facilities.

The sorting of recyclables may be done at the source (i.e. within the household or office) for selective collection by the municipality or to be dropped off by the waste producer at a recycling centers. The pre-sorting at the source requires public participation that may not be forthcoming if there are no benefits to be derived. In addition, a system of selective collection by the government can be costly. It would require more frequent circulation of trucks within a neighborhood or the importation of more waste separation at the source of production vehicles to facilitate the collection.

2.1.3.4 Waste treatment and disposal

According to (Singh *et al.*, 2014), waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of. Methods of treatment are selected based on the composition, quantity, and form of the waste material. Some waste treatment methods used

today include subjecting the waste to extremely to high temperatures, land filling and use of biological processes to treat the waste. Treatment and disposal options are chosen as a last resort to the previously mentioned management strategies such as reducing, reusing and recycling of waste. Disposal is the final stage in the solid waste management, and all the wastes whether they are residential, commercial or from any other sources are collected and transported to a disposal site.

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In third world countries, solid wastes are disposed around cities and towns along the roads, which gave rise to several problems like pollution due to smoke, water pollution due to leachate, blockage of drains and sewers due to plastics and health hazards to workers and rag pickers and humans living nearby areas (Nagarajan, Thirumalaisamy, & Lakshumanan, 2012). The amount of waste generation is high, the municipalities struggle to collect the waste and give less importance to disposal. They may not be having sufficient funds to pay the salaries of staff. The municipal corporations are inefficient in managing the waste due to various reasons. It may be due to corruption at all levels, or due to lack of political will to fund the practice of solid waste management. Many government authorities give less priority to waste management and do not reserve any funds for it. Wide ranges of options are available for the safe waste disposal. These include open dumping, sanitary dumping, composting, incineration, gasification, refuse derived fuel and pyrolysis.

2.1.3.5 Integrated solid waste management

"Solid waste management continues to be an issue of interest due to an increase in population growth in several cities of the world. This growth is accompanied by economic development characterized by greater use of materials and generation of wastes. This has led to ever increasing quantities of domestic solid waste while space for disposal decreases. A national strategy for the management of solid waste, called the Integrated Solid Waste Management (ISWM) which is the combination of techniques and programmes to efficiently manage the municipal waste streams is developed" (Weinstein, 2006). This system requires a sustainable consideration in managing solid waste. Integrated solid waste management is a conceptual framework that aims to provide guidance on waste management and waste reduction. It proposes a waste management hierarchy that ranks waste management options in order of sustainability, from the most favoured option to the least favored option. The first priority for a more sustainable waste management is *Prevention and Minimization*.

Integrated solid waste management requires the combination of waste management techniques to treat the different types of waste in ways that are environmentally, financially and socially sustainable. It also depends on collaboration among all the organizations and individuals involved in waste management (Klundert, 1999). The concept of integrated waste management hinged on four principles; sustainability, efficiency, effectiveness and equity.

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Equity

Paramount to the allocation of resources, services and opportunity to all segments of the population according to their needs is an effective waste management system. In waste management, this means that everyone has a right to be served by a waste management system that protects his or her health and the environment. Pollution travels and does not respect area boundaries. The neglect of one area can cause a much larger area to suffer (Nagarajan et al., 2012).

Effectiveness

Generally, effectiveness means that all the waste are collected and disposed of in a safe manner. Once this has been achieved, higher-level aims such as maximizing waste recycling and composting should be addressed. Again, a waste management system is only effective if it covers every part of the city or town (Weinstein, 2006).

Efficiency

Generally, efficiency refers to increasing output for a given input, or minimizing input for a given output. An efficient waste management system is one that is equal and effective while making the best use of the resources available (staff effort, use of equipment and cost) (Weinstein, 2006).

Sustainability

To achieve sustainability in waste management, it must be effective to last a long time. To achieve sustainability, social, environmental and economic factors must be considered. Sustainability of the waste management system can be achieved if it is appropriate to the local conditions and can continue in the long term by using the human, financial and material resources. It should also be environmentally sustainable in that it minimizes the use of non-renewable natural resources and does not lead to long-term environmental challenge that can affect future generation. This principle if well implemented in an integrated solid waste management, should lead to protecting public health and the environment, lessen the borders of future generations, and conserve resources. (Weinstein, 2006).

2.1.4 Regulatory framework for solid waste management

There are several policies regarding the management of solid waste. These includes the well-established and profound principles such as 'polluter pays', 'prevention' and the 'precautionary principle' which have been applied by various Governments internationally, with an aim to control waste generation as well as minimizing the negative effects on health and environment. These initiatives are generally called the waste management 'policy and regulation' which consist of government legislation mandatory as well as voluntary schemes.

This section aims at reviewing relevant waste management policies, legislations and regulations at the global level, national level and specific cities in Ghana.

2.1.4.1 Global regulatory framework for waste management

Internationally, the primary direction in regards to solid administration (waste electronic management) incorporates the Basel Convention on the control of Transboundary Movement of Hazardous Wastes and Disposal (Choksi, 2001). The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" such as household waste and incinerator ash (Choksi, 2001). The ratification of this convention mandates countries to solve the challenge of transboundary movement and disposal of hazardous wastes through international cooperation. The regulatory system of the Convention ensures that it achieves its aims and provisions. Based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement.

The Convention also provides for the establishment of regional or sub-regional centers for training and technology transfers regarding the management of hazardous wastes, other wastes, and the minimization of their generation to cater for the specific needs.

For France, strategy on waste management is similar to its natural arrangement when all is said in done, is firmly impacted by Community approach. It has logically expanded its goals: open cleanliness, security, decrease in the ecological effect of various medicines and, all the more as of late, avoidance and reusing. These main orientations are contained in the July 15th 1975 law amended by the July 13th 1992 law on elimination of waste and recovery of materials. Furthermore, waste treatment and elimination facilities are considered as classified installations

in France that is installations that may represent dangers or inconveniences for locals in terms of health, safety, public health, agriculture, protection of nature or the environment, and conservation of sites and monuments 2008/98/EC), environment with a view to reducing it.

Waste management in South Africa depends on the standards of government White Paper on Integrated Pollution and Waste Management (IP&WM) and the National Waste Management Strategy (NWMS) distributed by the Department of Environmental Affairs and Tourism in 1999 and 2000 (Department of Environmental Affairs and Tourism, 2000). South Africa supports the waste hierarchy in its approach to waste management, by promoting cleaner production, waste minimization, reuse, recycling and waste treatment with disposal seen as a last resort in the management of waste. According to the policy, recycling of waste refers to the separation at source of recyclable materials from the general waste stream and the reuse of these materials (Edison Muzenda, 2012). The objectives of recycling are to save resources as well as reduce the environmental impact of waste by reducing the amount of waste disposed at landfills. To meet these objectives, waste separation at source is proposed, as the quality of recyclable materials is higher when separated at source. In addition, recycling ensures job creation and is a viable alternative to informal salvaging at landfills, which is undesirable due to the problems of health and safety associated with salvaging (Department of Environmental Affairs and Tourism, 2000). In terms of regulations, this policy consists of a range of regulatory instruments that draw on direct controls and permits, market based instruments, land-use planning and controls, and voluntary agreements. These instruments are used in an integrated manner to maximize effective integrated pollution and waste management. A law reform process to identify all the requirements for new and amended legislation pertaining to all aspects of the environment took place in 2000. The government also considered the ratification of outstanding international

conventions on integrated pollution and waste management with a view to giving specific legislative effect to them (Department of Environmental Affairs and Tourism, 2000).

2.1.4.2 National regulatory framework

Waste generated is sent to a few dumpsites, but majority ends up in drains, streams and open places. Waste is normally disposed of in open dumping, open burning, controlled burning and tipping at dumpsites. This has created a pressing challenge as many towns and cities are overwhelmed with management of solid and liquid wastes (Department of Environment and Water, 2010). The waste management situation leaves much to be desired. Less than 40% of urban residents are served with solid waste collection services and less than 30% have an acceptable household toilet facility. (Department of Environment and Water, 2010). Over the years, the government of Ghana in her efforts to address the waste management challenges has developed various strategies and solutions that are still very relevant. In an effort to address the problem of waste management, successive government have over the years put in place adequate national policies, regulatory and institutional frameworks. An Environmental Sanitation Policy was formulated in 1999. This policy has currently been amended and strategic action plans developed for implementation. Various relevant legislations for the control of waste have also been enacted. These include the following:

1. *Local Government Act, 1990 (Act 462)*
2. *Environmental Assessment Regulations, 1999 (LI 1652)*
3. *Criminal Code, 1960 (Act 29)*
4. *Water Resources Commission Act, 1996 (Act 522)*
5. *Pesticides Control and Management Act, 1996 (Act 528)*

6. National Building Regulations, 1996 (LI 1630)

The District Assemblies are the key institutions responsible for the management of sanitation and waste at the local and community level. They are however, supported in this task by a number of other institutions and organizations. The Environmental Protection Agency (EPA) gives technical support to the District Assemblies by setting environmental standards and guidelines on waste management; administration of Environmental Assessment Regulations; undertaking environmental education and awareness programs; and monitoring environmental quality (Kuuzegh, 2014). Ghana Environmental Assessment Regulations, 1999 (LI 1652) make provisions for existing undertakings, which are required to submit Environmental Management Plans. A National Environmental Sanitation Policy Co-ordination Council has been established within the Ministry of Local Government and Rural development to oversee to the implementation of the policy objectives. Several guidelines for management of solid waste have been developed. These include, the guidelines for the Management of Health Care and Veterinary Waste in Ghana, July 2002, the Ghana Landfill Guidelines, July 2002, Manual for the Preparation of District Waste Management Plans in Ghana, July 2002, guiding Various Waste Management (Facilities) projects through the Environmental Impact Assessment (EIA) Process, field visit with members of the Parliamentary select committee on Environment Science and technology to some selected dump sites in Accra on 27th July 2011, the Closure and Decommissioning of Some Dumpsites, even though a few dumpsites have been closed e.g., Oblogo, Sarbah Anyaa dumpsites and Teshie compost plant and the National Source waste Segregation Program.

A report on waste management in Ghana (Kuuzegh, 2014; UN, 1999), on critical review of the current waste management policies, plans, and programes and implementation have revealed

that there has been a general reluctance by District Assemblies and the private sector to invest directly in waste infrastructure.

This review also identifies policies and byelaws pertaining to solid waste management in the city of Accra, Takoradi, Kumasi and Tamale.

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2.1.4.3 Accra Metropolitan Assembly regulatory framework

Evidence shows that municipal wastes in the Accra metropolis have been regulated, largely through the implementation of the Local Government Act, (Act 462), 1993 (Kissi, 2012). Regrettably, however, legislation in particular has not been able to keep pace with the mounting socio economic demands on the Accra Metropolitan Assembly (AMA) in addressing the environmental deterioration, more especially, the increasing burden of solid waste. It is apparent that no comprehensive legislative framework exists specifically, to address the problem of plastic wastes generated locally in households, manufacturing industries, market places, street comers, public places.

The existing legislation, however, is a piece of byelaw of the Accra Metropolitan Authority entitled: Solid Waste Management Bye Laws, 1991 (EPA, 1997). Although a byelaw may provide a useful basis on which to proceed in spite of its inadequacies, managing waste goes beyond the formulation and enactment of legislation. The AMA's has tried to pursue policies including, the disposal of garbage by private contractors (Domfeh, 1996). The pursuit of such policies and programs require the adoption of appropriate institutional and legislative frameworks. It has been indicated already that the above notwithstanding, the institutions to pursue such policies and legislative frameworks lack the capacity for such exercises. Indeed,

where policies and legislation have been applied, enforcement has proved elusive. Available literature on Accra's environmental issues has proved that the use of prosecution as a means of achieving behavioral change is fraught with a lot of difficulties and disappointments (Kissi, 2012). There is however a lack of data or information on the regulatory framework for cities such as Kumasi, Takoradi and Tamale.

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2.1.5 Inclusivity/ public participation in waste management decision-making

Solid waste management requires open strategy with a built up general objective, directing standards and basic leadership criteria to advise techniques for accomplishing the set up objectives. The general objectives behind the arrangement plan incorporate the assurance of general wellbeing and the earth (United Nations Environment Programme, 2015). A policy that is as a result of engaged stakeholders seeks agreement to its processes and practices with those who are a party to, or otherwise affected by, its decisions. These include not only a few powerful stakeholders but also others. Hence, the term governance is used here to denote institutions and processes, both formal and informal, which provide for the interaction of the state with a range of other actors or stakeholders affected by the activities of government.

Governance concept should embrace an inclusive consideration of all stakeholders (United Nations Environment Programme, 2015), with a particular emphasis on the involvement of the people in decision-making process, including those in underprivileged and poor communities. The interests and roles of a several kinds of stakeholders, and how these roles and are express represent good governance in waste management. Governance is about responsibility and should be expressed through various legal, financial and obligations, but also through a sense

of 'ownership' of waste-related issues, which is translated through involvement and care about the cleanliness of the towns and the community as well as protection of the broader environment and natural resources. A strategic waste management plan will be substantially better if it acknowledges local realities including waste composition, climate, culture, customs, characteristics of the local commodities market, level of technical expertise. (Akaateba and Yakubu, 2013; Carlos *et al.*, 2000; Otoo *et al.*, 2014; United Nations Environment Programme, 2015).

For the management decision or policy to have a higher chance of being accepted and owned by the community, stakeholders must be involved in the planning process. In this manner, stakeholders can get involved, contribute their knowledge and ideas, express their concerns, explain their needs and expectations, and come out with issues that are beneficial to their community. In such a process, the claims of different interests can be questioned, tested and validated or refuted; different values and perspectives can be incorporated. It is also important to keep fostering local feedback through a good communication among stakeholders. This could reveal valuable insights and experiences, allow activities to evolve from this interaction, and strengthen the system from within. This is characteristic of a governance form that adopts an inclusive approach to formulation of strategies and policies, based on complex adaptive systems thinking (United Nations Environment Programme, 2015).

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2.1.6 Waste as a public good

One of the reason it is necessary to develop an effective waste management services is the 'public good' nature of waste management. Public goods" are products that people in a society jointly create and jointly pay for. If a householder fail to pay her waste to be collected, she could still access the service by putting the waste in a neighbor's bin, or in a street litterbin, or by taking the waste to the work place where there is access to MSWM services. If some citizens' escape from their responsibilities for MSWM, they themselves may escape some costs but will cause harm to others and to society as a whole. If a householder dumps or burns his waste, he may avoid paying for the waste service, but the public health and environmental impacts affect everyone in the neighborhood. Waste management is a utility service that does not allow for disconnecting users who do not pay without affecting others, unlike other public or utility services that run on separate meters. If users of the service are paying for collection there is a clean environment but accumulation of waste in the nonpaying neighbor's yard impacts the users who regularly pay for the service (United Nations Environment Programme, 2015; Weng and Fujiwara, 2011a).

Municipal solid waste is neither a private good (a resource) nor a public 'bad' (a burden); it always has elements of both. It always contains both valuable items and residual waste that requires (expensive) management to protect the public. It is considered in economic terms as an impure public good (United Nations Environment Programme, 2015).

2.2 Theoretical Underpinnings and Conceptual Framework

2.2.1 Wilson's sustainable solid waste collection

To address the challenge of inappropriate governance and financing of municipal solid waste management, this study was conceptualized around sustainable waste management principles. Wilson (2007), derived a conceptual framework for analyzing sustainable waste management that was adopted by Oduro-Kwarteng (2011), (figure 2.1). The conceptual framework asserts that sustainable solid waste management constitute six components. The framework has policy, legal and institutional contexts as the first step in achieving sustainability: Per the framework, institution produces the legal and policy direction for managing waste. The policy and legal direction produced define the roles of both the private and public sector in the waste management business (Schübeler, 1997). The second component in this framework focuses on the evolvement of the Private Sector Involvement (PSI) in waste management, the role of the public sector and the relationship between the two sectors in the business. This component also details how residents are involved in waste collection and their level of awareness as well. Indeed the relationship between the public and private sectors is seen as a tool in ensuring success in waste management (Oduro-Kwarteng, 2011).

Component three on the framework focuses on the performance of the private sector. The performance of the private sector provides revelations into productivity and service quality in the delivery of sustainable solid waste management. Components four and five both lay emphasis on the private sector. Whilst component four focuses on private sector capacity, component five on the other hand details regulations of the private sector and its associated contractual obligations. The orientation of component four is to identify the performance

motivators and vice versa which include human and material resources available to players in the private sector. Though component five has a spotlight on the private sector, the public sector is not neglected as their contractual rights and obligations are dealt with.

As already pointed out, the above components all form part of a driving force towards achieving component six. At this stage, the framework is reviewed and changes are effected in the policy and legal contexts if need be.

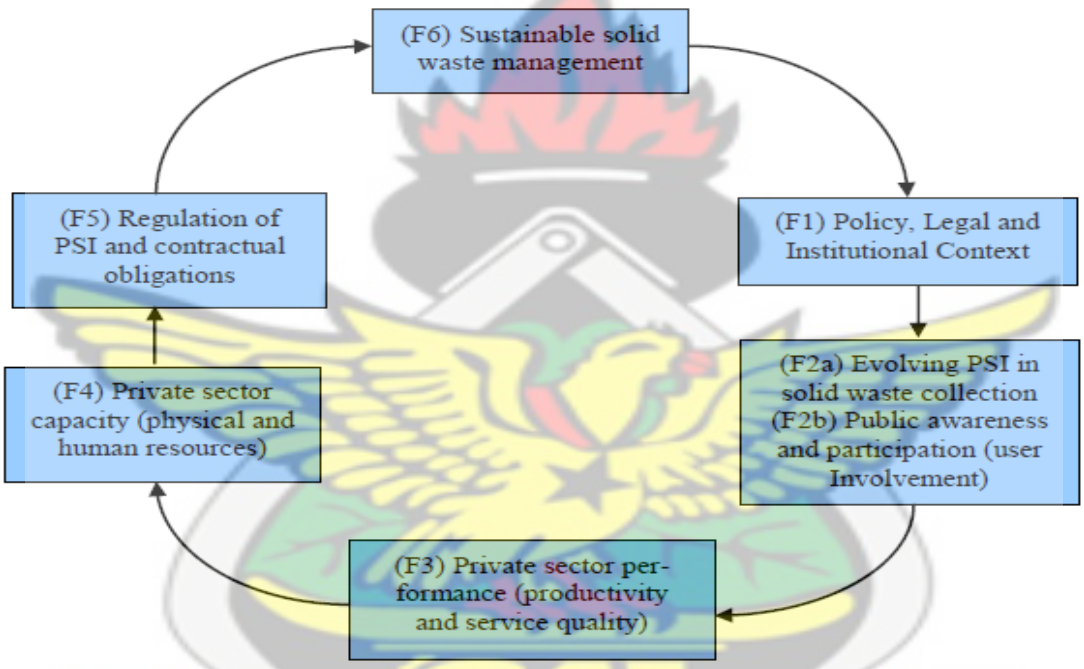


Figure 2.1: Conceptual framework for analyzing sustainable solid waste collection

Source: Wilson *et al* (2001).

2.2.2 Operator model

This concept is one of several integrated solid waste management (ISWM) models aimed at sustainable waste management practice. The concept aims at understanding and classifying diverse means in which waste management service across the globe are conducted. Operator model concept is localized though established by national institutional regulations, policy makers and planners. It is important to stress that, the Wilson model which was later adopted by Oduro-Kwarteng (2011), was not explicit on the inter-relationship that exist in terms of institutional arrangements such as agreements and contracts, responsibility, decision-making, as well as the flow of resources, especially financing mechanisms amongst client, revenue collector and the operator or service provider. These gaps are among key drivers that necessitated further study leading to conceptualization of the Operator model.

2.2.3 The GIZ operator model for sustainable solid waste management

The Operator Model is postulated by the GIZ (2013), as the systematic analysis of the inter-relationship that exist between agreements and contracts, responsibility, decision-making, money flows and management between client, revenue collector and the operator (See figure 2.2). In summary, the composition of an operator model includes the client, revenue collector and the operator or provider (GIZ, 2013).

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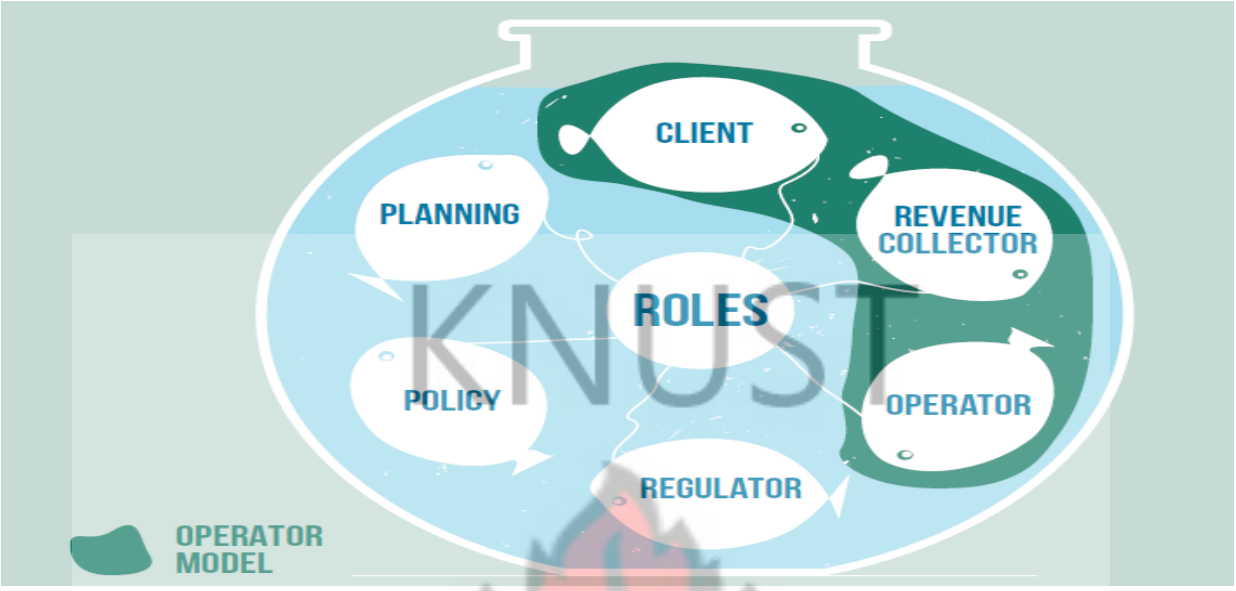


Figure 2.2: Roles and responsibilities in providing solid waste management services

Source (GIZ, 2013).

The key actors in the model are the operator, regulator, revenue collector, and client. The operator is the service provider who provide the waste management services to the clients.

- **Planning:** responsibility for strategic and operational planning and general programming and control.
- **Operator:** responsible for delivery of the MSW management service on the ground
- **Revenue Collector:** responsible for collection of revenue for ISWM
- **Regulator:** responsible for monitoring and compliance with legal standards for environmental protection with respect to ISWM
- **Client:** responsible for ensuring the provision of a reliable ISWM system meeting the required standards
- **Policy:** the framework set at National level and implemented at Regional and Local levels within which ISWM are delivered

2.2.4 Comprehensive Municipal Solid Waste Governance and Financing Mechanism

The current study draws inspiration from the two major concepts described above. The sustainable solid waste management concept developed by Wilson, 2001), adopted by Oduro-kwarteng, 2011 which had six components and the operator model concept adopted by GIZ, (2013). This study postulates that sustainable solid waste management depends on willingness-to-pay on the part of client, and a robust financing mechanism on the part of providers. The ability and willingness-to-pay for solid waste management services is a key function of sustainable financing. Policy and legal framework are required to regulate and provide a benchmark for carrying out solid waste management services in the country. This ensures proper integration of duties of all stakeholders in service delivery. The quality of services rendered becomes a function of revenue generated when more customers are enrolled in the services rendered. However, the current situation suggest that the service providers do not have much power on fixing what they term realistic price needed for sustainable financing for the provision of solid waste management services. Not only that, clients are not responsive in paying realistic price yet they demand quality services. The government represented by the MMDAs is reluctant to give providers ample platform to argue for realistic price. The service provider in desperation of continuity of his business vis-à-vis commanding political support succumb to the unrealistic price fixed by the MMDAs. Another interesting dimension, which is often ignored, is the regulatory aspect of solid waste management services. It appears the MMDAs is a player and at the same time a referee, this is unhealthy to the other stakeholders; clients and service providers.

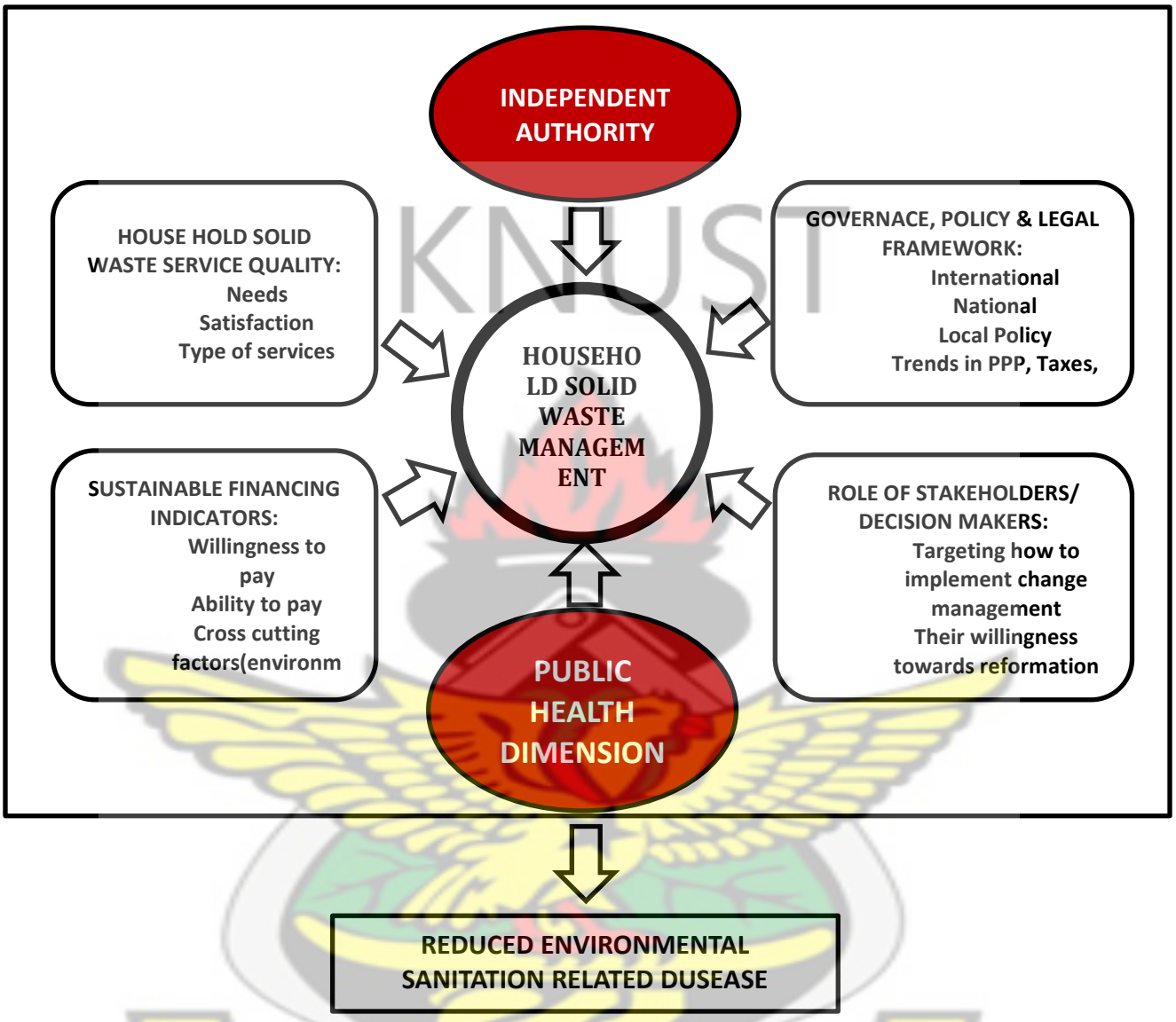


Figure 2.3: Conceptual framework for household solid waste management

Source: Author's construct, 2017.

The issues mainly addressed by the concept are; the legal and policy issues, service quality and utilization, inclusivity and sustainable financing indicators. This framework shows that a policy framework at National level and implemented at Regional and Local levels within which

integrated solid waste management system are delivered is key. The role of various actors and stakeholders is also key to an efficient solid waste management system and an improved SWM. Actors involved in the waste management should be identified and included in the decision making process. Service quality must also be ensured for improvement in utilization to ensure payment and financial sustainability of the waste management business.

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To ensure sustainable financing, clients must show commitment and the ability-to-pay for the charges associated with the services rendered. The mode of payment must also be flexible and transparent to ensure that all stakeholders benefit. All stakeholders are to show good faith in their various roles to ensure frequent generation of the needed revenue. The need for inclusivity is very important for acceptability of concept. All stakeholders especially decision makers must be involved to ensure sustainability and acceptability.

The standpoint of this study is that not all the pillars in Fig (2.2) are taken into consideration in fixing price for solid waste management service and hence the price is unrealistic. The consequences are weak capacities, escalating operating cost, poor service provision, flooding, increasing episodes of sanitation related conditions and huge cost incurred in disaster management. The most worrying aspect is the neglect of public health dimension of implications. The exclusion of public health implications from the current solid waste management service provision shrinks the magnitude of the deleterious effects of poor provision of solid waste management. Thus, the public and other stakeholders are deceived, which affects commitment and release of energy and other resources needed for high quality service provision.

2.3 Utilization of Household Solid Waste Management Services

Understanding the interplay of factors associated with household utilization of solid waste is critically important to control the growing solid waste problem in developing countries. The linkages among the socio-economic factors and attitudes toward waste have an influential role in solid waste service utilization. Most studies have shown that attitude, knowledge, demographic variables, and personality traits are significant determinants of household waste management adoption and practice (Chu & Chiu, 2003; Schultz, Oskamp, & Mainieri, 1995). Education, accommodation type, age, and other related socio-economic variables are significantly linked to household waste management decisions in Ghana (Otoo *et al.*, 2014).

Poverty, affordability, willingness-to-pay for services, age, and ethnicity have also been shown to significantly influence waste-recycling behavior (Bernstein, 2004). While the results have been mixed, substantial evidence points to socio-economic status as an important predictor of household recycling behaviour. In Kumasi Metropolis, a study indicated that the most important factor for utilizing waste management services was awareness of existing waste management services (Otoo *et al.*, 2014). Knowledge of WMS provider's availability significantly increased the odds of utilizing the services. Factors such as waste disposal and cost of waste disposal were also significant factors of whether or not households utilize available waste management services. Household utilization of waste management services were low in the Kumasi metropolis due to inability to afford the cost of services or not being aware of existing companies offering such services (Otoo *et al.*, 2014). This shows that, creating awareness on waste management services, and ensuring the households register with WMS providers, remain critical steps towards solid waste management campaigns.

Affordability of services provided play an important consideration for households. Even though education and awareness creation have links with decision making regarding waste management, it is also important that municipal authorities adopt a pricing policy for private waste service companies so that poor households can equally afford (Otoo *et al.*, 2014). A shared pro-poor waste management pricing policies will give incentives to residents to participate in waste management.

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2.3.1 Factors influencing waste management service utilization

According to Bernstein, (2004), individuals' waste-recycling behaviour is influenced by several factors some of which are discussed below.

2.3.1.1 Poor socio-economic status

Substantial evidence indicates that, poor socio-economic status is an important predictor of household recycling behavior. Poverty, affordability, willingness-to-pay for services, age, and ethnicity are socio-economic indicators that significantly influence waste-recycling behaviour. Rating socio-economic position as poor has been found to be associated with low utilization of SWM services (Bernstein, 2004).

Education, which is linked to socio-economic status (Jamison *et al*, 2006) was also associated with use of SWM services. Compared to those with no form of education, having a tertiary education was associated with higher odds of utilizing SWM services. The highly educated have higher income, improved socio-economic status (Jamison *et al*, 2006), and are therefore more likely to pay and utilize SWM services.

Apart from economic empowerment, educated individuals have positive perceptions and are more likely to understand the public health implications of indiscriminate waste disposal (Banjo, Adebambo, and Dairo, 2009; Purcell and Magette, 2010; Boada *et al.*, 2014).

In Ghana, low education is believe to contribute to poor waste management practices (Yoada et al., 2014) and high education is positively linked to the willingness-to-pay for improved SWM services (Awunyo-Vitor *et al.*, 2013). A study revealed that, waste disposal and cost of waste disposal were also significant factors of whether or not households utilize available waste management services. Previous studies have however indicated that the use of SWM services is dependent on the ability-to-pay for the services (Addai and Danso-Abbeam, 2014; Awunyo-Vitor *et al*., 2013).

2.4.1.2 Place of residence

The type of residence was also significantly associated with the utilization of SWM services in Ghana. Residing in an urban environment was associated with higher odds of using SWM services as compared to those who reside in peri-urban settlements or inner city slums (Zhu *et al.*, 2007). Boateng *et al* (2016), also found that the location of the household significantly affects the utilization of SWM services in Ghana. SWM service providers and Assemblies waste collection systems of cities in developing countries generally serve only a small part of the urban population, leaving the low income in urban areas and those living in rural areas (Zhu *et al*., 2007). This is attributed to the inadequate financial resources and work force to cope with the higher amount of waste generated by growing urban cities, leaving the SWM service providers to limit operations to high income urban.

A study conducted in Kenya for instance found that services of SWM companies were often concentrated in the more affluent areas who were more likely to pay for their services due to inadequate man-power to cover entire cities (Henry *et al*., 2006). Compared to those who reside in Estates, residing in new sites, Inner city or Old town and Slums or Zongos was associated with lower odds of utilizing SWM services. Dwellings in the inner cities and Zongos make it difficult for SWM companies to operate within these settlements. Narrow roads in these areas may not have space for locating storage bins and may be so narrow, treacherous or irregular for motorized collection, making it impossible to use vehicles. On the other hand, houses in New sites have considerable distances from the nearest accessible road and pose particular problems in receiving adequate waste services. SWM, with limited financial, technical and human resources are unable to extend their services to these areas, where there is not enough financial rewards to do so (Mwanthi *et al.*, 1997).

Parrot, Sotamenou and Dia, (2009), suggested the establishment of transfer stations through the collaboration of communities to reduce transport costs incurred by SWM companies whiles increasing services.

2.3.1.3 Knowledge of utilization services

Household utilization of waste management services are associated with being aware of existing companies offering such services. One of the important factors influencing utilization of waste management services was awareness of existing waste management services (Otoo *et al*., 2014). Knowledge of WMS providers significantly increased the odds of utilizing the services.

This shows that awareness creation about waste management services and ensuring the households register with service providers, remain critical steps towards improving the yield of household solid waste management. Affordability of services may be an important consideration for households already in the known of waste management services. Even though education and awareness creation have relationships with decision making regarding waste management, fixing an affordable and realistic price for private waste service companies is very critical (Otoo *et al*., 2014). Pro-poor waste management services may entice providers to enroll their services.

2.4 Consumers Acceptability and Willingness-to-pay for Household Solid Waste Services

2.4.1 Predictors of willingness-to-pay

Previous studies have demonstrated that, the willingness-to-pay for waste management services is influence by a number of factors such as socio-economic, knowledge and household income levels. Most of these studies utilized different model estimation techniques including logit and binomial logistic regressions.

Das *et al* (2008), conducted a study to inform efficient and effective solid waste management to improve local environmental quality and public health through the application of the Discrete Choice Experiment Method in West Bengal, India. The best fitting random parameter logit with interactions model revealed that there is significant conditional and unconditional heterogeneity in residents 'preferences for improvements in SWM services. The results revealed that on an average resident of these municipalities were WTP significant amounts, in terms of higher

monthly municipality taxes, to increase the frequency of waste collection, and to ensure that covered trucks collect the waste.

Awunyor-Vitor *et al* (2013), conducted a study to determine the factors influencing willingness-to-pay for improved waste management services using Logistic regression model and Tobit model. The logistic model shows that income, age, number of children, quantity of waste generated, and education have significant effects on the willingness-to-pay, while the amount of money the households are willing to pay was influenced by their income, quantity of waste generated, education, house ownership, and number of children.

Based on the findings it was recommended that the District Assembly could increase waste collection fees between GHC3 and GHC5.00 to improve waste management within the metropolis.

Subhan *et al* (2014), assessed attitudes and behaviour towards the improvement of urban solid waste management in Malaysia using the Contingent Valuation Method (CVM). The study found that the households were willing to pay for the improved services. The results of the regression model indicated that age, race and income had significant relation to the willingness-to-pay for the improved services.

Household income and poverty

Thirumarpan,(2016), using a binomial logistic regression confirmed that, household willingness-to-pay for improved solid waste management in Sri-lanka, is significantly and positively influenced by average household income, expenditure and household size.

Nkansah *et al* (2015), conducted a cross sectional survey of a sample of 156 households in Tema Metropolis using Contingent Valuation Method. A tobit regression was used to estimate the determinants of willingness-to-pay for improved solid waste management and found that income influences the willingness-to-pay for sanitation improvements.

Naeem and Amin (2013), in order to find out household willingness-to-pay for solid waste management in district Peshawar in Pakistan, Binomial logit Regression model was used to show that income has significant impact on households' willingness-to-pay.

Socio-demographic characteristics

Thirumarpan (2015), found an influence of gender on the willingness-to-pay for improved waste management. Nkansah *et al* (2015), also found that WTP for improved sanitation services was influenced by educational level, number of dependents and household size.

Naeem *et al* (2013), using binomial logit regression model also found that education, awareness, households size and diseases history have significant impact on households willingness-to-pay in Pakistan.

Amfo-Otu et *al* (2012), also conducted a study to assess the willingness-to-pay for solid waste collection in semi-rural Ghana. By employing the logistic regression model, study found that mode of waste collection; occupation and age have a significant effect on WTP. It was recommended that the district authorities should consider these parameters in prescribing most affordable mode of collection in order to get the support from the members of the society.

2.4.2 Economic valuation of waste management services

"Economic valuation of externalities that impact on ecological systems and human life can provide an indication of whether environmental policy fits the needs of public preferences" (Eshet *et al.*, 2005). Economists have developed several concepts for monetary valuation of externalities. With the exception of some methods that assign approximate values to externalities. There are different ways of valuing externalities concerning waste management

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2.4.2.1. Direct methods (stated preference)

The direct valuation methodology assumes that the consumer is the best judge of his best interests, and that he is able to make realistic choices based on his preferences, although he does not actually make any behavioural change (Shechter, 1999). Some of these methods are benefits transfer, experts' assessment of damage cost, indirect, choice modelling, and contingency valuation methods;

a. Contingent valuation method

Contingent valuation method (CVM) is a survey method in which people are asked directly to state their willingness-to-pay (WTP) for a benefit or to avoid a cost, or conversely on their willingness-to-accept (WTA) to forego a benefit or tolerate a cost, regarding a specific situation or policy [occasionally hypothetical (hence, 'contingent')] in which they are assumed to behave as though they were in a real market. The average WTP represents the related external cost/benefit (Pearce & Howarth, 2000).

b. Discrete choice modelling

Discrete Choice modelling methods represent a broad term for survey methods asking individuals to rank/rate/choose alternatives rather than explicitly express a WTP or WTA. A number of attributes, of which one will be monetary, characterizes each alternative. A baseline status quo alternative is usually included to help establish the other alternatives in relation to the respondent's actual experience. It is generally assumed that choice modeling approaches are preferred over CVM in contexts where it is important to value individual attribute.

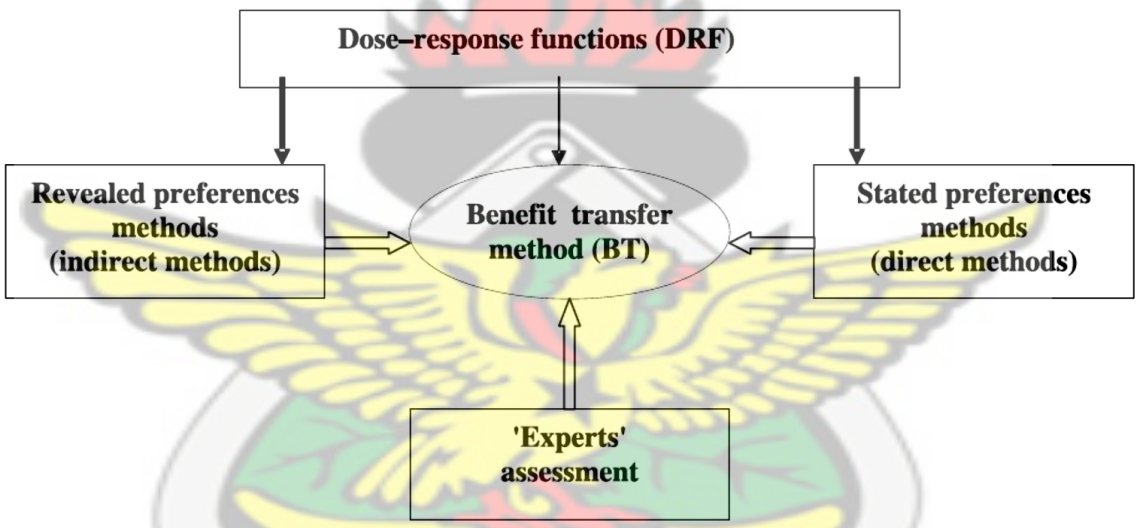


Figure 2.4: Monetary valuation methods and techniques. Source (Eshet *et al*., 2005b).

2.4.3 The model of choice for the study: Contingency valuation theory and willingness/ability to pay

The current study employs the Contingency valuation and willingness/ability to pay model to evaluate clients' willingness to-pay for solid waste management services for varying reasons.

The economic valuation of natural resources using stated preference (SP) information has come to be known as contingent valuation (CV), given that the value estimates obtained are contingent on the information previously provided to the respondent in the survey (Hoyos and Mariel, 2010). CV is deeply rooted in welfare economics: to be precise, in the neoclassical concept of economic value under the framework of individual utility maximization. CV surveys are capable of directly obtaining a monetary (Hicksian) measure of welfare associated with a discrete change in the provision of an environmental good, by substituting one good for another or the marginal substitution of different attributes of an existing good. There are some other terms that have been used for the value estimates derived from stated preference information, depending on the elicitation format used: discrete choice experiment, bidding game, open-ended question, choice-based conjoint analysis, contingent ranking, single- or double-bounded dichotomous choice, paired comparisons and payment card.

In order to identify the willingness-to-pay (WTP) goods or services, especially when the goods being transacted are not being traded in the market, the contingent valuation (CV) method can be used. The CV method is a widely used and accepted technique to study WTP for both marketable and non-marketable goods such as travel cost, reduction in the risk of death, improvement in air quality, sanitation, water supply and other environmental services. Because such conditions are non-existent in the targeted location, WTP cannot be extrapolated from the existing conditions (Maskey and Singh, 2017; United Nations, 2000).

In such a scenario, a "stated preference" approach such as CV is used, which is a direct assessment technique that measures the expected amount of the project in monetary terms by directly asking those who will be benefiting by the services under hypothetical circumstances through a questionnaire survey with the assumption that it will be implemented in the near future (Maskey and Singh, 2017).

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CVM obtains an individual's WTP for or willingness-to-accept (WTA) the change in environmental quality through the survey instrument. The utility theoretical model explained in the introduction to this research provides the basic framework for interpreting the responses to a CV study. Given that these responses are usually treated as random variables, the economic model needs to incorporate a stochastic component and the WTP distributions need to be linked to the survey response probability under the assumption that an individual maximizes her utility (Hoyos and Mariel, 2010).

2.4.3.1 Equity issues

Equity is generally defined as fairness, impartiality, or equality in the provision of a service. In solid waste management, equity is referred to as how evenly waste management service is provided across multiple service areas (Oakerson & Institute for Contemporary Studies., 1999). This generally can be determined by the following probing questions. Does everyone receive an equal level of service or are there pockets of uneven service delivery? Do some communities receive better or worse service than other communities? It is worthy to note that to achieve equity in public service, different individuals require different levels of resources and services (Wang and McFadden, 2016). Inclusivity and equity of waste management service delivery is made up of three distinct elements. These are collection coverage, dialogue and involvement of

users in decision-making on regulation, planning and setting of facilities and formal processes for measuring customer satisfaction and effective feedback mechanisms between service users and service providers. In industrialized countries, it is a known fact that communities receive waste collection services irrespective of their social status. This is normally not the case in certain cities such as Nairobi, Delhi, Dhaka and Accra (Wilson et al., 2012). Waste collections do not necessarily extend to peri-urban and slum areas. Whereas waste collection is almost 100% in cities of developed countries, it is interesting to note that in the developing countries, even though there are platforms for involvement in waste management policy and decision-making, waste collection is not equitable.

Inclusion of service providers represents the level to which both formal and informal, private or community-based service providers and waste recyclers are given equitable access to the system. However, the realities in a wide range of cities and towns cannot be refuted: informal-sector service providers are responsible for a significant percentage of waste collection. Informal sector service providers remove resources from the city and thereby in effect extend the use period of disposal facilities and save money in waste collection, transport, and disposal. This is to say that involving formal and informal firms in service delivery will better improve equity in waste collection especially in developing countries.

2.4.3.2 Service quality

Quality assurance of waste management service delivery is very important due to the health consequences associated with poor quality waste management services. Thus, the public and customers of service providers are more concerned about the quality of services delivered than they are about how services are provided.

The benchmark for determining service quality of waste management includes the following indicators (Carlos Afonso *et al*., 2000);

Personnel Indicators: this looks at the efficiency of more tasks performed by the staff. Administrative, operational and maintenance tasks are accounted for in this subset.

Physical Indicators: physical indicators contain information that describes the conditions of the infrastructures and equipment allocated to each management component.

Operational Indicators: this describes the operational performance of the system. Fuel, water and electricity consumption, equipment breakdowns, liquid and gaseous emissions, collection rates and recycling rates are examples of the information considered.

Service Quality: this parameter describes the quality patterns of the deposition, collection, transfer and elimination of services. It also assesses the environmental quality of these services.

Financial Indicators reflect the service's efficiency from a financial and economical perspective. It can be very useful in financial planning and the minimization of costs and profits of the entities. This is divided into two other groups: Balance sheet shows financial results that provide information on the WMS incomes, costs, expenses and assets.

Attempts have been made to assess the quality performance of private and public agencies in waste management in developing countries (Anestina, Adetola, & Odafe, 2014a; Massoud, El-Fadel, & Abdel Malak, 2003). It can be concluded from literature studies that although residents perceive marginal service quality improvements with private sector participation, the challenges of waste management continue to persist. According to Obirih-Opareh and Post (2002), private sector involvement in solid waste collection has benefited consumers in terms of wider scope

and service reliability but has also increased environmental dangers and worsened labor conditions. Akaateba and Yakubu, (2013), investigated the satisfaction of solid waste collection services in Wa by a private service provider. He realized that although the services delivered by the service provider can be considered as acceptable, much improvement could be made by simply addressing challenges on household education, prompt response to user complaints and ensuring effective monitoring and sanctioning by the Municipal Assembly.

Other studies that focused on private sector involvement in solid waste management pointed that house-to-house service proved to be more effective and appreciated by most residents (Anestina *et al.*, 2014). The result from severity index used to analyze the quality of service in the various studies depicts that, in the low income area, the sanitary condition of house-to house solid waste collection is moderate, while in the medium and high income areas were rated as high and very effective respectively. The latter areas have a moderate-to-high clean environment with less spillover of wastes. The reason for a high rate of sanitary condition in the high-income areas might be attributed to a high rate of quick responses of service providers to customers' complaint, high rate of reliability in terms of waste collection frequency, and high rate of positive attitude of the waste collectors' crew to services. While this raises an equity issue, it signifies that there is a difference in quality of service across the incomes groups.

2.5 Financing options for household solid waste management

Solid Waste Management has characteristics of what is generally known as a "private good" and a "public good". Generally, clients waste collection services in their homes and are willing to pay for this service either through a local tax or as a user charge system. Households may already be making payment for this service (Appasamy and Nelliyat, 2007a). Expenditure on

proper disposal is similar to pollution abatement. In this sense, solid waste management particularly treatment and disposal is like a public good.

Traditionally, there are four ways of financing local public goods such as solid waste management. These are;

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2.5.1 Local taxes

Solid Waste Management constitutes an appreciable percentage of the municipal budget in most urban cities. Again, SWM accounts for a very high percentage (75-85%) of salaries due large number of staff used for collection, street sweeping and transportation (Appasamy and Nelliyat, 2007a). A major challenge is to estimate the actual cost of solid waste management, since most of the labor cost is captured under salaries.

Usually a percentage of the municipal tax revenue is used for solid waste services. The main problem with this is that the assessment is not done regularly. In addition, there is underassessment and collection is inadequate.

2.5.2. User charges which are levied on various urban services

Since the tax revenue is not a buoyant source of revenue, many economists feel that urban (local) public goods should be financed through user charges to the extent possible. As mentioned earlier, households may be willing to pay a monthly fee or may actually be doing so, for the waste to be collected from their premises. Fees is based on either the volume/weight of the waste, in some countries. This create an economic incentive to reduce waste generation and encourage recycling.

In developing countries, there is the need to ensure that the fee is affordable. This will allow a large number of poor households to benefit .It is important to have an equitable tariff policy, by cross subsidizing poorer communities. In cities where solid waste collection is franchise to private operators, clients will pay the fee directly to the service provider but the local government fixes the tariff.

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2.5.3. Grants from higher levels of government

Conservancy taxes and user charges are used to defray operating costs, capital cost of collection (vehicles and equipment), treatment and disposal. Other external sources of finance may be required. These are usually in a form of grants and subsidies from government to the local assemblies or from donor partners to developing counties.

2.5.4. Loans from Financial Institutions or international agencies

In recent years, local governments have approached the capital market either directly or through an intermediary for funds towards their waste financing. This includes borrowing from the capital market. Local assemblies obtain loans from other financial institutions that were willing to lend at lower interest rates. One of the misconception or challenges with solid waste management is that it is expenditure with no financial benefit. It only possible to generate revenue only if the Local assemblies charge a user fee or earmarked conservancy tax that is high enough to cover the interest cost. Another option that the larger Local assemblies have considered is resource recovery or waste to energy plants. If it is possible to segregate the recyclables like paper, plastics, metals, and glass, it may be possible to generate some revenue by selling to recyclers.

2.5.5. Public-private partnerships

Private sector participation (PSP) in SWM has been sought for two reasons: (a) Improvement of quality of service due to better management, and (b) Innovation in investment and better technologies (Appasamy & Nelliyat, 2007b). There are many models of PSP, which range from service contracts, BOOT for waste treatment, privatization of disposal and so on .There are also issues relating to contract labour, displacement, performance requirements, service to slums, and compliance with MSW Rules, which need to be considered. The Ghana government in partnership with a local service provider have worked out a public-private partnership in which Chinese technology has been adopted in three waste recycle plants across the country. The beneficiary capital cities are Accra, Kumasi and Takoradi for the project implementation. One of the recycling plant has already been set up in Accra with the estimated daily capacity of recycling 300 tons of wastes generated in the city of Accra through the public-private partnership between the government and the private waste company.

2.5.6. Appropriate financing mechanism for municipal household solid waste management

According to Appasamy and Nelliyatt (2007), three financing mechanisms can be used for MSWM. Municipal taxes (property tax), user charges and grants. Many countries such as India, Malaysia, Thailand, Japan and Indonesia have implemented. In some part of India, solid waste management accounts for 25–50% of the municipal budget. A high percentage 70–85% is spent on salaries. Again, in Malaysia, about 50% of the municipal's operating budget is spent on MSWM, 70 % is spent on collection. Other methods such cost-recovery are increasingly being used, in the form of deposit refund systems and volume-based methods. The scenario also

applies to the volume-based system, where levies are either charged directly (based on waste volume) or indirectly through property tax.

Again, other strategy used in India is the allocation of funds for solid waste management. The federal state uses a different allocation formula to fund local cities to balance out the different economic circumstances across the country (Madubula and Makinta, 2014). Using waste management as a source of potential revenue is possible, most households are willing to pay for the services, but they normally do not pay the full cost of solid waste management. Estimating the actual cost is a however a challenge (Appasamy and Nelliyatt, 2007).

However, expenditure on proper disposal is similar to pollution abatement policies and if not regulated or enforced, municipalities will emulate industries and save money by underinvesting in disposal technologies (Appasamy and Nelliyatt, 2007).

The need to develop adequate financial base for the delivery of waste management services and cost recovery mechanisms are two major challenges to be faced in expanding the reach of urban environmental management in many urban areas in Ghana and other developing countries (Fobil *et al*., 2010). In a period of decreasing aid and reducing central government budgets, countries must find new and innovative ways to draw upon local capital markets for financing waste management. The lack of innovation in waste management financing in is an evident on the environment. Fobil *et al* (2010), further explain that the lack of innovative ways to finance waste management in Ghana hinder efficient waste management services delivery. This causes systemic environmental pollution and deterioration. We must look beyond holding onto traditional practices by exploring new marketing concepts to the delivery of environmental

management services. Levels of policy framework for governing waste management can be identified as follows:

a. cleansing
b. environmental
c. integrated

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For "cleansing" approach, importance is placed on removal of wastes from immediate areas of human activity in order to protect public health. The final point of management of the waste is of lesser importance. Waste management services are normally done as a public sector function and are therefore financed (at both capital and recurrent cost levels) from general public sector revenues (Fobil *et al.*, 2010).

Polluter-pays principle (PPP) is one of the core principles of sustainable development. This was first recognized and defined at international level in 1972. Recommendation by the Organization for Economic Cooperation and Development (OECD) Council on Guiding Principles concerning International Economic Aspects of Environmental Policies. In 1975, the European Community adapted and defined the PPP as the basic principle for its environmental policy.

The principle goal is to ensure that the polluter accepts partially or fully the cost of environmental damage and/or the cost incurred in controlling pollution for abatement and pollution cost.

In another development, the measures put in place to save the environment should reflect in the cost of goods and services, which cause the pollution in production and consumption. Most

economic activities (goods as well as services) cause various environmental impacts at different stages of production, transportation, consumption and disposal. The polluter-pays principle, emphasis that the costs incurred during environmental impact mitigation should be borne by the entities whose activities are responsible for polluting the environment at each stage of the product's life cycle.

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2.5.7 Solid waste management cost

Waste management poses many financial constraints to municipal authorities. Municipal authorities are tasked with the responsibility to achieve the successful management of waste with limited funds. Financial issues continues to be the most important barriers in improving solid waste management (Yukalang, Clarke, Ross, 2017). The World Bank has revealed a possible increase in the annual cost of solid waste management from the current $205 billion to $375 billion based on a new, far-reaching World Bank report on the state of municipal solid waste around the world (World Bank, 2018b).

World Bank has committed over $4.5 billion to more than 300 solid waste management programmes in six regions of World Bank engagement. In sub-Saharan Africa, $10.5 million has been committed to improve waste collection and construction of a new sanitary landfill and transfer stations in Liberia. Burkina Faso, has also benefited for supported the solid waste sector with over $67 million in loans since 2005 for the waste sector planning and construction of two landfills. The capital city, Ouagdougou, now collects an average of 78% of waste generated, which is significantly higher than the 46% average in Sub-Saharan Africa. In Ghana, it is estimated that the Greater Accra municipality spend about 0.17 percent of its Gross National Product (GNP) on solid waste management services in 1994 (World Bank, 1999).

The cost of solid waste management just like many other services rendered, vary significantly based on where one lives. In most developing countries, collection fees are usually based on a communities' wealth, ability to pay and the quality of services desired (Owusu and Kuitunen, 2003). This system places low social class community at a disadvantage since the quality of their primary collection service suffers. Poor people have a lower willingness-to-pay for environmental quality or amenities, due to income elasticity of environmental services. Only 31 percent, out of about 82 percent of the population that relied on communal waste disposal sites, paid a levy (Owusu and Kuitunen, 2003).

2.5.8 Price determination for waste management

Determination of price for municipal waste management is an important element in the overall service charges. This should be captured along the value chain of the waste management process that involve collection, transportation and treatment. The Environmental Services Providers Association (ESPA), Ghana in a sensitization workshop (September 2013), came out with a price determination formula to guide service providers and stakeholders.



Figure 2.5: Value chain for solid waste management. Source: Author's construct, 2017.

Table 2.1. Cost build-up ratios (storage, haulage, treatment & final disposable)

PROPOTIONAL BREAKDOWN (PB) ELEMENTS OF COST BUILD-UPS		**PROPORTIONAL BREAKDOWN FOR TYPE OF VEHICLE**		
		MUILTILIFT (125kW)	ROLL-ON-OFF (170Kw)	COMPACTION (170Kw)
1	Fuel & Lubricants	6.6%	5.8%	3.7%
2	Personnel (Direct Labour)	9.7%	7.2%	6.7%
3	O & M (Operations & Maintenance)	9.6%	8.5%	4.2%
4	Overheads	5.2%	4.3%	3.7%
5	Working Capital Cost	9.3%	7.8%	5.5%
6	Truck & Equipment Replacement Cost	19.9%	22.3%	46.8%
7	Treatment and Disposable	24.6%	30.1%	11.8%
8	Profit Margin	15.1%	14.0%	17.6%
	TOTALS/AVERAGE	100.0%	100.%	100.0%

ESPA SENSITIZATION WORKSHOP (2013)**.**

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Table 2.2: Rate for refuse compactor waste collection

INDEX		18M^3 REFUSE COMPACTOR			
		HAULAGE ONLY (GH¢)	STORAGE & HAULAGE (GH¢)	HAULAGE, TREATMENT & DISPOSAL (GH¢)	STORAGE, HAULAGE & DISPOSAL (GH¢)
1	RATE PER METRIC TONNE	55.58	104.78	69.58	118.78
2	AVERAGE MONTHLY SERVICE CHARGE (240LTR.)	29.00	54.67	36.31	61.98
3	RATE PER TRIP OF TRUCK LOAD	750.37	1,414.52	939.37	1,603.52

ESPA, 2013

2.5.9. Charges for Household Waste Collection

The privatization of waste management services has resulted in payment of cost for waste collection (Thompson, 2010), in many countries such as Ghana. In high-income communities, each household pays a fee for the privilege of waste collection. In low-income neighborhoods, the lack of payment of waste collection charges leads to waste accumulation at collection points. Where payment schemes have been instituted (such as requiring residents to pay a specific fee before the central container units are collected), residents simply free-ride (Thompson, 2010).

Traditionally, in many countries, a fixed fee is charged for solid waste management services generally disjointed from volume, weight or type of waste being disposed. In Ireland, flat rate fees for household waste collection have ended (Department of Communications Climate Action and Environment, 2018). Only clients on a flat fee are affected by the change. Instead, a service which includes a weight based (including a weight allowance or per lift) charge had been introduced. Household clients on a pricing plan with a variable charge element, such as per lift or weight based charging, generate significantly less waste. This new policy is based on the theory that, the reduction and separation of waste by households lessen the impact on the environment that may lead to an effective management of domestic waste. In many developed countries, there are three main ways cities may implement a variable fee policy for households. Clients may be required to purchase for a certain price-approved bags, tags or stickers that residents use or affix to the containers set out at collection centers. The benefit of this strategy is that it excludes the need for a billing system. Other cities also use unit pricing for different levels of subscription service. Clients subscribe to a waste collection service level that varies in price based on the number or size of cans/containers used. Finally, collection crews may actually weigh the solid waste disposed at the curb and charge customers based on these data (Folz & Giles, 2002).

2.6 Governance structure for municipal household solid waste management

Governance could be understood as a regulatory practice to solve societal problems, and environmental governance is a cognate concept used when speaking of governance in the niche of environmental issues (de Bie, 2017). Governance comprises aspects such as staffing at all levels of management and assigning of duties in a transparent and prudent way in terms of

delivering results, corporate culture, and strategy to deal with various stakeholders (Andrews, 2008). Improper SWM is one important societal environmental issue that needs to be addressed by governance. The aim of environmental governance is to impact environmental actions and behaviours by a set of regulatory actions undertaken by a variety of actors. These actors involve the central government and other civil society actors who may be individual or collective. According to Lemos and Agrawal (2006), environmental governance can be understood as being *"identical with interventions aiming at changes in environment-related incentives, knowledge, institutions, decision making, and behaviours*". The value of non-state actor partnerships within solid waste governance, the importance of community based management, the decentralization of environmental policy and the involvement of the often neglected informal sector are recently being emphasized by ecological researchers (Lemos and Agrawal, 2006; Nzeadibe and Anyadike, 2010).

These governance systems influence the SWM practices at all levels including households.

A recent study from Sri Lanka for example found that household practices were influenced by solid waste manage at the local government and municipal councils (de Bie, 2017). Their study found that the local governance is very important and greatly affects the practices of the waste chain actors and the households. Local governmentalities were also an important factor in deciding policy. However, they found that the national government's centralized policy has little influence on either local governmentalities or practices. They recommended that a more hybrid governance structure is suggested to improve the solid waste situation (de Bie, 2017).

2.6.1 Urban waste management governance structure in Ghana

In Ghana, local governments, or assemblies, are responsible for SWM in the cities under their jurisdiction. As a legal entity, the local government has powers conferred on it by the Ghana Local Government Act 1993 (Act 462) (Government of Ghana, 1993) to effect by-laws to govern and regulate SWM, sanitation, public cleansing, and abatement of nuisance in the cities. Various regulations are stipulated in the Local Government Act and by-laws, Ghana National Procurement Act, and other national legislative instruments that provide rules for SWM.

The Ghana National Procurement Act 2003 (Government of Ghana, 2003) makes it mandatory for the local governments' tender boards to use competitive bidding when selecting companies for waste collection, and to sign contracts. The regulation of the agent (companies) by the local governments is a necessary condition for cost efficiency and better service quality.

A study of the governance structure for urban waste management in Ghana found that the current government structure is weak, a situation that has allowed elected local government officials to become involved in illegal collection of user charges (Oduro-Kwarteng *et al*., 2017). Their study also covered the involvement of private sector in SWM and revealed the existence of weak regulatory practices, but also of non-adherence to contractual obligations. They further found that service quality and cost recovery were affected by unsigned contracts, delays in raising user charges, and delays in the payment of subsidies and these practices affected the investment in SWM resources and serve as a disincentive for private-sector development. The study recommended an improved and integrated SWM system that involves all actors of governance (Oduro-Kwarteng *et al*., 2017).

Table 2.3: Regulatory framework: relevant rules and practices (source: Oduro-Kwarteng et al. 2017**).**

Regulatory instruments	Regulatory rules	Regulatory practices by the local governments
Procurement Act (2003)	Competitive bidding for all contracts	Evidence of lack of competitive bidding prior to 2007, except PSP project bidding
	Signing of awarded contracts	Most contracts not signed (13 of 25 contracts not signed in 2007)
Local Government Act 462 (1993)	By-Law on fee-fixing resolution/ tariff setting	Evidence of irregular approval of fees in the five cities
Contract rules and conditions	Upward review of fees and service charges	Evidence of irregular upward review of fees in the five cities
	Payment of interest on contractors claims delayed beyond 45 days	No interest was paid on claims delayed; a clause on interest payment on delayed claims was repealed from contracts signed after 2008
	Regulation of quality Monitoring of service quality	Monitoring undertaken but service quality compromised
	Access to information	
	Level of user charges/ tariff	Low level of user charges
Regulations of residents' behavior	Enforcing by-laws and abatement of nuisance	Weak enforcement

2.6.2 Regulation in solid waste management structure

Regulation is very vital in ensuring that all actors in the governance structure play their respective roles to enhance efficient SWM structure. Solid waste collection requires efficient sector-specific regulation. Regulation was defined by Chan (1997) as government activity that is intended to affect directly the behaviour of private-sector agents in order to ensure their alignment with the public interest. It involves the definition of rules and laws meant to impose duties on actors or bare specific activities among actors. As put forward by van Dijk (2006), the purpose of regulation is to *'sustain and focus control, exercised by a public agency over activities of [the] private sector which are valued by a community'.* In SWM, there are gaps between formal rules (regulation) and actual practice and these depend on local institutional capacity and the political context at the local level. The private sector is also key in SWM. It has a duty to deliver quality services and stay competitive despite regulation. It must have adequate capacity for service provision, and the fact that it has to make a profit helps ensure efficient utilization of resources; this also stimulates innovation, because of competition among the various private partners (Oduro-Kwarteng et al., 2017). The activities of actors from the private sector however needs to be subjected to effective regulation. Regulation provides the basis upon which private service providers are prohibited, permitted, or encouraged (Batley, 2006).

In Ghana, regulation of SWM is by agreement (Ballance and Taylor, 2005) and revolves around regulation of prices and specification of service levels. Solid waste collection by the private sector needs the establishment of institutions for contract preparation, monitoring, and implementation, as well as mechanisms for dealing with contract incompleteness. Awortwi's (2004), systematic analysis of contract processes also showed that awarding of contracts in

Ghana, as of 2003, was based more on agents' connections with people in higher authority than competitive bidding.

A study by Oduro-Kwarteng *et al* (2017), identified weak regulatory practices in Ghana over the past two decades. These included:

- Incorrect zoning of cities
- Weak competitive bidding processes prior to 2007, with or without signed contracts
- Low prices and delays in the regular upward review of user charges
- Delays in making payments for service contracts and subsidized franchised services, and failure to pay due interest
- Weak enforcement of by-laws and sanctions
- Undocumented service standards and performance monitoring indicators
- The repeal of a contract clause on interest payments and
- Fragile adherence to regulations when awarding contracts and issuing payments.

2.7 Diseases trend and their relationship with solid waste management practices

Adequate environmental sanitation, access to safe drinking water and encouraging personal, domestic and community hygiene improves the quality of life of millions of individuals. The role of adequate sanitation and good hygiene including the provision of safe drinking water are basic fundamental tenets to good and resilient health system and to a greater extent social and economic development (Bartram and Cairncross, 2010) of any nation.

Poor water, and environmental sanitation was responsible for 842 000 annual deaths from diarrhea, and 1.5% of the global burden of disease (in Disability-Adjusted Life Years or DALYs) in 2012 alone (Prüss-üstün *et al.*,2002).

Poor environmental sanitation has been a major concerned in the transmission of many infectious diseases including cholera, typhoid, and diarrheal diseases. Poor sanitation and hygiene also leads to a reduced physical growth, weakened physical fitness and impaired cognitive function, mainly for children under the age of five.

2.7.1 Cholera

Cholera is a diarrheal disease. It occurs when an individual gets into contact with the bacteria *Vibrio cholera*. It is transmitted through person to person because of poor hygiene and sanitation. Limited access to environmental sanitation, and inadequate water supply, also contribute to the rapid progression of an outbreak (Prüss-Üstün et al., 2008). Cholera remains an important public health burden worldwide. It is estimated that 1.4 to 4.3 million cholera cases, and 28,000 to 142,000 cholera deaths occur worldwide each year (Ali et al., 2012). According to the UNICEF, cholera was first reported in Ghana in 1970. Between 1990 and 2010, reports shows a decrease trends in cholera outbreaks in Ghana and the overall yearly trend showed a decrease over time in size (UNICEF, 2013). Ghana suffered large outbreaks in 2011 and 2012. Between 1998 and 2013, epidemiological surveillance reports reveled 55,784 cases reported with 1,095 fatalities (case fatality rate ≈ 2%) in Ghana (UNICEF, 2013). Main outbreaks were reported in the densely populated regions of Greater Accra and Ashanti, and in bordering coastal regions. Ghana is also affected by cross-border outbreaks mainly from Nigeria and Togo, especially along the Guinea coast.

Cholera distribution and epidemiology in Ghana

Cholera cases is mostly reported along the coast of Ghana. Greater Accra, Central, Western and Volta reported over 70% of cholera cases between 1998 and 2013. Major outbreaks usually occur in the Greater Accra region. In the middle of the country, the main outbreaks were recorded in the densely populated Ashanti and Eastern regions that shares border with the Greater Accra region, representing nearly 18% of reported cases. In the Northern belt of the country, less than 10% of cholera cases were reported. Outbreaks in Greater Accra, Central and Eastern occurred at similar times-all-year round and are connected due to movement between these regions. Separate sporadic outbreaks in other regions appeared to be seasonal, emerging around June and September for Ashanti region and the northern part of the country.

Cholera outbreak in Accra

Cholera is one of the main environmental sanitation related disease in Ghana. Ghana recorded its worst cholera outbreak in 2014 with eight out of its 10 regions being affected. According to a study conducted Ohene-Ajei *et al*. (2017), the Greater Accra Region was the most affected, recording almost 98% of all cholera cases. Cholera cases were reported in 15 out of the 16 districts. The Accra Metropolis recorded the highest number of cholera cases (52%, 10,504). The districts with high case fatality rates were La Nkwantanang, Ashiaman, Ledzokuku Krowor, Ada East and Tema. Three years on, cholera outbreak occurred after heavy rains have exposed the filthy state of the capital, Accra. Foul smell emanating from dirty gutters and piles of garbage on various streets can be seen in the open. The Ghana Health service reported that, recorded with eight cases of cholera in the Accra region. Outbreak of cholera in the region has become perennial owing to poor disposal and management of solid waste in the region.

Cholera outbreak in Kumasi

Between 1998–2013, 5,146 cases of cholera were reported in Kumasi with 99 deaths representing 9.8% of total cases reported (UNICEF, 2013). In Kumasi, heaps of uncollected solid waste within the central business district has characterized outbreaks of cholera. During the 2014 deadly cholera outbreak in Ghana, the Ashanti region recorded 10 cases with no death from 3 districts including the Adsansi South, Kumasi metro and Asante Akim Central. Most cases in the Kumasi metropolis may not be documented, however, cholera cases in Kumasi remains lower compared to Accra. Studies indicate that, high urbanization, high overcrowding, and improper environmental sanitations in communities within Kumasi Metropolis are the most important predictors of cholera in Ashanti region (Ohene-Adjei *et al*., 2017).

Cholera outbreak in Takoradi

In 2014 and 2015, Western Region reported 1,165 cases of cholera with 15 deaths (CFR of 1.3). Secondi Takoradi reported the highest number of cases of 43.9%, (Ghana Health Service, 2014)the total number of cases recorded in Sekondi Takoradi Metropolitan Assembly were 502 and 7 deaths (International Federation of Red Cross and Red Crescent Societies, 2015).

Cholera outbreak in Tamale

In 2005, 33 cases (with nine deaths) were reported in Tamale Metropolis. The worst hit suburb of Tamale Metropolis was Mohiye-Bihi and its surrounding communities around Agric Ridge. In the 2014 outbreak, one person out of the 29 reported cases was reported in Tamale (International Federation of Red Cross and Red Crescent Societies, 2015).

2.7.2 Diarrheal diseases

Good hygienic practices and adequate environmental sanitation, together with safe drinking water, are fundamental to good health and to social and economic development. Diarrhea is caused mainly by the ingestion of pathogens, especially in unsafe drinking water, contaminated food or from unclean hands. Inadequate sanitation and insufficient hygiene promote the transmission of these pathogens. Eighty-eight percent of cases of diarrhea worldwide are attributable to unsafe drinking water, inadequate sanitation or insufficient hygiene (Prüss-Üstün et.al., 2008). These cases result in 1.5 million deaths each year, most being the deaths of children (Prüss-Üstün *et al*., 2008).

Poor environmental sanitation has been linked to diarrhea diseases such as cholera, typhoid and dysentery. It is caused by a variety of microorganisms including viruses, bacteria and protozoans. Diarrhea causes a person to lose both water and electrolytes, which leads to dehydration and, in some cases, to death. About 4 billion cases of diarrhea per year cause 1.8 million deaths, over 90 per cent of them (1.6 million) among children under five (UNICEF, 2013). Diarrhea is the most important public health problem directly related to water and sanitation. Provision of adequate environmental sanitation facilities and proper disposal of solid waste can cut diarrheal disease by one third.

Over 10,000 Ghanaian children die each year from diarrhea and pneumonia. Handwashing with soap alone could reduce diarrhea by up to 50% and pneumonia by 25%, yet only 20% of Ghanaians wash their hands. Thousands of lives could be saved if washing hands becomes a habit for everyone (UNICEF, 2013). Poor sanitation and contaminated sources of drinking water and poor feeding practices account for the burden of diarrheal diseases. Diarrhea accounts for

25% of mortality in children under five years of age, with more than 9 million episodes occurring annually in Ghana (Binka *et al.*, 2011).

2.7.3 Typhoid

Typhoid Fever, a gastrointestinal infection caused by *Salmonella enterica typhi* bacteria. The transmission route is from person to person through the fecal-oral route where an infected or asymptomatic individual with poor hand or body hygiene passes the infection to another person. The bacteria multiply in the intestinal tract and can spread to the bloodstream. Poor water and sewage sanitation are the main causes of typhoid.

2.7.4 The burden of environmental sanitation related diseases

Sanitation related diseases have several impacts on the economy and development of a nation. A healthy community spent less on health care as well as increased productivity. Illness due to poor sanitation can affect both the sick person and their family. Whereas most diarrheal diseases are associated with poor environmental sanitation and tend to be endemic, some are epidemic. This includes cholera and typhoid fever. Studies have shown that, every year there are roughly 1.4 million to 4.3 million cases, and 28,000 to 142,000 deaths per year worldwide (Ali *et al.*, 2012).

Inadequate water, environmental sanitation and hygiene account for a large part of the burden of illness and death in developing countries. Nearly 4 billion cases of diarrhea per year cause 2.2 million deaths, most-1.7 million-children under the age of five, about 15% of all under-5 deaths in developing countries. Diarrheal diseases account for 4.3% of the total global disease burden (62.5 million DALYs). An estimated 88% of this burden is attributable to unsafe

drinking water supply, inadequate sanitation, and poor hygiene. These risk factors are second, after malnutrition, in contributing to the global burden of disease. 500 million 300 million people suffer from malaria 200 million people are infected with schistosomiasis, 20 million of whom suffer severe consequences (The World Bank, 2003).

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The two most effective interventions for controlling endemic diarrhea are improved sanitation and hygiene (Laxminarayan, Chow, & Shahid-Salles, 2006). Additional critical intervention is to improve food hygiene, which may prevent many diarrhea deaths, especially in hot climates where food hygiene is difficult to maintain (Curtis *et al.*, 2011).

Improved solid waste management has both economic and health advantages. Proper waste disposal such as recycling has several benefits. The initial stage in the recycling process (collecting material from households and businesses) is cost and labor-intensive; it however provides employment for the citizens. Improved waste management improves the local environment and benefits the national and even the global environment. Good waste management means less litter in the streets and communities of waste disposal sites. It also reduces the smell in the streets from decomposing wastes. Improved access to sanitation is a critical step towards reducing the impact of environmental health and sanitation related diseases burdens. It also helps create physical environments that enhance safety, dignity and self-esteem. Safety issues are particularly important for women and children, who otherwise risk sexual harassment and assault when defecating at night and in secluded areas (Caetano et al., 2017).

2.8 General Challenges of Solid Waste Management

A good solid waste management system allows for proper disposal of waste in a manner that protect the environment. Components of a waste management system include the facilities and equipment used to temporarily store waste (collection bins) or transfer collected waste to its final disposal site (Thompson, 2010). The effectiveness of implementing a well-functioning solid waste management system is limited due to various challenges.

Singh *et al* (2014), explained that increasing amounts of waste throughout world economies show an inextricable link between economic growth and waste amounts. Interestingly, emerging waste are entering into the waste streams. Even countries with a relatively developed infrastructure for waste management face challenges to manage wastes sustainably due to products that are not suited for recycling and or unsatisfactory waste sorting. The following are the general challenges to effective waste management.

2.8.1 Segregation

The lack of well-organized and scientifically planned segregation of solid waste at household level community collection point is a major barrier to waste management. Sorting of waste, is mostly accomplished by organized sector and seldom practiced by waste producers. Major concerns including unsafe and hazardous conditions for segregation and sorting of solid waste have been stated as one of the main reasons for lower rates of segregating of waste in India (Joshi and Ahmed, 2016). Improper handling of segregated constituents may lead to mix up during transportation and disposal and this could deprive proper scientific disposal of waste (Joshi and Ahmed, 2016).

2.8.2 Collection

Household waste is usually transferred into communal collection points for onward transportation to disposal units. Street sweepings also find its way into community waste collection centers. The use of these waste collection centers by other commercial waste companies may lead to overflow of waste and cause problems for transportation.

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2.8.3 Reuse/recycle

This involve activities such as collecting waste, which could be gainfully retrieved and utilized for making new products. Since unsegregated waste is dumped at community bins, its optimal recycling may not be entirely possible. One of the challenges associated with waste management is seen as promoting recycling while making sure consumers are protected from toxic substances that can be found in waste. While the Waste Framework Directive promotes recycling through the waste hierarchy and binding targets, there must be regulation to prevent chemicals contained in products, in order to protect public health and the environment (Bourguignon, 2015).

2.8.4 Transportation

Waste can be transported using equipment such trucks, tractor, trailers, and dumpers. Stationary compactors, mobile compactors/closed tempos, and tarpaulin-covered vehicles are used in the transportation of solid waste in many cities. The poor of maintenance of vehicles and equipment used in for transportation of waste causes many transportation challenges for waste collection companies. Constant breakdown of these vehicles leads to reduction of waste collection, transportation, and disposal efficiency.

2.8.5 Disposal

Improper waste disposal and treatment has severe impact on the environment and the health of individuals. Practices such as open dumping which includes directly disposing waste indiscriminately have severe consequences on the environment and public health. Open dumping of solid waste leads to frequent flooding. Inadequate land availability for waste disposal and non-availability landfill sites are running beyond their capacity (Joshi and Ahmed, 2016) of municipal waste disposal in many cities.

2.8.6 Other challenges in waste management

The lack of credible data and reporting methods on waste, unreliable waste statistics in terms of both quality and comparability further compound the challenges associated with waste management. Energy recovery of waste can in some cases compete with recycling as a waste treatment method. Waste-to-energy is generally preferable to landfilling and enables the generation of heat and electricity. However, recycling can be a better option, including in terms of energy generated and saved, if material quality is maintained. Although waste prevention is at the top of the waste hierarchy, a 2014 report by the European Environment Agency finds that most Member States lack effective waste-prevention measures (European Environment Agency, 2014).

In Ghana, just like in several developing countries, barriers to waste management are enormous. Most importantly, negative attitudes of the public towards the environment in general, poor and inadequate waste infrastructure, inadequate equipment and operational funds to support waste management activities, weak planning for waste management program, unplanned human

settlement, and lack of political will to enforce byelaws on sanitation and building regulations by the MMDAs.

2.9 Knowledge Gaps

This review has identified operating, administrative and cost determination issues in waste management in Ghana and other resource-limited settings.

Financial

The current practices points to gaps in fee determinations because of inadequate costing of the resources and efforts that goes into waste management and for political reasons. Currently, there is no fee fixing formula and pricing of solid waste services is non-uniform among and across the country. These are important for cost recovery issues and ensure effectiveness and efficiency in waste management. Waste management efficient decision models such as WAMED has been applied to SWM schemes and recommended to be useful in evaluating the ecological efficiency of waste management (Mutavchi, 2012). Generalized methodologies to evaluate the financial cost-effectiveness of MSW management systems have also been developed in other settings (Dobraja et al., 2016; Tin et al., 1995; Weng and Fujiwara, 2011b). Finally, there are also gaps on sustainable waste management framework that encompasses all actors, their roles as well as mode of payment of service delivery.

Institutional arrangement

The review also identified that there is no independent authority in SWM in Ghana. The use of independent body as an outsourcing policy has been recognized as a useful strategy for efficient

SWM (Swedish International Development Cooperation Agency, 2015). Such institutional arrangement is however missing in SWM in Ghana. A recent study also recommended a strong and independent authority to regulate waste management as a means of improving SWM in India (Kumar *et al.*, 2017). This review also found gaps in knowledge regarding the capacity of municipalities and involvement of governmental and non-governmental organizations who have a stake in solid waste management.

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Social issues

The social aspect of SWM services in Ghana has also not been adequately reported in literature. This include the conditions of SWM workers and their level of satisfaction with their work. Household participation in decision making regarding SWM is also not available in literature. Households are important stakeholders in the management of solid waste and their active involvement ensure their acceptability, willingness to pay and efficient generation of waste to reduce waste burden (Maryati *et al*., 2018).

Technical issues

The literature further did not highlight on technical issues of waste management including the waste collection and transportation strategies, waste disposal and treatment strategies and how these are implemented. The type of equipment for household solid waste collection and transportation and storage of waste are also not well elaborated in literature. Waste minimization strategies are not available in Ghana and are not discussed in literature on SWM in Ghana. Waste minimization, recycle and reuse are identified as important strategies to reduce the current waste burden in developing economies like Ghana (Cheremisinoff, 2003).

Health and general environmental concerns

Despite the impact of waste on environmental related diseases such as malaria and cholera, literature on the direct relationship between waste generation and these diseases is not available. In Ghana, there is persistent outbreak of cholera and other diarrhea diseases and therefore the need to ascertain the contribution of poor environmental conditions to these disease outbreaks. There is also generally lack of strategic direction towards flooding and its effects on health and diseases in Ghana. Elsewhere, the health impacts of disasters and the underlying causes of health impacts associated with flood have been studied, leading to the development of theoretical framework that may aid with the development policies and comprehensive programs to prevention, mitigation, and management of flooding (Du et al., 2010). Poor solid waste handling also leads to pollution of surface water. According to USAID (2009), solid waste streams if not handled well can release toxic materials and pathogenic organisms into dumps and landfills (USAID, 2009). This is usually found in endless landfills runoff that can pollute soil or surface water, depending on the drainage system and the composition of the soil. At the beginning of the rainfall, deteriorating environmental conditions due to the mismanagement of solid waste, lead to drainage, flooding of residential areas, surface water contamination and ground water pollution, which will have a detrimental effect on water bodies and aquatic life (Triassi et al., 2015). Poor waste disposal also leads to the concentration of waste attracting flies and other disease vectors (Angeles, York, & Francisco, 2013).

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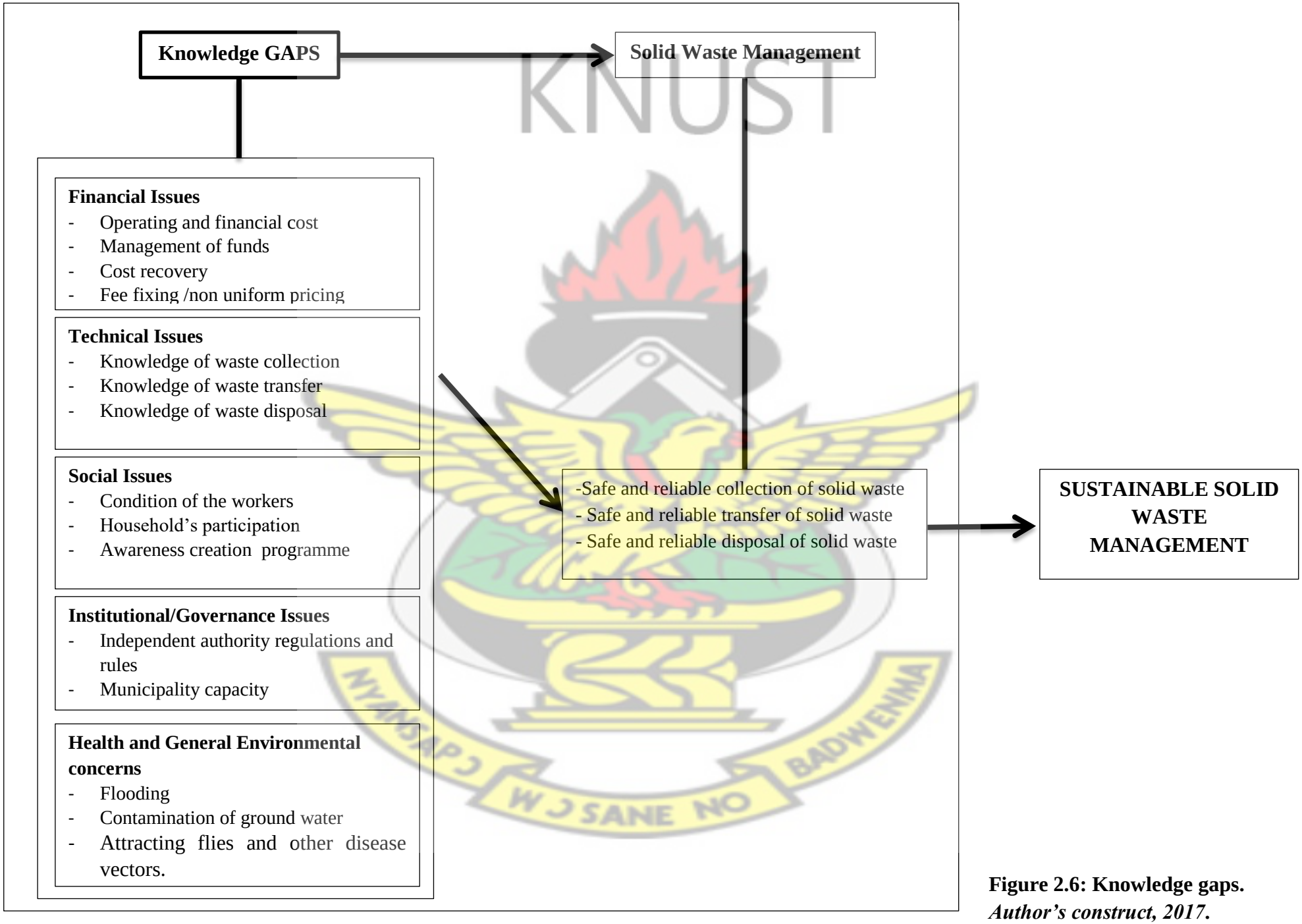


Figure 2.6: Knowledge gaps.
Author's construct, 2017.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section presents the methods employed in the study. It comprises the study design adopted, description of the study population, data collection and tools as wells as data analysis.

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3.1 Philosophical Worldviews Guiding this Study

This study is based on the philosophy of epistemology, which concerned what is regarded as true knowledge (Panas & Pantouvakis, 2010). According to Saunders *et al* (2009), the epistemological philosophy describes the researchers position on what is regarded as acceptable knowledge. Two main paradigms of the epistemology philosophy are Positivism and Interpretivism. The positivist view is concerned with the quantitative approach that of the interpretivist leaned towards the qualitative approach and it involves verification of facts established through scientific study in an objective manner for replication. Creswell (2014), under the philosophical inferentiality used post-positivism which involved the use of numeric measurement to observe and study the behaviour of a population to mean positivism and participatory/advocacy to mean Interpretivism.

Fundamental to the positivist approach is the idea that the study of the social world can use the tools of science in order to create understandings, which are verifiable. The Positivists assumption is that situations are according to the natural laws and can be subjected to quantitative logic, such that the reality can be observed, studied and even modelled.

Positivism is formed on the basis that the acquisition of accurate and value-free knowledge of a phenomenon is real such that societal and institutional patterns can be observed objectively just as the natural world (Fisher & Buglear, 2010).

Interpretivism, on the other hand, believes that the researcher and the society interact with each other such that what is believed to be facts are not static and lacks objectivity as they are subjected to the ideas of the research. It relies on the interaction and the experience of the researcher and the social world to understand the phenomena. It is important to note that while in the positivism approach, the researcher is not part of the observations; the researcher however is part of the study under Interpretivism. Positivism measures concepts for generalization through statistical methods, contrary to the Interpretivism idea where concepts are incorporated as per the perspective of stakeholders (Cao Thanh & Thi Le Thanh, 2015).

3.2 Study Design

The study was a descriptive cross-sectional design and employed quantitative, qualitative and documentary analysis.

The study was organized in three phases. Phase one consisted of desktop review, which assessed existing situation with respect to types of service quality and utilization of municipal solid waste management services, existing financing options and willingness-to-pay. Phase one also involved interactions with service providers and managers at the MMDAs, EPA and Waste Management Departments to assess the managerial perspective of the study; it lasted for twelve months May 2015 to April 2016. The preceding months, September 2014 to April, 2015 were used for protocols development and desktop review. Data cleaning and analysis were done from May to December 2016. In Phase one, cross sectional surveys using structured questionnaire

and interview guides were employed. The structured questionnaire was administered on clients while interview guides were used on key informants mainly managers from stakeholders in waste management services. Phase one ended with a submission of abstract to Waste Management conference. A manuscript on waste management service utilization across four major cities has been submitted for publication.

Phase two took place between February and July 2017. During this phase, public health implications of the exiting situation and their significance in modelling appropriate financing mechanism were elaborated. In this same phase, data on environmental sanitation related diseases were extracted and analysed to ascertain the public health implications of the existing situation. The effects of including public health dimension into the financing modeling were critically analysed. Phase two ended with a submission of a second paper on household willingness and ability-to-pay for waste management services for publication.

In phase three, the remaining data were analysed to complete the PhD Thesis write-up for submission in August, 2018 alongside preparations for additional two papers for publication.

3.3 Study Sites

Geographically, the study area covered four regional capitals in Ghana; (Greater Accra) Accra, (Ashanti) Kumasi, (Western) Takoradi and Northern (Tamale) coinciding with the three epidemiological zones of northern, middle and coastal belts. These cities were purposively chosen due to increasing urbanization and high levels of economic activities. These cities have a combined population of 4,566,450 as per the 2010 Ghana housing and population census (Ghanan Statistical Service, 2011). With a growth rate of 5.4%, annually the combined population is expected to grow beyond the figure given in 2012. The vegetation of these cities

vary from moist-semi deciduous forest in Kumasi to strand and mangrove zone in Accra to coastal scrubs and grassland in Takoradi.

Major economic activities occur in the various Central Business Districts (CBD), with varying economic activities. Economic activities are predominant in Accra and Kumasi where the Central Market (the largest open-air market in West Africa) and the Adum Shopping Centre (Baeyens, 2012) are situated. The economic activities of these cities operate on mainly industry, commerce and the service sector, which are either formal or informal. The former is characterized by businesses with corporate ownership, large scale with the use of sophisticated technology while the informal is made up of a maze of tiny workshops and enterprises producing almost everything including wood processing, weaving, pottery, carving, tailoring etc. The cities have various tourist attractions sites including the famous Manhyia Palace with a museum, Accra Shopping Mall, Kotoka international airport and a host of other facilities. Accra and Kumasi alone generate more than 4000tonnes per day according to a Ghana Business News publication of September 12, 2015. A waste generation rate of 0.47/person/kg is believed to be in use in these cities.

Accra Metropolis

More than half of the households (59.4%) allow contractors to collect their solid waste while about 33.0 percent disposed theirs through public dumping (container) (Ghana Statistical and Service, 2014). Only 1.1 percent of households dump indiscriminately while 0.3 percent disposed their waste by burying. Details of waste disposal methods is shown in Table 3.1.

Table 3.1: Methods of waste disposal by households in the Accra metropolis

Method of waste disposal	Total country	Total Region	Metropolis Total Number	Metropolis Total Percent	Metropolis Urban	Metropolis Rural
Solid waste						-
Total	5,467,054	1,036,370	501,903	100.0	100.0	-
Collected	785,889	502,642	298,178	59.4	59.4	-
Burned by household	584,820	134,654	13,402	2.7	2.7	-
Public dump (container)	1,299,654	266,287	156,481	31.2	31.2	-
Public dump (open space)	2,061,403	87,379	23,647	4.7	4.7	-
Dumped indiscriminately	498,868	22,123	5,408	1.1	1.1	-
Buried by household	182,615	14,003	1,412	0.3	0.3	-
Other	53,805	9,282	3,375	0.7	0.7	-
Liquid waste						-
Total	5,467,054	1,036,370	501,903	100.0	100.0	-
Through the sewerage system	183,169	95,188	41,000	8.2	8.2	-
Through drainage system into a gutter	594,404	191,228	135,248	26.9	26.9	-
Through drainage into a pit (soak away)	167,555	55,807	20,012	4.0	4.0	-
Thrown onto the street/outside	1,538,550	127,782	33,064	6.6	6.6	-
Thrown into gutter	1,020,096	351,349	236,463	47.1	47.1	-
Thrown onto compound	1,924,986	208,821	33,436	6.7	6.7	-
Other	38,294	6,195	2,680	0.5	0.5	-

Source: Ghana Statistical Services, 2010.

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Kumasi Metropolis

The main toilet facility used in the Metropolis is water closet in homes (42.5%), public toilet (36.2%), and pit latrine (11.1%) (Ghana Statistical Service, 2013, 2014a). About 2.4 percent of the households in the Metropolis have no toilet facility. The most common method of solid waste disposal is public dump (container) (58.8%), collection (17.2%) and public dump (open space) (15.6%). Dumping of solid waste indiscriminately is practiced by 1.9 percent of the households. For liquid waste disposal, waste through drainage system into gutter (35.9%), throwing waste into gutter (32.2%) and throwing of liquid waste onto compound (15.4%) are the most common practices by households in the Metropolis (Ghana Statistical Service, 2014a, 2013). Details of solid waste disposal in the metropolis is shown on Table 3.2.

Table 3.2: Methods of waste disposal by households in the Kumasi metropolis

	Total country		Region		Districts			
					Total			
Waste disposal method	Number	Percent	Number	Percent	Number	Percent	Urban	Rural
Solid waste disposal								
Total	5,467,054	100.0	1,126,205	100.0	440,283	100.0	440,283	-
Collected	785,889	14.4	102,035	9.1	75,879	17.2	75,879	-
Burned by household	584,820	10.7	59,303	5.3	19,551	4.4	19,551	-
Public dump (container)	1,299,654	23.8	399,121	35.4	258,958	58.8	258,958	-
Public dump (open space)	2,061,403	37.7	472,344	41.9	68,585	15.6	68,585	-
Dumped indiscriminately	498,868	9.1	55,647	4.9	8,230	1.9	8,230	-
Buried by household	182,615	3.3	30,215	2.7	7,137	1.6	7,137	-
Other	53,805	1.0	7,540	0.7	1,943	0.4	1,943	-
Liquid waste disposal								-

Total	5,467,054	100.0	1,126,205	100.0	440,283	100.0	440,283	-
Through the sewerage system	183,169	3.4	35,882	3.2	23,179	5.3	23,179	-
Through drainage system into a gutter	594,404	10.9	223,451	19.8	156,270	35.5	156,270	-
Through drainage into a pit (soak away)	167,555	3.1	28,885	2.6	15,542	3.5	15,542	-
Thrown onto the street/outside	1,538,550	28.1	258,473	23.0	34,147	7.8	34,147	-
Thrown into gutter	1,020,096	18.7	245,146	21.8	141,959	32.2	141,959	-
Thrown onto compound	1,924,986	35.2	330,818	29.4	67,825	15.4	67,825	-
Other	38,294	0.7	3,550	0.3	1,361	0.3	1,361	-

Source: Ghana Statistical Services, 2010.

Takoradi metropolis

According to the 2014 District Analytical report (based on the 2010 Population and Housing Census), the population of Sekondi-Takoradi Metropolis was 559,548 representing 23.55 of the region's total population (Ghana Statistical Service, 2014b). The Metropolis has a sex ratio of 95.6. The population of the Metropolis is youthful (32.6%) depicting a broad base population pyramid which tapers off with a small number of elderly persons (6.1%). The total age dependency ratio for the Metropolis is 58.2, the age dependency ratio for males is higher (58.6) than that of females (57.9).

The most widely method of solid waste disposal is by public dump in the container accounting for 47.1 percent. About 1.4 percent of households dump their solid waste indiscriminately. House to house, waste collection accounts for 7.9 percent. For liquid waste disposal, throwing waste onto the gutter (41.3%) and throwing through drainage system into a gutter (29.2%) are

the two most common methods used by households in the Metropolis**.** Details of waste disposal is shown in Table 3.3.

Table 3.3: Method of solid waste disposal by locality, Takoradi metropolis

	Total		Metropolis Total			
Method of waste disposal	Country	Region	Number	Percent	Urban	Rural
Solid waste						-
Total	5,467,054	553,634	142,560	100.0	100.0	100.0
Collected	785,889	45,630	32,206	22.6	23.2	7.1
Burned by household	584,820	32,348	11,311	7.9	7.5	19.0
Public dump (container)	1,299,654	116,994	67,133	47.1	48.0	23.8
Public dump (open space)	2,061,403	280,109	26,269	18.4	17.4	42.9
Dumped indiscriminately	498,868	53,725	1,958	1.4	1.4	1.7
Buried by household	182,615	19,641	2,999	2.1	2.0	5.1
Other	53,805	5,187	684	0.5	0.5	0.3
Liquid waste						
Total	5,467,054	553,634	142,560	100.0	100.0	100.0
Through the sewerage system	183,169	14,000	7,277	5.1	5.2	3.4
Through drainage system into a gutter	594,404	60,735	41,581	29.2	30.0	8.0
Through drainage into a pit (soak away)	167,555	11,486	4,119	2.9	3.0	0.6
Thrown onto the street/outside	1,538,550	131,104	10,953	7.7	7.1	21.8
Thrown into gutter	1,020,096	119,736	58,905	41.3	41.6	35.3
Thrown onto compound	1,924,986	211,768	18,898	13.3	12.6	30.5
Other	38,294	4,805	827	0.6	0.6	0.3

Source: Ghana Statistical Services, 2010.

Tamale Metropolis

The Tamale Metropolitan Area (TAMA) is the second fastest growing metropolis in Ghana after Kumasi. The Tamale Metropolitan Assembly was established by legislative instrument (LI 2068) which elevated the then Municipal Assembly into a Metropolis in 2004 (Ghana Statistical Service, 2014c). At present, it is one of the six Metropolitan Assemblies in the country and the only Metropolis in the three Northern regions namely: Upper East, Upper West and Northern Regions. Tamale is strategically located in the Northern Region and by this strategic location, the Metropolis has a market potential for local goods from the agricultural and commerce sectors from the other districts in the region (Ghana Statistical Service, 2014b). Besides the comparative location of the Metropolis within the region, the area stands to gain from markets within the West African region from countries such as Burkina Faso, Niger, Mali and the northern part of Togo and en-route through the area to the southern part of Ghana.

The commonest toilet facility is used by 56.2 percent of households in the metropolis and that is public toilet (WC/KVIP/Pit latrine/pan) (Ghana Statistical Service, 2014b). The use of KVIP is the second commonest used by just 7.1 percent of households. As much as 26.1 percent of households in the district has no toilet facility. The most widely used method of solid waste disposal is by public dump (container) accounting for 98.3 percent households in urban areas and 1.7 percent in rural in the metropolis. About 72.5 percent of household in urban locations have their solid waste collected and for rural households only 27.5 percent have their waste collected. The commonest way of disposing of waste for most rural households (70.9%) is by indiscriminate dumping, even though in urban areas, 29.1 percent of households also dispose of waste by the same method. For liquid waste disposal, the largest proportion of households throw onto the street/outside or onto the gutter. Seventy two percent of urban households dispose of

by throwing onto the street/outside and that for rural households is 27.3 percent (Ghana Statistical Service, 2014b).

Table 3.4: Methods of waste disposal by households in the Tamale Metropolis

Method of waste disposal	Total country	Region	District			
			Total		Urban	Rural
			Number	Percent		
Method of rubbish disposal by household						
Total	5,467,054	35,408	35,408	100.0	82.8	17.2
Collected	785,889	1,652	1,652	100.0	72.5	27.5
Burned by household	584,820	2,886	2,886	100.0	66.6	33.4
Public dump (container)	1,299,654	20,934	20,934	100.0	98.3	1.7
Public dump (open space)	2,061,403	5,288	5,288	100.0	75.0	25.0
Dumped indiscriminately	498,868	3,685	3,685	100.0	29.1	70.9
Buried by household	182,615	798	798	100.0	59.4	40.6
Other	53,805	165	165	100.0	65.5	34.5
Method of liquid waste disposal by household						
Total	5,467,054	35,408	35,408	100.0	82.8	17.2
Through the sewerage system	183,169	595	595	100.0	96.3	3.7
Through drainage system into a gutter	594,404	6,151	6,151	100.0	98.0	2.0
Through drainage into a pit (soak away)	167,555	1,262	1,262	100.0	88.4	11.6
Thrown onto the street/outside	1,538,550	15,314	15,314	100.0	72.7	27.3
Thrown into gutter	1,020,096	7,535	7,535	100.0	98.7	1.3
Thrown onto compound	1,924,986	4,453	4,453	100.0	66.3	33.7
Other	38,294	98	98	100.0	85.7	14.3

Source: Ghana Statistical Service, 2010 Population and Housing Census

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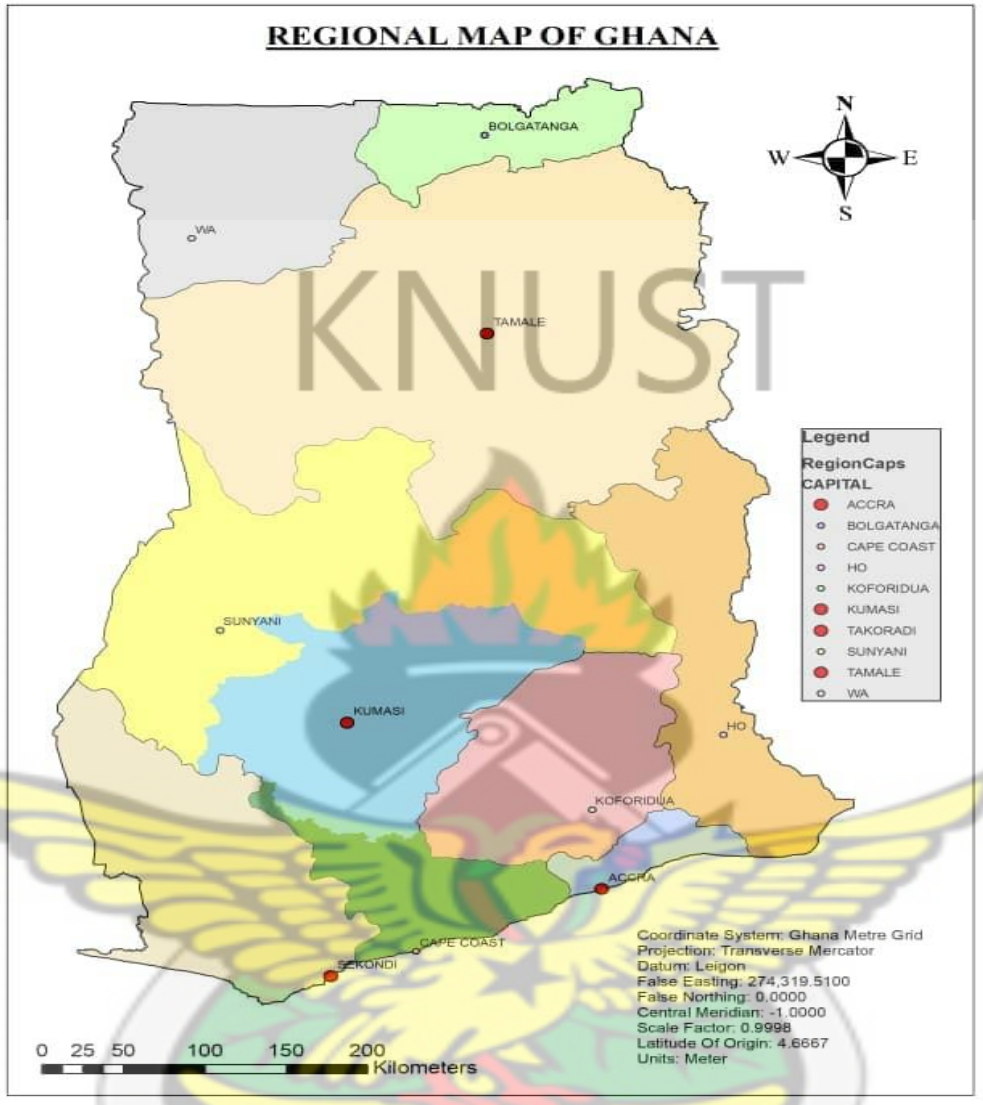


Figure 3.1: Map of Ghana showing the Geographical Regions and vegetative cover.

3.4 Study Population

The study population consisted of heads of households resident in the study area for the past 6 months, waste management service providers, heads of waste management departments at the assemblies. Heads of households were defined by members of the household while waste management service providers were used as defined by their company structure and by the MMDAs.

3.4.1 Inclusion and Exclusion Criteria

The study included consented heads of households and SWM service providers in the selected metropolitan assemblies in Kumasi, Accra, Takoradi and Tamale. Household heads who were outside the study area and or did not consent, and non- solid waste management services providers and service providers outside the study sites were excluded. 70% of the populations utilized waste management service.

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3.5 Sample Size Calculation

The sample sizes for all the quantitative cross sectional surveys were estimated using the single proportion formula by Cochran (1977); $n=z^2pq/d^2$, where: n= the desired sample size; z= the standard normal deviation 1.96 which corresponds to 95% confidence level. P = Proportion of the target population estimated to use solid waste management services, set at 60% (0.6), q = 1-p (1-0.6), d = margin of error, set at 3%, $n = (1.96)^2*0.6\ (1-0.6)/\ (0.03)^2 = 1{,}024$. With a design effect of 1.5, a sample size of 1,536 was rounded up to 1,600 to account for sampling variability. Based on the population size in the four study sites in 2017 ("Ghana Population 2017," n.d.), the sample size was allocated as 500 each in Accra and Kumasi and 300 each in Takoradi and Tamale.

3.6 Method of Sampling

The study employed a multistage random sampling technique (combined cluster sampling and simple random sampling techniques). The metropolis were clustered into sub-metros. Then within the sub-metro, the households were selected from clustered households based on electoral areas by random sampling. Those who consented were interviewed, and where there

are more than one eligible households, the lottery method was used to pick one household to reduce redundancy. During this exercise, papers with inscription "YES" and "NO" were developed and put in a cup for potential heads of households who met the inclusion criteria to pick. Those who picked "YES" were enrolled while those who picked "NO" were excluded. In each sub-metro, a house opposite sub-metro office was used as the starting point and within the house; a household was randomly selected to start the interview. The number of households for the various sub-metros was calculated with an assumption that.

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Table 3.5: Summary of methodology

S/N	Objective	Methods	Data analysis
1	Utilization of Household SWMS	• **Study** 1: Mixed methods • **Sample**: 1600 heads of household; 13 SWM firms; 6 stakeholders (key informants) • **Data collection**: Questionnaire; in-depth interviews	Descriptive statistics, Bivariate (Chi Square, ANOVA, Logistic regression
2	Current financing options	• **Study 2**: Mixed methods • **Sample**: 13 SWM firms; 6 stakeholders (key informants) • **Data collection**: Questionnaire; in-depth interviews	Descriptive analysis, thematic analysis of in-depth interview and quotations from respondents
3	Consumers acceptability and willingness to pay for improved SWM services	• **Study1:** Quantitative survey • **Sample**: 1600 heads of households • **Data collection**: Questionnaire	Descriptive statistics, Bivariate (Chi Square, ANOVA, Logistic regression
4	Trends of environmental related diseases	• **Study 3** :Data extraction from Database	Trend Analysis

		• **Sample**: 2012 to 2017 data from DHIMS 2 • **Data collection**: Hospital data/ Reports, DHIMS Report, Desk review	
5	Governance and financing model	• **Study 4:** Mixed methods • **Sample:** 6 stakeholders (key informants) • **Data collection**: Document review; in-depth interviews	Descriptive statistics

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3.7 Study Variables

Table 3.6: Variable table

Objectives	**Dependent variable**	**Independent variable**	**Conceptual definition**	**Scale of measurement**	**Indicators**	**Data collection methods**	**Type of statistical analysis**
To examine the current level of utilization of household solid waste management services	Utilization of service	Economic incentive, proximity, price/charges, socio-	Extent to which group access service	Nominal & ordinal	Proportion	Questionnaire, literature review	Descriptive and inferential

		econ status					
To examine the current financing options for municipal household solid waste management	Financing option	Type of service, household characteristics, Location, service quality, Type of consumer, etc		Nominal & ordinal	Proportion/frequency, coefficient, SE, CI, etc	Records checklist, questionnaire, literature review	Descriptive and inferential
To evaluate consumers' ability-to-accept and pay municipal household solid waste services	Willingness and ability to accept and pay	Income, education,socio-economic status, attitude,	Maximum amount a person is willing to pay	Nominal & ordinal	Proportion/frequency, coefficient, SE, CI, etc	Questionnaire	Contingency valuation method/sensitivity analysis

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To analyse the trends of environmental sanitation related diseases	Environmental sanitation related disease	Poor waste disposal, Socio economic status, Educational level		Ordinal and categorical	Frequencies of occurance,Odds ratio	Reports from hospitals, DHIMS report	Trend Analysis
To develop a governance and financing model for municipal household solid waste management	financing model	Type of service, household characteristics, Location, service quality, Type of consumer, etc		Nominal & ordinal	Proportion/ frequency, coefficient, SE, CI, etc	Questionnaire	Descriptive & Inferential statistics

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3.8 Data Collection Tools and Techniques

Data for the study were obtained from both primary and secondary sources. Primary data collection tools were structured questionnaire, interview guide and checklists comprising both closed and open-ended questions.

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3.8.1 Primary data

Data were collected mainly with the use of structured questionnaires and in-depth interview guides. The questionnaires were used to elicit responses from household heads on their socio-economic characteristics, utilization of SWM services, experiences with current SWM services and willingness-to-pay for extra or improved SWM services. The questionnaire were administered with assistance of 20 trained graduate research assistants through face-to-face interview. Questionnaire and data collected were checked for consistency and protected under lock and key. The qualitative study involved in-depth interviews, which were also conducted with waste management departments in the four Metropolitan Assemblies and Solid Waste Management Service providers.

All qualitative interviews were tape-recorded by a note taker, tape with permission from participants. The questionnaires and interview guides used are attached as Appendices A and B. For reliability and validity of the study conclusions, a 3-day training sessions were held for the research assistants by the principal investigator. The data collection tools were pre-tested on 50 households prior to the data collection. Prior to data collection, the study was explained to respondents and consent was duly sought. As already explained, the sample size was scientifically estimated and respondents were sampled using probability sampling techniques to minimize biases. The data was subjected to rigorous statistical analysis and were collected from multiple sources in order to triangulate or validate the responses.

3.8.2 Secondary data

Additionally, secondary data consisted of extensive review of existing literature on the waste management service and financing options. Data were also derived from relevant search engines and databases such as Google, Pubmed, Google Scholar to retrieve articles from journals and reports of similar researches conducted. Data related to health conditions in the selected sites were extracted from the DHIMS2 interface and annual Metropolitan Health Reports.

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3.9 Data Analysis

All the study variables were analyzed qualitatively and quantitatively. The qualitative analysis was used to further explain the numbers produced by the quantitative analysis. The qualitative interviews and discussions were conducted and audio-taped in English language, then transcribed with the help of a professional transcriber. The data was coded and summarized using NVIVO version 11.

Quantitative data were analyzed as follows. The background information of respondents were assessed and categorized into socio-economic status using income, assets index or other available data. Data were first presented as frequency tables or charts to assess the distribution. This was followed by bivariate analysis where selected study variables were related to the various outcomes of interest from the study objectives. The final stage of the analysis explored the strength of study independent variables in influencing the outcomes of interest. Where necessary relevant variables were controlled for in assessing their influence or impact on the outcome of interest.

3.9.1 Quantitative data

The collected data was validated for completeness and accuracy. The cleaned data were entered using a template that is created in Microsoft Excel or SPSS and imported to SPSS version 22 (IBM Corp. Released, 2015) for analyses. Data were checked for completeness and accuracy on a daily basis so that irregularities can be detected promptly.

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General characteristics were summarized as proportions and mean ± standard error of the mean (SEM) and stratified by study site. Bivariate associations were tested using Pearson and ordinal (linear) Chi-square for categorical and ordinal data respectively. Continuous variables were tested using one-way analysis of variance (ANOVA). Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated to assess the socio-demographic characteristics associated with the utilization and SWM services. The socio-demographic characteristics included are described in Table 2. In the adjusted model, interactions terms were added for site and education, residence and type of residence. Based on the Akaike's Information Criterion (AIC), the model with interactions terms for site, residence and type of residence was selected. A stratified analysis of association between residence and type of residence and utilization of SWM services.

The association between socio-economic characteristics on the willingness to pay for SWM services was also assessed using univariable and multivariable logistic regression analysis. In the multivariable analysis, a backward selection procedure was applied to select the predictors of willingness to pay for SWM services. All statistical tests were conducted at a significance level of $p<0.05$. Data were analyzed with SPSS version 22 (IBM Corp. Released 2015).

The logistic regression model

- Logistic model: $(y_i|X_i) \sim Bin(n, p_i)$
    - $\mathrm{E}(y_i|X_i) = \mu_i = p_i = e^{\eta_i}/(1 + e^{\eta_i})$ systematic part
    - $\mathrm{Var}(y_i|X_i) = \mu_i(1 - \mu_i)$ random part (error), according to the binomial distribution

Key assumptions:

- The linear predictor η_i is a non-linear function of the mean μ_i: $\eta_i = \log(\mu_i/(1 - \mu_i))$
- Random part is a function of the mean: $\mathrm{Var} = V(\mu) = \mu_i(1 - \mu_i)$
    - ***No uniform variance for everybody. No assumption of homoscedasicity.***

For this analysis, our data was coded 1=utilizes waste management services and 0=do not utilize waste management services.

The logistic regression formula for determining the probability of utilizing SWM services and the willingness to pay is given as;

$$\mathrm{Prob\ of\ a\ case} = \frac{\exp\left[\beta_0 + \beta_1 X_1 + \beta_2 X_3 + \ldots + \beta_p X_p\right]}{1 + \exp\left[\beta_0 + \beta_1 X_1 + \beta_2 X_3 + \ldots + \beta_p X_p\right]}$$

Where; $X_1 \ldots X_p$ are the predictors (independent variables)

$\beta_1 \ldots \beta_p$ are the coefficients of the predictors

β_0 is the constant value.

Willingness to pay

The willingness-to-pay for waste management services was estimated based on the contingent valuation (CV) method. Contingent valuation surveys are argued to be a viable method of collecting information on preferences for providing public goods and services in developing countries (Whittington, 2002). Using this method, many empirical studies have provided evidence that households are willing to pay a significant amount for the provision of improved waste management (Afroz et al., 2009; Niringiye and Omortor, 2010).

The willingness-to-pay of a group of consumers for a particular product at a price (or bid) B can be assumed to have a certain probability distribution function (Kimenju and De Groote, 2007). This distribution function can be seen as a function of price, with a higher price having lesser probability of being accepted. In applied research, the logistic distribution is commonly used, and the effect of price is entered indirectly in an argument called the index function, denoted as v. The most common index function is linear in the price or bid B:

$$v = \alpha - \rho B, \quad (1)$$

and the probability distribution of the WTP is then presented by

$$P(WTP = B) = \exp(v)/(1+\exp(v))^2 \quad (2)$$

The logistic function has the advantage of a closed-form cumulative distribution function $G(.)$, which then represents the proportion of the population whose WTP lies below a certain value B:

$$G(B) = P(WTP < B) = \exp(v)/(1+\exp(v)). \quad (3)$$

People who will accept an offer of value B are those whose WTP is equal to, or higher than B, (Hanemann & Kanninen, 1996).

In the double-bounded dichotomous choice model, the consumer is presented with two consecutive bids, and the second bid depends on the response to the first. If the consumer answers "yes" to the first bid (B_i), the second bid (B_i^u) is set higher,

but if the individual responds "no" to the first bid, the second bid (B^d) is set lower. There are four possible outcomes: "yes" to the first bid followed by a "yes" to the second bid (with probability denoted by π followed by "yes" (π^{ny}); and two consecutive "no" answers (π^{nn}).

To receive information on a wider range of values, different amounts for the bids are assigned randomly between respondents i. The probability of receiving a "yes" answer to both questions equals to the probability that the respondent's WTP is higher than the highest bid offered:

$$\pi_i^{yy}(B_i, B_i^u) = \Pr(B_i^u < WTP) = 1 - G(B_i^u). \quad (4)$$

Similarly, the probability of receiving a "yes" followed by a "no" equals the probability that the WTP of respondent i lies between the initial bid and the second, higher bid offered:

$$\pi_i^{yn}(B_i, B_i^u) = \Pr(B_i^u < WTP_i < B_i^u) = G(B_i^u) - G(B_i). \quad (5)$$

The probability of receiving a "no" followed by a "yes" is again the probability that *WTP* lies between the individual and the second bid, now the lower bid offered:

$$\pi_i^{ny}(B_i, B_i^d) = \Pr(B_i^d < WTP_i < B_i) = G(B_i) - G(B_i^d). \quad (6)$$

Finally, the probability of receiving two "no" answers are equal to the probability

that WTP lies below the second bid offered:

$$\pi^{nm}(B, B^a) = \Pr(B^a < WTP) = G(B^a) \quad (7)$$

Combining the probabilities of four outcomes, the log-likelihood function for a sample of N consumers takes the form

$$\ln L^D(\theta) = \sum_{i=1}^{N} \{d_i^{yy} \ln \pi^{yy}(B_i, B_i^u) + d_i^{nm} \ln \pi^{nm}(B_i, B_I^d) + d_i^{yn} \ln \pi^{yn}(B_i, B_I^d) + d_i^{ny} \ln \pi^{ny}(B_i, B_I^d)\}, \quad (8)$$

Where $d_i^{yy}, d_i^{mn}, d_i^{yn}, and\ d_i^{ny}$ are binary variables with 1 denoting the occurrence of that particular outcome, and 0 otherwise.

Household willingness to pay for improved solid waste management can be specified as:

$$WTP = \alpha + \rho b + \beta z + \varepsilon \quad (9)$$

Where b represents the last bid level which the respondent was offered, z is socio economic factors and ε is the random variable accounting for unobserved factors, $\alpha, \rho\ and\ \beta$ are parameters to be estimated.

The empirical formulation of equation (9) is finally formulated as:

$$WTP = \alpha + \rho b + \beta_1 AGE + \beta_2 GEN + \beta_3 EDU + \beta_4 MARI + \beta_5 EMP + \beta_6 OCC + \beta_7 INC + \beta_8 RESI + \varepsilon \quad (10)$$

Where *AGE* is the age of the respondent, *GEN* is the gender of the respondent, *EDU* is the level of education of the respondent, *INC* is the average monthly income of the respondent, *MARI* is the marital status of the respondent, *EMP* is the employment status of the respondent, *OCC* is the occupation of respondent, *RESI* is the residence of the respondent.

Table 3.7: Description of explanatory variables

Variable	Contextual definition
Age	Age of respondents in years
Sex	Sex of respondents; male, female
Education	Educational level of respondents; no formal, basic, Senior High School, post-secondary, tertiary
Marital Status	Married, cohabiting, single, divorce or widowed
Employment status	Respondents' employment status; employed, unemployed
Area of occupation	Private sector, government (civil or public servants), self-employment (informal sector)
Residence	Urban, peri-urban or rural
Description of residency	Estate, new site, inner-city or old town, slums, zongos
Rate of economic status	Very rich, rich, moderately rich, poor, very poor
Duration of stay in community	Length of stay of respondents in their respective communities
Amount earned from economic activities	Total monthly income from all economic activities
Study site	Cities where the study was conducted

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Appropriate financing mechanism

An appropriate financing mechanism is one that combines all possible financing options to cater for the rising cost of waste management. For instance, Aldrich and Eisner (1975), proposed a financing mechanism that encompasses provision of subsidy by the Government

through the municipality, purchasing of by-products and raising of funds through bonds to raise capital for finance solid waste management (Figure 3.2).

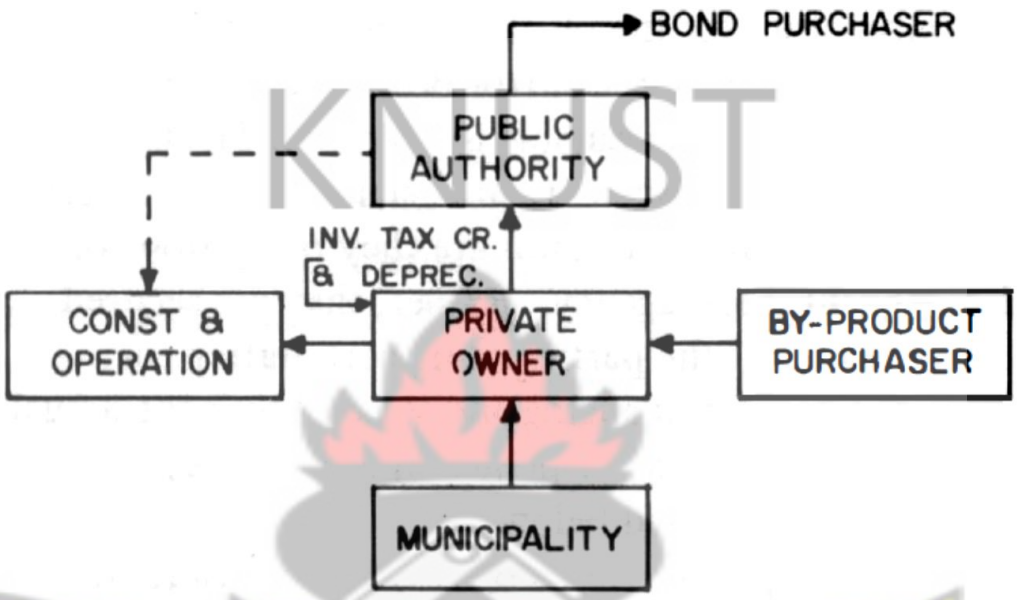


Figure 3.2: Financing solid waste management. *Source: Aldrich and Eisner, (1975)*

The current study posits that the existing financing options are inappropriate as they leave out important element such as input from client, input from service providers, public health dimension and other key stakeholders. The existing situation is demonstrated by the equations 1-4 below:

$$User\ charges\ (U)\ alone = Unsustainable\ finance\ mechanism \quad (1)$$

$$Government\ subsidy\ (G)\ alone\ = Unsustainable\ finance\ mechanism \quad (2)$$

$$By-product\ purchasing\ (B)\ alone = Unsustainable\ finance\ mechanism \quad (3)$$

$$Loans\ or\ grants\ or\ bonds\ alone\ (L) = Unsustainable\ finance\ mechanism \quad (4)$$

$$U + ([G\ or\ B\ or\ L] or\ [(G + B) or\ (G + L)\ or\ (B + L)]) =$$

$$Improved\ finance\ mechanism \quad (5)$$

$$U + G + B + L + H = Sustainable\ finance\ mechanism \quad (6)$$

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As described by equations 5 and 6, the combination of user charges (U) with any other form of financing, government subsidy (G), by-product purchasing (B) or loans or grants (L) could lead to some improvement in the financial mechanism for SWM in Ghana. However, for a sustainable finance mechanism, as shown in equation 6, a combination of all available options is required. The diagram below captures few of the options that can be adopted in addition to the user charges/polluter pay.

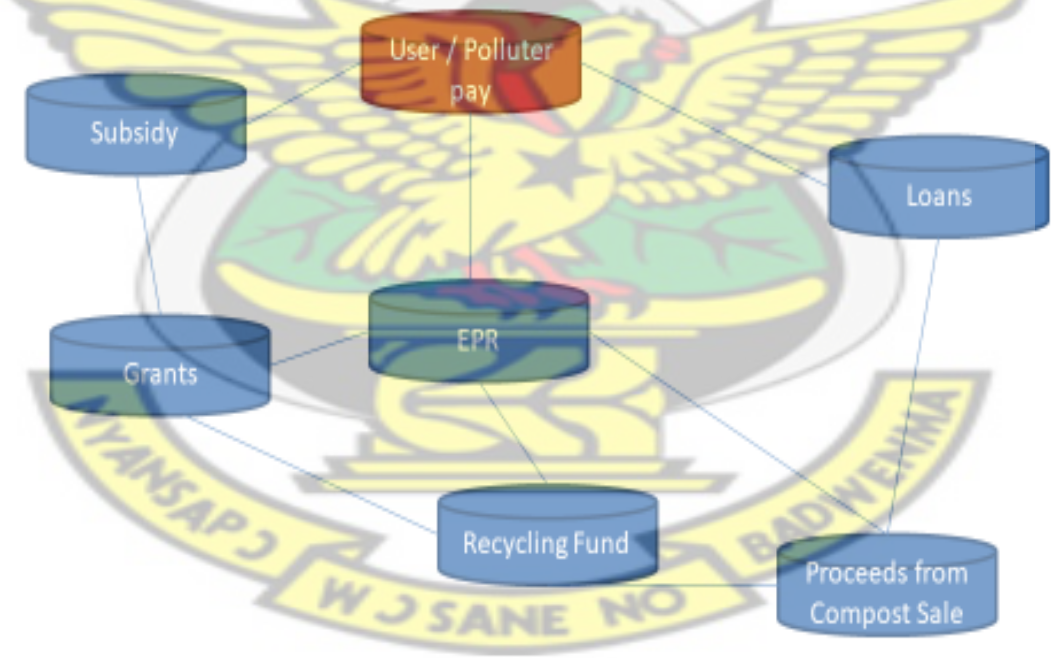


Figure 3.3: Financing options/ mechanisms for household solid waste management

Source: Author's construct, (2018)

3.9.2 Qualitative Data

The perceptions, views and experiences of stakeholders, including SWM companies and municipal and metropolitan staff were analyzed as follows: Recorded interviews were transcribed verbatim in the language used in the interview. Qualitative data was thematically analyzed using variable matrix, flow charts and relevant quotes to highlight results. The analysis was supplemented with the use of NVIVO version 11 software. The codes were stored within nodes in the software. We further identified duplications in the codes and then explored possible connections between various themes, with the use of electronic memos in the software.

3.10 Ethical Considerations

Consent of respondents were sought after the study intent, procedure, expected risks and benefits had been explained to them. In addition, the confidentiality and anonymity and right to withdraw at any stage of the study were elaborated in the consenting process. Prior to the implementation of the study, the study protocol were submitted to the Committee for Human Research Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST) for review and clearance which were successfully done. Permission were also sought from the Waste Management Department of the Metropolitan Assemblies and other waste management service operators. Throughout the process confidentiality, beneficence and other ethical principles were strictly adhered to.

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3.11 Limitations of the study

This study is the first nationwide survey that looks at the utilization of SWM services in Ghana, and documenting the experiences and perceptions of households across four regional capitals in the country. By ensuring consistent measures and data collection across sites, it is believed that findings from this study are more generalizable and applicable to the Ghanaian context. This study also document some important predictors of utilization of SWM in Ghana, nonetheless, not all factors were explore. Household wealth, for instance was not assessed and utilized in this study. The perception of socio-economic status, income and educational levels, which is believed to be useful proxies for the socio-economic position of the household were however assessed although households were likely to conceal information on their economic status. There was also the possibility of information concealment and inaccurate information from the stakeholder, regarding the current managerial and financing challenges of solid waste management in Ghana.

3.12 Quality Control

High quality standard was strictly ensured throughout the study and research assistants were trained on the basic research methods prior to data collection. All data collection tools were pre and pilot tested before used. The study held discussions and/or outsource, where necessary, the services of experts in the various aspects to improve quality.

3.13 Assumptions of the Study

- It is assumed that the sample size is a representative of people who utilize waste management service in the study area.
- It is also assumed that 70% of the population utilize waste management services.
- Furthermore, responses from the participants is a true reflection of the current situation.
- Tools used to collect and analyzed data were accurate.
- The confidence interval set at 95% with 5% significant level is appropriate.
- The study design is appropriate to investigate the issue.

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CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the results of the study. The results are presented in tables and figures preceded by a narration. The section is organized according to the objectives of the study.

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4.1 Background Characteristics of Respondents

4.1.1 Background characteristics of Heads of Households

The mean age of the study participants was (35+sd) years and participants from the Northern and Ashanti Regions were significantly older than those from the Western and Accra (Table 4.1). Overall, less than half (45.8%) of the study participants were men. However, per study site, more than half of study participants from Takoradi (51.2%) and Accra (60%) were males. Accra had the highest proportion of respondents with tertiary education (77.7%) Kumasi had the lowest proportion of participants with tertiary education (25.5%) and highest proportion of respondents with no formal education (15.0%).

Most of the participants were employed (93.5%) and Kumasi had the highest proportion of participants working in the informal sector (73.3%). The proportion of residents in estates and new sites was highest in Takoradi (27.8%; 36.6%) and lowest in Kumasi (8.8%; 22.2%), whiles the Kumasi site had the highest proportion of participants resident in old towns (43.7%).

Table 4.1: Socio-economic characteristics of respondents, stratified by study site

Variables	Total	Takoradi	Tamale	Accra	Kumasi
N	**1560**	**295**	**297**	**467**	**501**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Age in years, (mean±SD)	35±0.3	29±0.5	38±0.7	31±0.4	39±0.6
Male household head	715 (45.8)	151 (51.2)	85 (28.6)	280 (60.0)	199 (39.7)
Education Level					
– Never been to school	117 (7.5)	7 (2.4)	31(10.4)	4 (0.9)	75 (15.0)
– Basic education*	184 (11.8)	30 (10.2)	37 (12.5)	8 (1.7)	109 (21.8)
– Senior High School	323 (20.7)	51 (17.3)	54 (18.2)	68 (14.6)	150 (29.9)
– Post- Secondary (training/vocational)	140 (9.0)	39 (13.2)	38 (12.8)	24 (5.1)	39 (7.8)
– Tertiary (Diploma & Degree)/ other	796 (51.0)	168 (56.9)	137 (46.1)	363 (77.7)	128 (25.5)
Marital status					
– Single	605 (38.8)	185 (62.7)	55 (18.5)	223 (48.8)	137 (27.3)
– Married	831 (53.3)	97 (32.9)	219 (73.7)	203 (43.5)	312 (62.3)
– Co-habitation	45 (2.9)	6 (2.0)	3 (1.0)	28 (6.0)	9 (1.8)
– Widow/Divorce	75 (5.0)	7 (2.4)	20 (6.7)	8 (1.7)	43 (8.6)
Type Employed	1457 (93.5)	271 (91.9)	279 (93.8)	427 (91.4)	42 (96.2)
Occupation					
– Government (Civil servants)	303 (19.4)	96 (32.5)	88 (29.6)	75 (16.1)	43 (8.6)
– Private	488 (31.3)	78 (26.4)	53 (17.8)	267 (57.2)	91 (18.2)
– Self-employment (informal sector)	769 (49.3)	121 (41.0)	156 (52.5)	125 (26.8)	367 (73.3)
Type of occupation	*N=1347*	*N=260*	*N=272*	*N=396*	*N=419*

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– Skilled	836 (62.1)	157 (60.4)	180 (66.2)	300 (75.8)	199 (47.5)
– Semi-skilled	366 (27.2)	78 (30.0)	51 (18.8)	71 (17.9)	167 (39.9)
– Unskilled	144 (10.7)	25 (9.6)	41 (15.1)	25 (6.3)	53 (12.6)
Amount earned from all	*N=1218*	*N=227*	*N=228*	*N=323*	*N=440*
economic activities, GH₵,	900.00	800.00	1000.00	1100.00	800.00
median (25^{th}, 75^{th} percentile)	(500.00, 1500.00)	(500.00, 1500.00)	(500.00, 1600.00)	(600.00, 2000.00)	(500.00, 1200.00)
– ≤300	150 (12.3)	28 (12.3)	23 (10.1)	25 (7.7)	74 (16.8)
– 300-600	276 (22.7)	68 (30.0)	50 (21.9)	50 (18.0)	101 (23.0)
– 600-100	334 (27.4)	57 (25.1)	56 (24.6)	77 (23.8)	144 (32.7)
– >1000	457 (37.5)	74 (32.6)	99 (43.4)	163 (50.5)	121 (27.5)
Rate of socio-economic					
status	101 (6.5)	29 (9.7)	7 (2.4)	15 (3.2)	51 (10.2)
– Very rich	172 (11.0)	35 (12.0)	40 (13.4)	30 (6.4)	67 (13.4)
– Rich	1139 (73.0)	197 (66.7)	197 (66.4)	395 (84.6)	350 (69.9)
– Moderately rich	147 (9.4)	34 (11.6)	53 (17.8)	27 (5.8)	33 (6.6)
– Poor					
Place of residence					
– Estate	293 (18.8)	82 (27.8)	40 (13.5)	127 (27.2)	41 (8.8)
– New site	423 (27.1)	108 (36.6)	80 (26.9)	123 (26.3)	111 (22.2)
– Inner-city	262 (16.8)	30 (10.2)	37 (12.5)	134 (28.7)	61 (12.2)
– Old town	367 (23.5)	34 (11.5)	77 (25.9)	37 (7.9)	219 (43.7)
– Slums	19 (1.2)	5 (1.7)	5 (1.7)	4 (0.9)	4.0 (0.8)
– Zongo	123 (7.9)	26 (8.8)	47 (15.8)	23 (4.9)	27 (5.4)
– Other	75 (4.8)	10 (3.4)	11 (3.7)	19 (4.1)	3.0 (7.0)
Description of residency					
– Urban	1196 (76.7)	226 (76.6)	235 (79.1)	359 (76.9)	376) (75.0)

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– Peri-urban	363 (23.3)	69 (23.4)	62 (20.9)	206 (23.1)	125 (25.0)
Duration of stay in	*N=1467*	N=291	N=260	N=445	N=471
community, years, median	7 (4, 17)	5 (3, 11)	6 (3, 18)	7 (4, 15)	10 (4, 20)
(25th, 75th percentile)					
– <5	604 (41.2)	157 (54.0)	130 (50.0)	179 (40.2)	138 (29.3)
– 5-10	359 (24.5)	61 (21.0)	55 (21.2)	123 (27.6)	120 (25.5)
– 10-15	120 (8.2)	20 (6.9)	8 (3.1)	45 (10.1)	48 (10.2)
– 15-20	150 (10.2)	40 (13.7)	12 (4.6)	38 (8.5)	59 (12.5)
– >20	235 (16.0)	13 (4.5)	55 (21.2)	60 (13.5)	106 (22.5)
Number of dependents	*N=1223*	*N=119*	*N=76*	*N=155*	*N=313*
Median (25th, 75th	2 (3,5)	2 (2, 4)	4 (3, 6)	3 (2, 4)	3 (2, 5)
percentile)	15 (1.2)	0 (0.0)	0 (0.0)	3 (2.2)	5 (1.7)
– 0	185 (15.1)	24 (20.4)	5 (6.4)	25 (15.9)	52 (16.7)
– 1	303 (24.8)	48 (40.7)	12 (15.7)	39 (25.1)	65 (20.9)
– 2	216 (17.7)	15 (12.4)	14 (19.1)	35 (22.8)	48 (15.2)
– 3	504 (41.2)	32 (26.5)	45 (58.9)	53 (34.0)	142 (45.5)
– ≥4					

SEM, standard error of the mean; **Primary and Junior High School*

Source: Field work,2017.

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4.1.2 Background Characteristics of Waste Management Companies/Firms

Thirteen staff were interviewed from eight waste management service providers in this study as detailed in Figure 4.1.

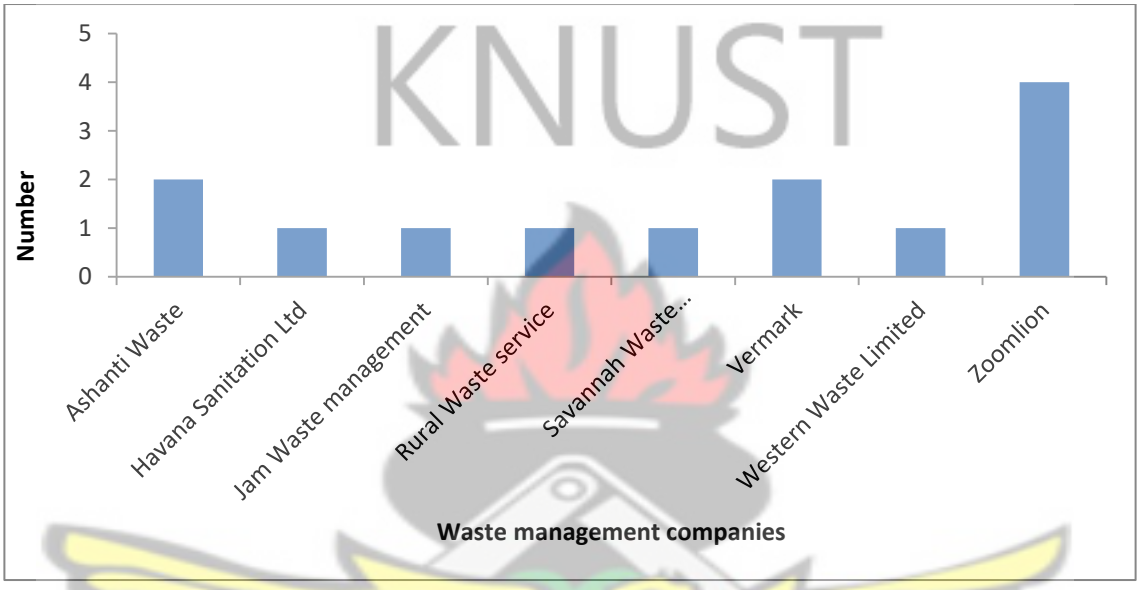


Fig 4.1: Number of respondents from Waste Management firms

Source: Fieldwork, 2017

Table 4.2 shows results of the background characteristics of respondents and their firms involved in this study. Majority, 53.9% of the staffs interviewed were general or operation managers with 2 (15.4%) being regional coordinators and 1 (7.7%) Chief Executive Officer. Majority had worked with their firms for more than 7 years (53.8%) and held masters degrees (61.5%). Most of the firms were limited liability companies (76.9%) and had existed for 6- 10 years (53.8%) with three of them being in existence for more than 10 years. More than half of them were into management of both solid and liquid waste (53.8%) with one of them (7.7%) being involved in E-waste as well.

Almost all with the exception of one firm provided services to domestic and industrial premises (92.3%). Only one of them provided fumigation and vector control services (7.7%) with one them (7.7%) going into landfill management in addition to house hold waste collection. Eleven (84.6%) of the firms indicated that they have valid contract with their respective municipal assemblies to manage household waste. The means by which the contracts were given as disclosed by respondents included unsolicited proposal 1 (7.7%), competitive tendering 6 (46.2%), Public private partnership 1 (7.7%). The duration of contract was one year (1, 7.7%), 2 years (1, 7.7%), 3 years (1, m 7.7%) and 5 years (5, 38.5%).

Table 4.2: Background characteristics of respondents from service providers

Variables	Frequency	Percentage (%)
Position of Staff		
– Administration	1	7.7
– CEO	1	7.7
– General/ Operations Manager	7	53.9
– Head of Environmental Sanitation	1	7.7
– Head of operations	1	7.7
– Regional coordinator	2	15.4
Number of years in the company		
– <5years	2	15.4
– 5-7years	4	30.8
– 7-10years	7	53.8
Academic qualification		
– HND	1	7.7

– Degree	4	30.8
– Masters	8	61.5
Number of staff under you		
– 5-10	3	23.1
– 10-20	2	15.4
– 20-40	2	15.4
– >40	6	46.2
Years of existence of company		
– 3-5	3	23.1
– 6-10	7	53.8
– >10	3	23.1
Nature of company		
– Sole proprietorship	3	23.1
– Limited liability company	10	76.9
– Partnership	-	-
Area of specialty		
– Only solid waste	6	46.2
– Only liquid waste	-	-
– Both solid and liquid waste	7	53.8
Services provided by firms*		
– Solid waste management service to domestic premises	12	92.3
– Solid waste management service to commercial/trade premises	13	100
– Solid waste management service to industrial premises	12	92.3
– Communal waste collection services	11	84.6
– Street sweeping	6	46.2

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–	Drain/sweeping	5	38.5
–	Landfill management	1	
–	Other, fumigation and vector control	1	7.7

*Source: Field work, 2017 CEO=Chief executive officer *multiple response question*

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4.2 Utilization of Household Solid Waste Management Services

4.2.1 Utilization and Quality of household Solid waste Management Services, Stratified by Site

The level of utilization of household SWM services was sub optimal with a mean value of 55% in the whole study population, (Figure 4.2). Other ways of waste disposal including sending to a communal container site (22%) and burning or putting in a dug pit (22%). The proportion that burnt waste or disposed in a dug pit was highest in Kumasi (36.1%) and lowest in Takoradi (14.2%).

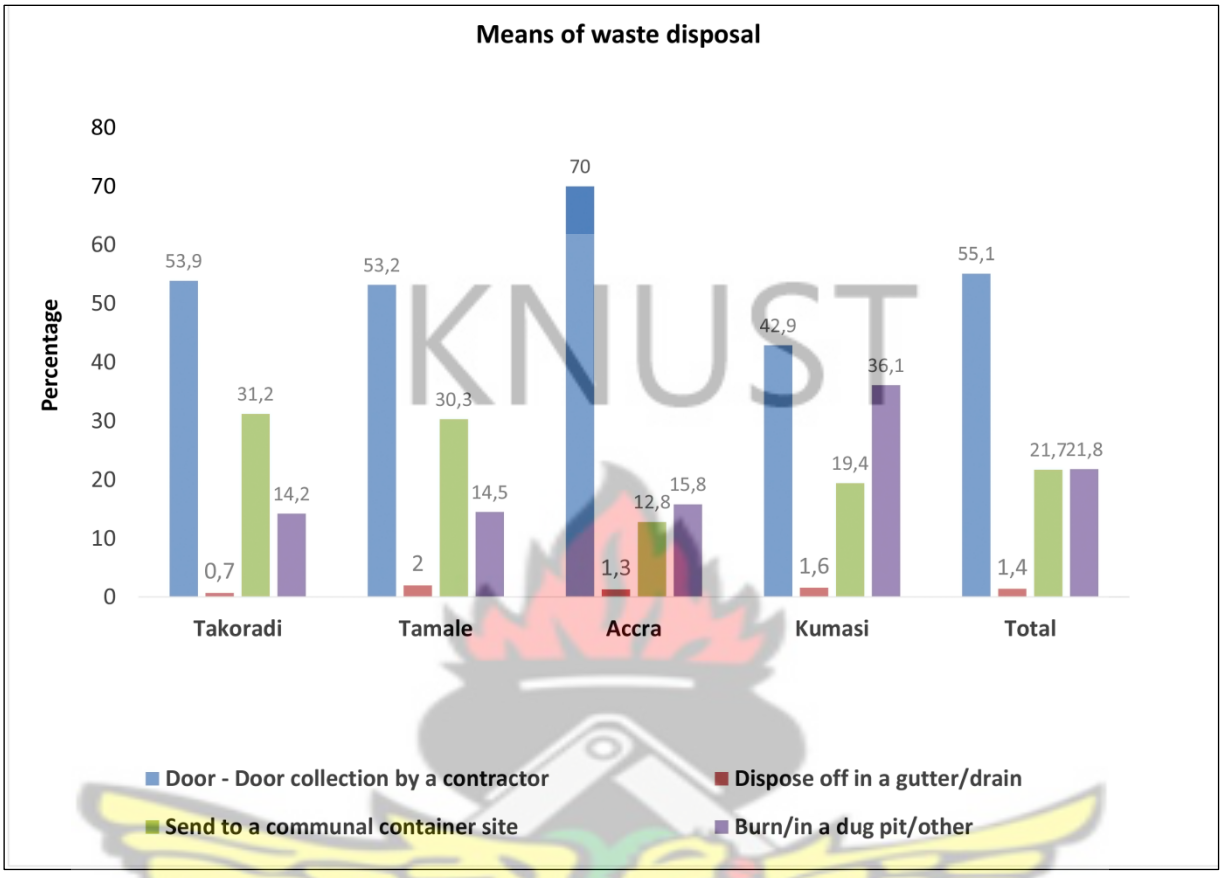


Figure 4.2: Ways of household solid waste disposal, stratified by site

Source: Fieldwork, 2017.

Compaction truck was the most cited equipment used in collecting waste at all sites (Takoradi, 61.2%; Tamale 44.6%; Accra, 52.2%), with the exception of Kumasi (20.2%) where the tricycle machine was the most cited waste collection equipment (Table 4.3). The compaction truck was also the most preferred waste collection equipment at all sites (Takoradi, 76.9%; Tamale 71.0%; Accra, 76.1%),, with the exception of Kumasi (41.5%). Satisfaction with the service provision was relatively higher in the Tamale, where 60.5% were very satisfied with service provision. At Takoradi, 39.5% and 34.5% were moderately and very satisfied respectively whereas 34.9% and 38.3% were moderately and very satisfied in Kumasi respectively. The service mostly

satisfied with was regular and timely lifting of waste (64.9%) followed by the moderate fees charged (23.5%). Displeasures with service delivery was mainly container overflows (60.5%).

Provision of receptacles was significantly higher in the Takoradi (51.1%) and lowest in Kumasi (20%). Less than half of the participants from Tamale (35.4%) and Kumasi (36.7%) as compared to majority from Takoradi (52.7%) and Accra (58.9%) paid for the receptacles. Majority of participants who were not supplied with receptacles in Kumasi stored refuse in normal buckets (55.1%), whereas participants in Tamale (78.1%) and Accra (75.6%) stored refuse in other materials or containers in the absence of receptacles. This included aluminum containers, jute bags, metallic bins and sacks. Majority of respondents (65.4%) were willing to pay for receptacles.

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Table 4.3: Utilization and quality of household solid waste management services, stratified by site

Variables	Total	Takoradi	Tamale	Accra	Kumasi
Utilized SWM services, N	**859**	**159**	**158**	**327**	**215**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Have agreement/contract with the contractor	524 (61.0)	110 (69.0)	131 (82.8)	212 (66.0)	79 (36.8)
Type of equipment used to collect waste					
– Compaction truck	376 (43.8)	97 (61.2)	70 (44.6)	171 (52.2)	43 (20.2)
– Tricycle machine	360 (41.9)	25 (15.9)	74 (46.9)	138 (64.4)	
– Skip truck	46 (5.4)	18 (11.6)	6 (4.0)	121 (37.0)	6 (2.9)
– Push cart	38 (4.4)	7 (4.3)	5 (2.9)	9 (4.2)	
– Wheelbarrow	40 (4.6)	11 (6.9)	3 1.7)	14 (4.2)	18 (8.3)
				17 (5.2)	
				4 (1.3)	
Preferred equipment for waste collection					
– Compaction truck	565 (65.8)	122 (76.9)	112 (71.0)	249 (76.1)	89 (41.5)
– Tricycle machine	198 (23.0)				96 (44.6)
– Skip truck/wheelbarrow	96 (11.2)	16 (10.1)	32 (20.5)	48 (14.6)	30 (13.9)
		21 (13.0)	13 (8.5)	30 (9.3)	
Services provided by contractors adequately meet needs	635 (73.9)	117 (73.3)	128 (80.2)	248 (75.8)	147 (68.6)

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Rate of satisfaction with the	*N=635*	*N=113*	*N=127*	*N=248*	*N=147*
services	50 (7.9)	10 (8.5)	13 (9.9)	12 (4.7)	15 (10.2)
– Not at all satisfied	92 (14.5)	13 (12.0)	6 (4.9)	42 (16.9)	28 (19.2)
– Slightly satisfied	222 (34.9)	45 (39.5)	24 (19.1)	101	51 (34.9)
– Moderately satisfied	243 (38.3)	39 (34.5)	77 (60.5)	(40.8)	56 (38.3)
– Very satisfied	28 (4.4)	6 (5.5)	7 (5.6)	87 (35.2)	6 (4.4)
– Extremely satisfied				6 (2.4)	
Services satisfied with	*N=635*	*N=113*	*N=127*	*N=248*	*N=147*
– Regular and timely lifting	412 (64.9)	61 (54.0)	94 (74.3)	140	116 (78.9)
– Prompt feedback	57 (8.9)	17 (15.0)	12 (9.7)	(56.4)	11 (7.5)
– Moderate fee charged	149 (23.5)	33(29.2)	20 (16.0)	17 (6.9)	17 (11.4)
– Other (specific)	17 (2.7)	2 (1.8)	0 (0.0)	79 (32.0)	3 (2.2)
				12 (4.7)	
Displeasures with services	*N=220*	*N=43*	*N=30*	*N=79*	*N=68*
– Container overflow	133 (60.5)	23 (54.0)	18 (61.4)	42 (53.2)	49 (72.1)
– Indiscipline of staff	30 (13.6)	6 (13.3)	5 (17.5)	12 (15.2)	7 (10.3)
– Poor communication	26 (11.8)	5 (12.4)	4 (14.0)	12 (15.2)	5 (7.4)
– High service charge	20 (9.1)	8 (18.6)	2 (7.0)	5 (6.3)	5 (7.4)
– Other (Specify)	11 (5.0)	1 (1.8)	0 (0.0)	8 (10.1)	2 (2.9)
How often service providers					
pick refuse					
– Daily	309 (36.0)	48 (30.5)	70 (44.1)	59 (18.0)	110 (51.1)
– Once a week (weekly)	388 (45.2)	72 (45.4)	67 (42.4)	178	82 (38.1)
– Twice in a week	122 (14.2)	32 (20.3)	15 (9.8)	(54.4)	22 (10.4)
– Once in a month	28 (3.3)	4 (2.7)	6 (3.7)	56 (17.1)	1 (0.4)

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– Other (Specify)	12 (1.4)	2 (1.0)	0 (0.0)	21 (6.4)	0 (0.0)
				13 (4.1)	
Preferred frequency for picking waste					
– Daily collection	226 (26.3)	41 (26.1)	17 (10.8)	35 (10.7)	117 (54.4)
– Once a week	394 (45.9)	37 (23.4)	92 (58.0)	196	81 (37.7)
– Once a month	26 (3.0)	5 (3.2)	16 (10.2)	(59.8)	3 (1.3)
– Twice a week	209 (24.3)	73 (45.9)	31 (19.9)	3 (1.0)	14 (6.6)
– Other (specify)	4 (0.5)	2 (1.4)	2 (1.1)	93 (28.4)	0 (0.0)
				0 (0.0)	
Contractor provides you with receptacles,	321 (37.4)	81 (51.1)	58 (36.5)	146	43 (20.0)
				(44.8)	
If yes, pay for receptacles	*N=419*	*N=84*	*N=56*	*N=193*	*N=79*
	204 (48.8)	44 (52.7)	20 (35.4)	114	29 (36.7)
				(58.9)	
If no, what containers do you use to store your refuse	*N=431*	*N=59*	*N=102*	*N=134*	*N=136*
– Polythene bag	73 (16.9)	10 (16.9)	5 (4.9)	26 (19.4)	32 (23.5)
– Normal bucket	114 (26.5)	11 (18.6)	16 (15.7)	12 (9.0)	75 (55.1)
– Wooden basket	12 (2.8)	3 (5.1)	1 (1.0)	7 (5.2)	1 (0.7)
– Other (specify)	232 (53.8)	35 (59.3)	80 (78.4)	89 (66.4)	28 (20.6)
Wish that contractor provides you with a bin	618 (72.0)	132	103	272	118 (55.1)
		(83.0)	(65.2)	(83.2)	
Willing to pay for the bin	562 (65.4)	103	86 (54.5)	228	143 (66.5)
		(64.5)		(69.8)	

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Involved in the selection of your service provider	280 (32.6)	65 (40.7)	95 (60.0)	77 (23.5)	50 (23.4)
Prefer to change the service provider	259 (30.2)	50 (31.4)	43 (27.0)	76 (23.3)	85 (39.4)

Source: Field data, 2017

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4.2.2 Association of socio-economic factors and the use of household solid waste management services

In the univariable analysis, sex, educational level, marital status, area of occupation, amount earned, rate of socio-economic status, residence, description of residency, duration of stay in the community and the region were significantly associated with use of SWM services (Table 4.4). In the multivariable analysis, having basic education (adjusted odds ratio [aOR], 0.46; 95% confidence interval [CI], 0.27-0.78, p<0.01) was associated with reduced odds whereas tertiary education (aOR, 1.60; 95% CI, 1.01-2.60, p<0.05) was associated with higher odds of utilizing SWM services as compared to those with no formal education. Utilization of SWM services decreased with decreasing rate of socio-economic status, with lower odds of SWM utilization among those who rated themselves poor compared to those who rated themselves very rich. Compared to residing in a peri-urban area, urban residency was associated with higher odds of utilizing SWM services (aOR, 2.80; 95% CI, 1.55-6.69, p<0.001). Residing in new sites (aOR, 0.27; 95% CI, 0.17-0.45, p<0.001), inner city or old town (aOR, 0.10; 95% CI, 0.05-0.22, p<001) and slums or Zongos (aOR, 0.05; 95% CI, 0.02-0.14, p<0.001) were associated with lower odds of utilizing SWM services as compared to participants residing in the estates.

Table 4.4a: Logistic regression analysis of socio economic factors influencing use of household solid waste management services

Variables	Utilized SWM services N=859	p-value	Crude OR [95% CI]	Adjusted OR [95% CI]
Age in years, mean (SD)	34 (10.1) vrs 35 (11.4)	0.113§	1.01 [0.99, 1.02]	1.03 [1.01, 1.04]**
Gender				
– Male	57.8	0.049	0.82 [0.67, 0.99]*	1.17 [0.92, 1.49]
– Female	52.8		1.00	1.00
Education				
– No formal	45.3	<0.001	1.00	1.00
education	25.0		0.40 [0.25, 0.66]***	0.46 [0.27, 0.78]**
– Basic education	41.8		0.87 [0.57, 1.33]	0.92 [0.57, 1.50]
– Senior High	55.7		1.52 [0.93, 2.49]	1.42 [0.79, 2.24]
School	68.7		2.65 [1.79, 3.93]***	1.60 [1.01, 2.60]*
– Post- Secondary				
– Tertiary				
Marital status				
– Married	55.4	0.017	1.00	1.00
– Cohabiting	55.7		1.01 [0.82, 1.25]	0.91 [0.68, 1.23]
– Single	32.6		0.39 [0.21, 0.73]**	0.27 [0.13, 0.58]***
– Widow/Divorce	65.9		1.16 [0.71, 1.87]	1.21 [0.65, 2.24]
Employed				
– Yes	56.4	0.773	0.94 [0.63, 1.39]	0.51 [0.32, 1.23]
– No	55.0		1.00	1.00
Area of Occupation				

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– Government (Civil servants)	68.2	<0.001	1.00	1.00
– Private	67.7		0.98 [0.72, 1.33]	1.18[0.83, 1.68]
– Self-employment (informal sector)	41.9		0.34 [0.25, 0.44]***	0.58 [0.41, 0.82]**
Amount earned from all economic activities, GH₵	35.3	<0.001	1.00	N/A
– ≤300	44.8		1.48 [0.98, 2.34]	
– 300-600	44.9		1.49 [1.00, 2.22]*	
– 600-100	70.5		4.36 [2.95, 6.45]***	
– >1000				
Rate of socio-economic status	68.6	<0.001	1.00	1.00
– Very rich	65.1		0.85 [0.51, 1.44]	0.77 [0.39, 1.52]
– Rich	54.9		0.56 [0.36, 0.86]**	0.60 [0.33, 1.08]
– Moderately rich	36.8		0.27 [0.15, 0.46]***	0.39 [0.19, 0.82]*
– Poor				
Residence				
– Urban	59.4	<0.001	2.13 [1.68, 2.72]***	2.80 [1.55, 6.69]***
– Peri-urban	40.7		1.00	1.00
Description of residency				
– Estate	81.9	<0.001	1.00	1.00
– New site	60.0		0.33 [0.23, 0.47]***	0.27 [0.17, 0.45]***
– Inner-city/Old town	45.8		0.19 [0.13, 0.26]***	0.10 [0.05, 0.22]***
	36.1		0.12 [0.08, 0.19]***	0.05 [0.02, 0.14]***

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– Slums/ Zongo/ Other				
Duration of stay in community, years				
– <5	60.1	0.005	1.00	1.00
– 5-10	58.2		1.08 [0.83, 1.39]	1.02 [0.76, 1.38]
– 10-15	58.7		1.10 [0.74, 1.62]	1.29 [0.82, 2.03]
– 15-20	45.0		0.63 [0.44, 0.90]*	0.57 [0.38, 0.85]**
– >20	50.9		0.80 [0.59, 1.08]	0.83 [0.58, 1.19]
Region				
– Western	53.9	<0.001	1.00	1.00
– Northern	53.2		0.97 [0.70, 1.34]	0.87 [0.53, 1.43]
– Greater Accra	70.0		1.99 [1.48, 2.70]***	1.05 [0.50, 2.19]
– Ashanti	42.9		0.64 [0.48, 0.86]**	0.43 [0.15, 1.24]

*Age=Not utilized versus utilized; SWM, Solid Waste management; Adjusted model included two interaction terms; site*type of residence and site*residence. AIC: model with interaction terms = 1833.1; without interaction terms=1840.2*
**p<0.05; **p<0.01; ***p<0.001*
Source: Fieldwork, 2017

In the stratified analysis (Table 4.4a and Table 4.4b), the association between residence and utilization of SWM services was observed only for Takoradi and Accra whereas the association between type of residence and type of SWM services was observed for all sites with differences in odds ratios.

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Table 4.4b: Logistic regression analysis of socio economic factors influencing use of waste management services, stratified by site

Variables	Adjusted odds ratios [95%CI]			
	Takoradi	**Tamale**	**Accra**	**Kumasi**
Residence				
– Urban	5.40 [2.44, 11.94]***	1.79 [0.88, 3.65]	2.69 [1.56, 4.63]***	1.30 [0.81, 2.10]
– Peri-urban	1.00	1.00	1.00	1.00
Description of residency				
– Estate	1.00	1.00	1.00	1.00
– New site	0.35 [0.15, 0.81]*	0.12 [0.03, 0.59]**	0.33 [0.17, 0.67]**	0.25 [0.11, 0.61]**
– Inner-city/Old town	0.12 [0.05, 0.30]***	0.06 [0.01, 0.29]***	0.44 [0.23, 0.85]*	0.18 [0.08, 0.40]***
– Slums/ Zongo/ Other	0.14 [0.05, 0.40]***	0.10 [0.02, 0.53]**	0.28 [0.11, 0.68]**	0.27 [0.11, 0.70]**

Adjusted for age, marital status, education, type of occupation, rate of socio-economic status, length of stay in community
p<0.05;p<0.01; ***p<0.001*
Source: Field work 2017.

Hypothesis testing

The study explored the level of utilization of SWM services in Ghana. The study hypothesized that *there is sub-optimal utilization of household solid waste management services in major metropolitan assemblies in Ghana.*

H_0:p>50% (0.5); H_1p<50%(0.5)

The level of utilization found in this study was **55.1%.**

Significance level, $\alpha = 0.05$

Test statistic, $z = \frac{\hat{p}-p}{\sqrt{pq/n}}$

$\hat{p} = 55.1\ (0.551)$

P=0.5; q = 1-0.5 = 0.5

z=4.048

z-score =0.4999

p-value =0.5-0.4999 =0.0001

The p-value 0.0001 is less than the significance level, *($\alpha = 0.05$)*, therefore the null hypothesis is rejected, and the study states that: *there is sub-optimal (<50%) utilization of household solid waste management services in major metropolitan assemblies in Ghana.*

4.2.3 Utilization of household solid waste management services – the perspective of managers

Table 4.5 presents results of service providers' views of quality of waste management services. Nine service providers, constituting 69.2% of respondents experienced employee turnover and majority indicated that the rate of turnover was moderate (53.8%). Majority of the service providers (77.0%) supplied bins to clients and most of them (69.3%) believed clients use the bins exclusively or almost exclusively, with only one service provider indicating that clients never used the bins (7.7%). The type of storage bins used included 240 litter bins (53.8%), communal containers (53.8%), 120 litter bins (53.8%) and individual plastic bins (38.5%) as

detailed in Figure 4.3. Collection of containers was mostly weekly (77.0%) or twice a week (61.5%). The average volume of waste collected daily and weekly was 183.1 and 1215.0 tons respectively.

The various disposal methods cited by respondents were open dumping (38.5%), controlled tipping (38.5%) and sanitary landfill (46.2%) as detailed in Figure 4.4. Most of the firms (75.0%) disclosed that they experience intermittent closure of disposal site that could last for up to 5 days. The reasons cited for closure of dumping site included *"Breakdown of machines for pushing or leveling (53.8%), delays in supply of fuel (23.1%), workers sometimes embark on strike (15.4%)"; "Faulty operational equipment at site (46.2%), heavy rains (30.8%), inaccessible roads to the site (46.2%)"* and *"poor access of road during raining season, when the site becomes full up, failure to pay tipping bills (38.5%)".*

The equipment used for primary waste collection by most of the firms included compactors (53.8%), tricycles (77.0%), and skip trucks (61.5%) as detailed in Table 4.5.

Table 4.5: Quality of service and utilization

Variables	Frequency	Percentage
Experience employee turnover		
– Yes	9	69.2
– No	4	30.8
Rate of employee turnover		
– Never	-	-
– Occasional	5	38.5
– Moderate	7	53.8

– High	1	7.7
– Very high	-	-
Causes of employee turnover		
– Financial issues	3	23.1
– Health	-	-
– Poor motivation	6	46.2
– Apathy of nature of work	4	30.8
Supply bins to clients (Yes), n=10	10	77.0
How often bins used		
– Exclusively	4	30.8
– Almost exclusively	5	38.5
– Frequently	3	23.1
– Sometimes	-	-
– Never	1	7.7
How often containers are collected*		
– Daily	6	46.2
– Weekly	10	77.0
– Twice a week	8	61.5
– Monthly	2	15.8
– When full	5	38.5
Average volume of waste collected , mean (SD)		
– Daily	183.1 (187.8)	
– Weekly	1215.0 (1517.1)	
– Monthly	8765.6 (8081.7)	
Experience intermittent closure of disposal site	8	61.5
Duration of intermittent closure, days (n=8)		
– 1-2	6	75.0

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–	2-5	2	25.0
Equipment for primary collection*			
–	Wheel barrow	1	7.7
–	Push carts	1	7.7
–	Compactor	7	53.8
–	Tricycles	10	77.0
–	Skip truck	8	61.5
–	Roll on/off	5	38.5

Source: Field work, 2017 **multiple response question*

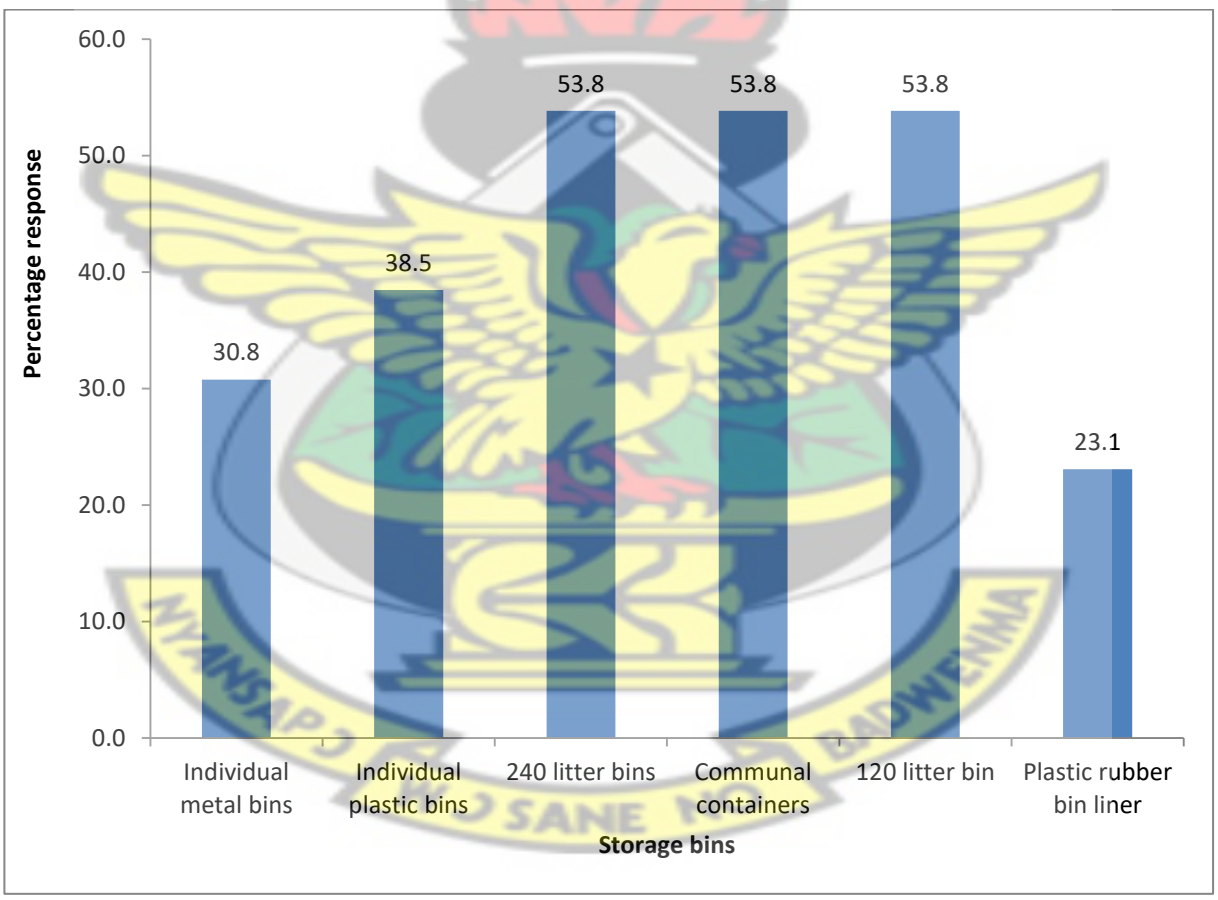


Figure 4.3 Type of storage bins used

Source: Fieldwork, 2017

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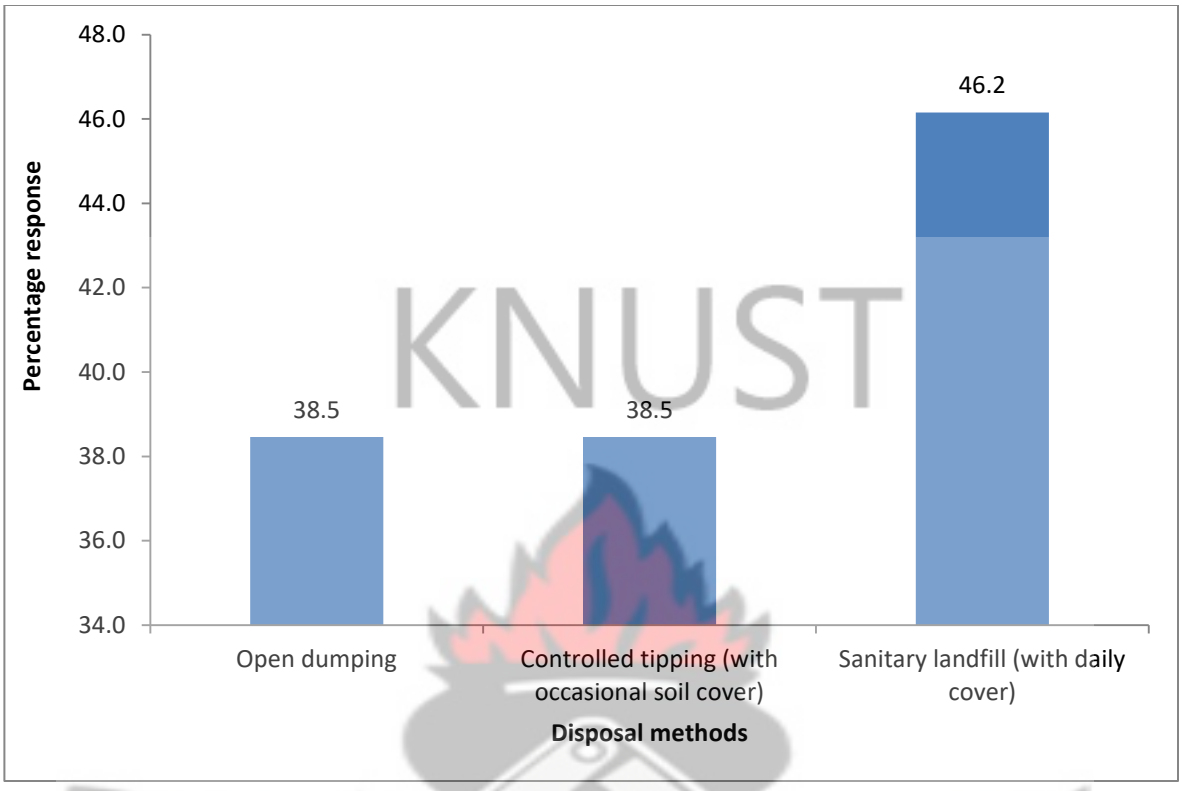


Figure 4.4 Methods of disposing waste by service providers

Source: Fieldwork, 2017

As shown in Table 4.6, majority of the service providers bemoaned lack of financial resources (66.7%), vehicle breakdowns (50%), lack of legislation (50%), lack of enforcement measures and capability (75%), poor government cooperation (54.5%), poor response to waste minimization (72.7%), lack of hazardous waste control (66.7%) and poor public attitude towards waste disposal (81.8%) as serious problems with waste management in the country. Inadequate trained personnel (16.7%), difficulty in obtaining landfill sites (36.4%), lack of contractual agreement (33.3%) and low level of staff education (41.7%) were not seen as serious problems facing waste management in Ghana as detailed in Table 4.6.

Table 4.6: Challenges encountered in providing solid waste management service

Challenges	N	% Response			
		1	2	3	4
Inadequate service coverage	10	40.0	10.0	20.0	30.0
Lack of financial resources	12	66.7	25.0	8.3	-
Inadequate trained personnel	12	25.0	25.0	33.3	16.7
Inadequate vehicles	12	33.3	16.7	16.7	33.3
Lack of equipment	12	41.7	25.0	8.3	25.0
Old vehicle/equipment frequent breakdown	12	50.0	16.7	33.3	-
Lack of legislation	12	50.0	8.3	8.3	33.3
Lack of enforcement measures and capability	12	75.0	8.3	8.3	8.3
Lack of planning	11	36.4	27.3	27.3	9.1
Rapid urbanization outstripping service capacity	10	30.0	20.0	20.0	30.0
Uncontrolled proliferation of squatter settlements	10	30.0	40.0	20.0	10.0
Difficult to locate and acquire landfill sites	11	18.2	18.2	27.3	36.4
Poor cooperation by government agencies	11	54.5	9.1	27.3	9.1
Poor response to waste minimization (reuse/recycling)	11	72.7	18.2	9.1	-
Lack of control on hazardous waste	12	66.7	16.7	-	16.7
Low level of education of staff	12	25.0	8.3	25.0	41.7
Noncompliance to safety rules by staff	11	9.1	9.1	63.6	18.2
Poor attitude of the public towards solid waste disposal	11	81.8	18.2	-	-
Poor revenue mobilization/collection	12	33.3	41.7	25.0	-
Lack of contractual agreement	`12	-	25.0	41.7	33.3

Source: Field data, 2017; scale: 1- very serious, 2-serious, 3-Not so serious, 4-No problem at all

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4.2.4 Type of waste collected from households

Key informant from the Metropolitan Assemblies interviewed were mostly deputy heads, director of waste, and field supervisors who had worked 2 to 26years, with 3 of them having worked more than 15 years in their respective organizations. A third had diploma and two-thirds had masters' degrees. Their specialties were environmental health officers, general administrators and sanitary engineers.

The span of control of respondents averagely 4 to 10, with all of their subordinates having registered their companies. The structure of waste management in the municipalities was mainly joint operation (3 out of 6 responses), joint operations (1 out of 6 responses), zonal operations (1 out of 6) and operation arrangement (1 out of 6).

The study further explored some operational challenges in provision of waste management services. When asked about the challenges with the current operation system, some respondents opined that;

> *"The major challenge with the current operation system is funding for logistics and equipment",* (TMA).
>
> *"... Inadequate equipment, financial constraint and attitudinal problems from the community"* (KMA).
>
> *"Challenges with the current system include waste collection outsourced to waste contractors. Currently, the assembly does night cleaning and Zoomlion does collection at the central business district. However the volume of refuse generated cannot be wholly sent to the landfill"* (KMA).

The annual budget for solid waste management ranged from GHC1million to 4 million (USD 25000-80,000) and the respondents disclosed that they could not assess the entire budget. One respondent disclosed that they are able to assess only 10% of the budget.

Out of the 6 stakeholders interviewed, 4 of them rated performance of waste management companies as good whiles 1 each rated waste management companies satisfactory and very poor. Challenges faced by waste management companies as indicated by the stakeholders were financial constraints (3 responses), logistics challenge (2 responses), difficulty in accessing landfill in rainy season (2 response) and vehicle breakdown (2 responses). The reasons for these challenges were lack of finance (4 responses) and waste management policy and regulations (2 responses).

When asked about the monitoring systems put in place to check operations of waste management companies, the stakeholders opined;

> *"We do call them to hear their challenges during assembly meetings"* (KMA).

> *"We conduct monthly checks based on developed performance indicators to judge the performance of the companies"* (AMA).

Other monitoring systems disclosed by the stakeholders interviewed were daily inspections by environmental officers and monthly reporting reports.

The waste management directors indicated that they meet with waste management companies monthly, quarterly or as and when the need arises. The issues they discuss during meeting include *financing problems, irregular collection of domestic waste and breakdown of vehicles*. On what they discuss during meetings, the stakeholders opined;

"We encourage them to always act swiftly during such breakdowns. We also tell them to put up back up to curtail some of these challenges" (AMA).

With respect to the financing of solid waste management, the assembly staff believe that the waste management companies are funded on bank loan, internally generated fund and by government and individuals. The mode of payment known to the stakeholders were self-payment through revenue collectors, pay as you dump and by government. One respondents however opined;

"There is currently no payment by the assembly due to the pay as you dump principle. The landfill management is also paid for" (KMA).

The stakeholders interviewed believed that the current financing mechanism for waste management is not entirely sustainable. The disclosed that *"because it is cash and carry waste management companies come for their bins if the household refuse to pay for their service"*. However, one respond suggested, *"pay as you dump is better than payment by the assembly due to accumulation of debt to contractors"*.

The stakeholders further suggested best ways by which waste management could best be managed. This included; "*including all stakeholders including the grassroots level to see a way forward" "strengthening partnership with the private sector" and "looking at recycling waste for other alternative use".* Another respondent opined;

"Waste management companies should reduce fee to encourage every household to go for a bin. They should also be enforcement of by-laws and ensure that those who flout the law be punished" (AMA).

The stakeholders disclosed that there are taxes on solid wade management operations. They further believed that these taxes are crippling their businesses and therefore should be scrapped. They disclosed that the taxes;

> *"affect the economics of solid waste management"*. Others also stated that the
>
> *"taxes should not be scrapped altogether but should be reviewed"* and
>
> *"some of the contractors are still struggling to survive so the taxes can suffocate them to collapse"*.

Most of the stakeholders promote waste separation3Rs/ 4Rs in their municipality, although they admitted that is challenging. They also recommended the promotion of 4Rs as an option of financing.

4.3 Financing Options for Household Solid Waste Management

4.3.1 Perceived-financing sources for household solid waste management

As shown in Figure 4.5, 42% and 23% the households believed that cost of SWM should be borne by the user and government respectively. Each (17%) opined that SWM should be financed by the assembly or through taxation.

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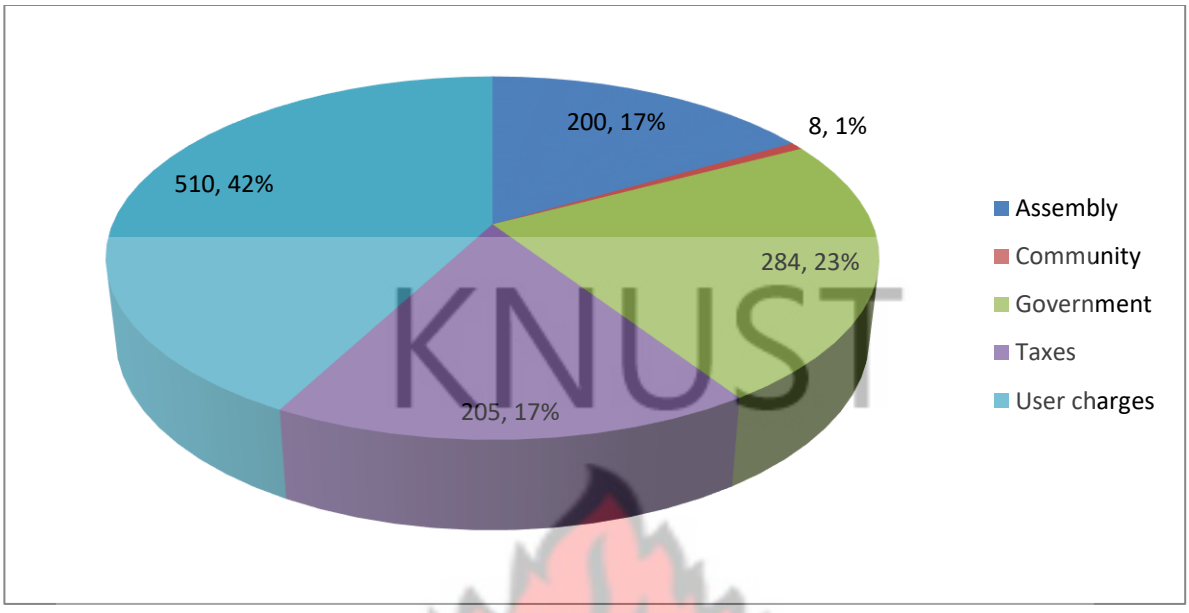


Figure 4.5 Perceived-financing sources for household solid waste management

Source: Fieldwork, 2017

4.3.2 Current financing options for household solid waste management

The current financing options for most of the households were user charges (43.1%) and self-payments (42.3%), (Table 4.7). Majority (42%) of the households were of the view that the current payment options were effective whereas others (69.6) believe the payment systems have effect on service delivery. Some of these effects, as cited by respondents included dumping of refuse elsewhere (2%), discourages continuous use of services (65%), poor service delivery (32%) and arbitrary charging (1%).

Knowledge of the polluter pays principle was not universal across the study sites; it was about 52.6% and 71.8% in Tamale and Kumasi but 55.1% and 63.4% in Takoradi and Accra respectively. Among those who had heard of this strategy, majority (64.6%) were willing to recommend it, with the exception of Tamale where only 38.1% would recommend for its

implementation. Similarly, there were gaps in the knowledge and practice of the 4Rs (reduce, recycle, re-use, recover) among the households interviewed. Most of the households (88.9%) however believed that the 4R concept would help solve the challenge of solid waste financing by generating income (69.6%), reducing waste (64.1%), reducing the cost of dumping refuse (50.0%) and helping treat waste for industrial use (43.6%). Majority would therefore recommend it promotion (92%). Suggestions by households to strengthen financing for solid waste management in their respective communities included government subsidizing or providing for SWM (58.9%), provision of improved services (64.7%), enactment of laws (59.6%), educating the populace on solid waste management (35.9%) and utilization of electronic platforms for payment of user fees (63.3%).

Table 4.7: Current financing options for household solid waste management

Variables	Total	Takoradi	Tamale	Accra	Kumasi
N	**1560**	**295**	**297**	**467**	**501**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Current financing option for your household waste	672 (43.1)	164 (55.7)	97 (32.5)	156 (33.5)	244 (48.7)
– User charges	83 (5.3)	13 (4.4)	14 (4.8)	16 (3.5)	38 (7.5)
– Through taxes	75 (4.8)	18 (6.2)	30 (10.0)	20 (4.3)	9 (1.8)
– Subsidy from assembly	70 (4.5)	2 (2.6)	9 (3.0)	4 (0.8)	48 (9.5)
– Government grants	660 (42.3)	92 (31.1)	148 (49.7)	270 (57.9)	163 (32.5)
– Self-payments					
Current financing option effective	1119 (76.2)	183 (61.9)	205 (68.9)	345 (74.7)	449 (89.6)
Current financing option have effect on the service delivery	1086 (69.6)	180 (61.0)	222 (74.7)	257 (55.0)	424 (84.7)
Heard about the polluter pays principle	775 (49.7)	104 (35.1)	168 (56.7)	191 (41.0)	309 (61.6)
Recommend for it implementation	1008 (64.6)	169 (57.3)	113 (38.1)	239 (51.2)	452 (90.3)

Have you heard about the 4Rs (Reduce, Recycle, Re-use, Recover)	977 (62.6)	163 (55.1)	156 (52.6)	296 (63.4)	360 (71.8)
If yes, do you practice it	799 (51.2)	132 (44.9)	157 (52.7)	197 (42.2)	301 (60.0)
Do you want to practice it if you find it important	1182 (75.8)	246 (83.3)	145 (48.8)	357 (76.5)	453 (90.4)
Do you think the 4R concept can help solve solid waste financing challenges	1387 (88.9)	240 (81.4)	236 (79.4)	422 (90.4)	483 (96.5)
Recommend promoting the 4R concept	1435 (92.0)	256 (86.8)	247 (83.2)	441 (94.5)	490 (97.8)

Source: Fieldwork, 2017

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4.3.3 Proposed means of financing household solid waste management

Figure 4.6 presents views of waste management firms on how waste management should be financed in Ghana. The suggestions included government support by subsidizing the cost of equipment to service providers (33% of responses) and shared responsibility between government and the public (17% of responses). The most provided response was direct payment by the polluter through taxation or the polluter pay principle (42% of responses).

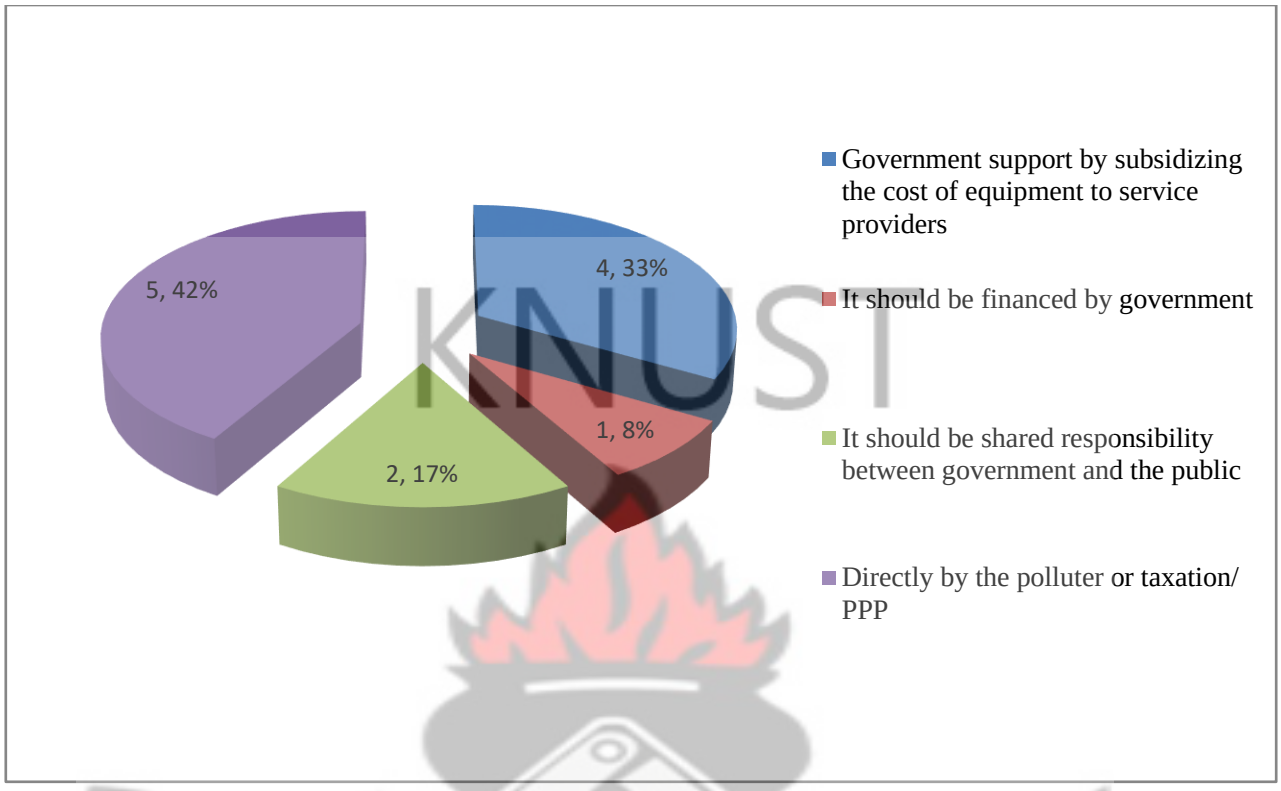


Figure 4.6: Perceptions of how household solid waste management should be financed (multiple response)

Table 4.8 presents results of the current options for financing municipal solid waste management in Ghana. Majority (84.6%) of the firms indicated that the current financing options is the user charge or the polluter pay principle. More than half (61.5%) of the firms interviewed believed the current financing options are effective.

Suggested alternative financing options included government support (4, 30.8%), through taxes (3, 23.1%) and by adding to property rate (2, 15.4%). Most of them (54.6%) pay for disposal of waste with majority paying GHC 50.00 and above. Majority of the firms (61.5%) also charge clients for dumping of fee for which they think is appropriate. Cash/cheques (53.8%) and household revenue collection (38.5%) were the most cited modes of payment for services rendered to clients. More than half (53.8%) of the firms disclosed the mode of payment was

appropriate for them. Other suggested methods included electronic payment, 46.2%, mobile money (15.4%), prepaid cards (7.7%) and property rate (7.7%).

The most cited ways by which firms price collection charges was charge per bin (92.3%), followed by charge per collection frequency (46.2%). Most of the firms (69.2%) however disclosed that they make losses with only 3 (23.1%) meeting operation cost. The losses were mainly due to default in payment by clients (84.6%), equipment breakdown (53.8%), low charges (53.8%) and high cost of vehicle/equipment spare parts (53.8%). Charges for waste collection was mainly determined by assemblies (97.8%) with less than half (38.5%) of the firms having input into that. Most of the firms (76.9%) are involved in clients' education about the 3Rs.

Other comments by the firms to improve waste management were:

> "*Enforcement of bye laws, payment of subsides by the assembly, accessible areas within our operations areas need to be opened up to enable companies get to residents*". (General Manager, Takoradi).

> "*Waste management should be a collective responsibility, the DEHOS and MEHOS should be tasked to work as before to instill discipline as before*". (Operations manager, Takoradi).

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Table 4.8 Current financing options for municipal household solid waste management

Variables	Frequency N=13	Percentage
Current financing options for household waste collection/management		
– User charge/polluter pay principle	11	84.6
– Taxes	1	7.7
– Subsidy from assembly	-	-
– Government grants	1	7.7
– Property rate	-	-
Current financing option effective (n=8)	8	61.5
Alternative financing options		
– Government support	4	30.8
– Taxes	3	23.1
– Adding to property rate	2	15.4
Pay for disposal/dumping fee	11	84.6
If yes how much (n=11)		
– 10-50	5	45.5
– 50-100	2	18.2
– >100	4	36.4
Charge clients for dumping/disposal fee (n=8)	8	61.5
Think it's appropriate to pay dumping fee (n=6)	6	46.2
Who think should pay for dumping/ disposal		
– Local assembly	4	30.8
– Contractors	5	38.5
– Consumers/polluter	3	23.1
– Government	1	7.7
Mode of payment of services rendered to clients		
– Cash/cheques	7	53.8
– Household revenue collection	5	38.5

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– Pay as you dump	1	7.7
Appropriate for you?, Yes (n=7)	7	53.8
Suggest other method that will be appropriate for the business		
– Electronic payment	6	46.2
– Enforcement of bylaws to make people register	2	15.4
– Establishing payment points	1	7.7
– Mobile money	2	15.4
– Prepaid cards	1	7.7
– Property rate	1	7.7
Ways of pricing collection charges*		
– Charge per bin	12	92.3
– Charge per ton	2	15.4
– Charge per collection frequency	6	46.2
Amount charge for collection		
– <=20	5	38.5
– 20-30	5	38.5
– 30-40	3	23.1
Meet operating cost, Yes (n=3)	3	23.1
Often make loss, Yes (n=9)	9	69.2
% of loss (n=7)		
– **<=20**	2	28.6
– **30**	4	57.1
– **60**	1	14.3
Causes of loss*		
– Default in payment by clients	11	84.6
– Inefficiency of staff	1	7.7
– High taxes	1	7.7
– Frequent breakdown of equipment	7	53.8
– Low charges	7	53.8
– High cost of spare parts	7	53.8

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Who determines charges		
– Assembly/ local authorities	11	97.8
– Company in conjunction with assembly	2	15.4
Have input in determination of charges, Yes (n=5)	5	38.5
Think it is appropriate to collect service charges as part of other utility charges (n=8)	8	61.5
Sources of funding		
– Donor Funded	-	-
– Government Funded	1	7.7
– Bank Loans	1	7.7
– Service charges	5	38.5
– All of the above	6	46.2
Educate clients on 4Rs (n=10)	10	76.9
Think it is necessary to promote the concept (n=1)	1	7.7

*Source: Field data 2017; *multiple response 3Rs= Reduce, Re-use, Recycle and Recover*

4.4 Consumers Acceptability and Willingness-to-Pay for Household Solid Waste Management Services

4.4.1 Payment and amount paid for household solid waste management services

As shown in Figure 4.7a, most of the respondents across all sites pay for the management of solid waste. Figure 4.7b shows the amount paid for SWM services at the various regional capitals studied. Overall, 43.8% paid below GHC10.00 for the management of solid waste. There were difference in how much people pay for SWM as shown in Figure 4.8b. In Tamale for instance, majority (61.2%) paid GHC10.00-20.00 whereas in Takoradi the biggest proportion of households (35.8%) paid from GHC20.00-30.00. No household paid above GHC 50.00 in Tamale whereas 9.2% did so in Takoradi.

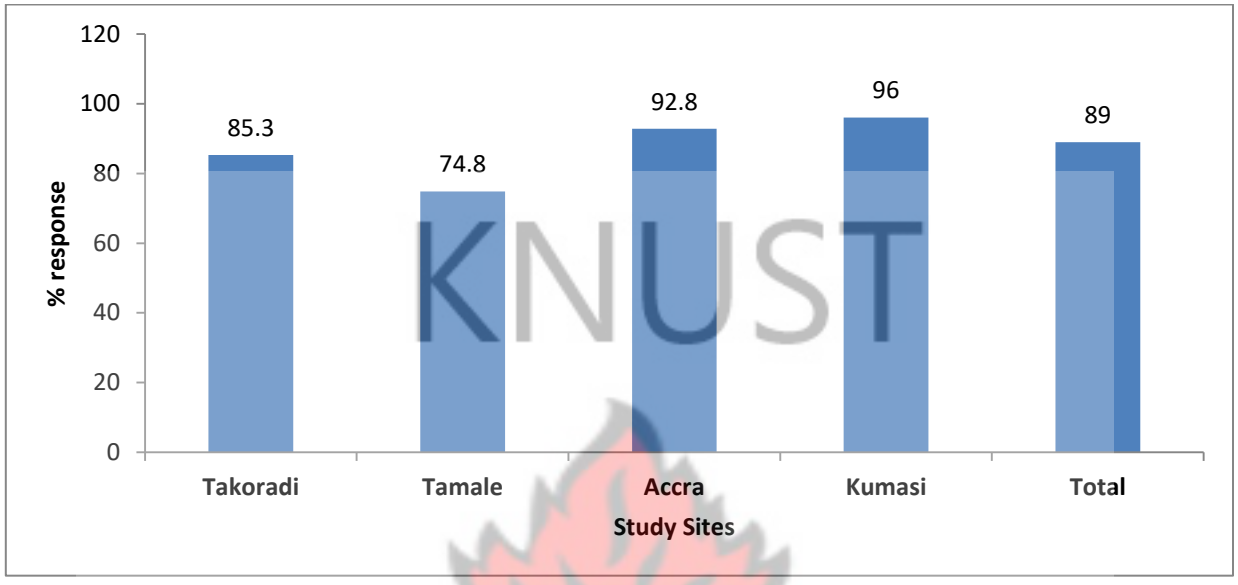


Figure 4.7a: Payment for household solid waste management

Source: Field data 2017.

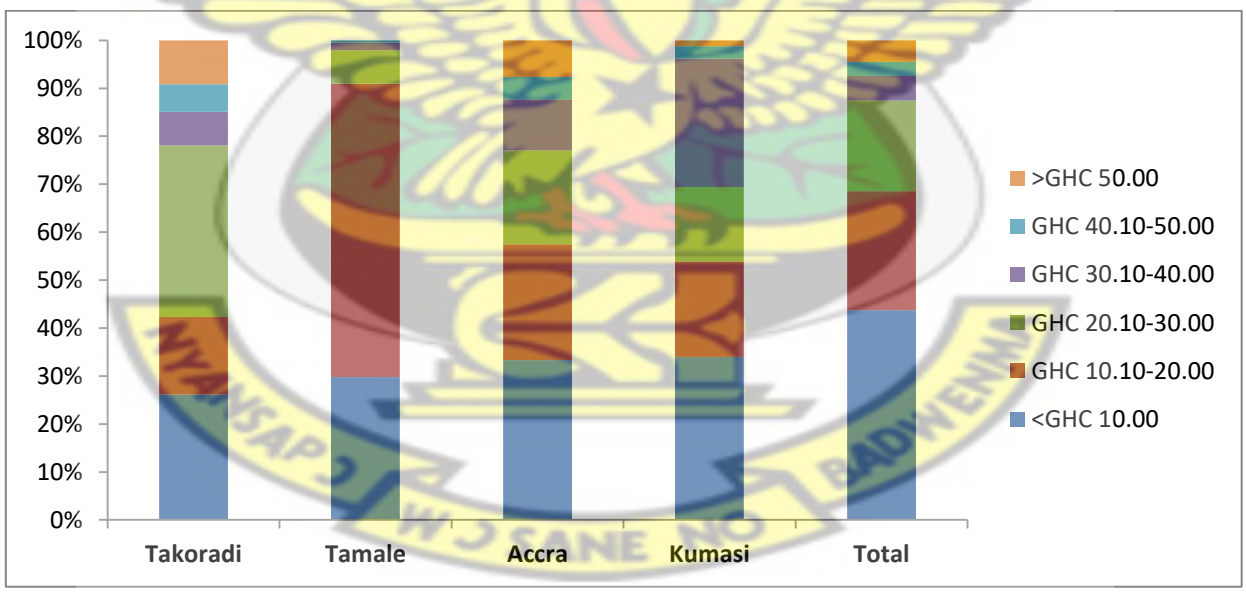


Figure 4.7b: Amount paid for household solid waste management

Source: Field data 2017.

4.4.2 Willingness-to-pay for household sold solid waste management services

Table 4.9 and Figure 4.8 present results of clients' willingness to pay for SWM services and their motivation to pay extra. Majority of study respondents (82%) from all study sites agreed that it was worth paying for the services of waste collection or management. Modes of payment included mobile money (36.3%), special taxes 25.0%), and pay and collect (64.7%). With the exception of Kumasi, most of the respondents from study sites paid for existing SWM services through a revenue collector (Takoradi, 74.9%; Tamale, 75.1%, Accra, 81.9%). In Kumasi, most of them (53.6%) paid by a pay point outlet. Most respondents (82.7%) were satisfied with the current payment system. Preferred mode of payment varied across sites; 75% in Tamale preferred being added to electricity bill, 62.6% and 43% from Kumasi and Takoradi respectively preferred payment through taxation whereas 34% and 29.4% from Takoradi and Accra preferred being added to property rate.

In the overall population, majority of the respondents believed individual users (51%), followed by local Government or the Assembly (32.7%), should pay for waste collection services. However, majority from Takoradi (55.3%) indicated that Local Government or the Assembly should pay for it. Majority of respondents across all sites (61.2%) however believe that the district or municipal assembly should pay for treatment and disposal. Most households at the various sites (62.2%) were willing to pay towards the treatment and disposal of waste. As shown in Figure 4.8a, more than half of households across all study sites (74.1%) were willing to pay up to GHC10.00 per month for the treatment and disposal of waste. Kumasi had the highest proportion of households (45.7%) willing to pay up to GHC2.00 whereas the majority of households in Takoradi (54.1%) and Accra (52.1%) were willing to pay from GHC2.00 to 10.00 per month.

Generally, majority (53.7%) were willing to make additional payment for improved quality of services, with increased frequency of lifting being the most cited motivation (62.5%) for paying extra. Majority (73.6%) were willing to pay from 50p to GHC10.00 per month in the overall population, (Figure 4.8b). Across the various sites, majority were willing to pay up to GHC2.00 in Accra (53.4%) and Kumasi (45.9%) whereas majority from Takoradi (53%) were willing to pay from GHC2.00 to 10.00. Reasons for not paying extra-included taxation (41.6%), low income and economic reasons (38.8%), collection frequency not adhered to by waste management companies (72%), the belief that Government should pay (43.1%) and inadequate/poor service delivery (67.7%).

Table 4.9: Willingness-to-pay for household solid waste management services

Variables	Total	Takoradi	Tamale	Accra	Kumasi
N	**1560**	**295**	**297**	**467**	**501**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Worth paying for the services of waste collection/management	1279 (82.0)	230 (77.8)	234 (78.8)	419 (89.7)	395 (78.9)
How pay for existing services					
– Revenue collector	1002 (64.2)	221 (74.9)	223 (75.1)	382 (81.9)	138 (27.6)
– Pay point outlet	382 (24.5)	36 (15.5)	51 (17.2)	45 (9.6)	269 (53.6)
– Walk to service provider's office	159 (10.2)	22 (7.3)	23 (7.7)	33 (7.0)	91 (18.1)
– Through bank	6 (0.4)	5 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
– Other	11 (0.7)	1 (0.5)	0 (0.0)	7 (1.5)	4 (0.7)
Satisfied with the mode of payment	1290 (82.7)0	219 (74.1)	246 (82.8)	381 (81.6)	444 (88.7)
If no, preferred payment model					
– Add to Electricity bill	463 (29.7)	24 (8.0)	223 (75.0)	122 (26.1)	35 (6.9)
– Add to Water bill	201 (12.9)	38 (13.0)	34 (11.3)	78 (16.8)	54 (10.7)
– Add to property rate	326 (20.9)	100 (34.0)	10 (3.2)	137 (29.4)	99 (19.8)

– Taxation	543 (34.8)	127 (43.0)	24 (8.1)	118 (25.2)	314 (62.6)
– Other	27 (1.7)	6 (2.0)	7 (2.4)	12 (2.5)	0 (0.0)
Consider waste management as a public good	1292 (82.8)	255 (86.3)	258 (86.8)	420 (89.9)	362 (72.2)
Who you think should pay for your waste collection					
– Local government/Assembly	510 (32.7)	163 (55.3)	86 (29.1)	163 (34.8)	172 (34.4)
– Community	53 (3.4)	5 (1.7)	7 (2.2)	50 (10.6)	26 (5.2)
– Taxation	187 (12.0)	28 (9.6)	42 (14.0)	64 (13.8)	64 (12.8)
– Self-payment	810 (51.9)	95 (32.1)	159 (53.7)	190 (40.6)	256 (45.1)
– Other	0 (0.0)	4 (1.3)	3 (0.9)	1 (0.2)	12 (2.4)
Prepared to pay something towards the treatment and disposal of waste	970 (62.2)	170 (57.7)	168 (56.5)	313 (67.1)	321 (64.1)
If No, whom you think should pay for treatment and disposal	361 (61.2)	80 (64.2)	98 (75.7)	97 (63.2)	88 (49.0)
– Municipal Assembly	80 (13.7)	21 (16.8)	4 (2.8)	24 (15.8)	30 (16.5)
– Service Provider	142 (24.1)	22 (17.9)	25 (19.4)	31 (20.0)	62 (34.6)
– Through tax	5 (0.8)	2 (1.2)	3 (2.1)	2 (1.0)	0 (0.0)
– Other (most cited: government)					
Willing to make additional payments for improved quality of services	838 (53.7)	161 (54.5)	158 (53.1)	288 (61.7)	233 (46.6)
Motivation to pay extra					
– Increased in frequency of lifting	975 (62.5)	149 (50.5)	209 (70.3)	241 (51.6)	418 (83.4)
– Adding bin liner	212 (13.6)	34 (11.5)	42 (14.1)	94 (20.1)	36 (7.2)
– Effective communication	179 (11.5)	60 (20.3)	37 (12.5)	39 (8.4)	38 (7.6)
– Provision of free receptacle	168 (10.8)	52 (17.6)	9 (3.1)	72 (15.4)	9 (1.8)
– Other	25 (1.6)	0 (0.0)	0 (0.0)	21 (4.4)	0 (0.0)

Source: Field data, 2017

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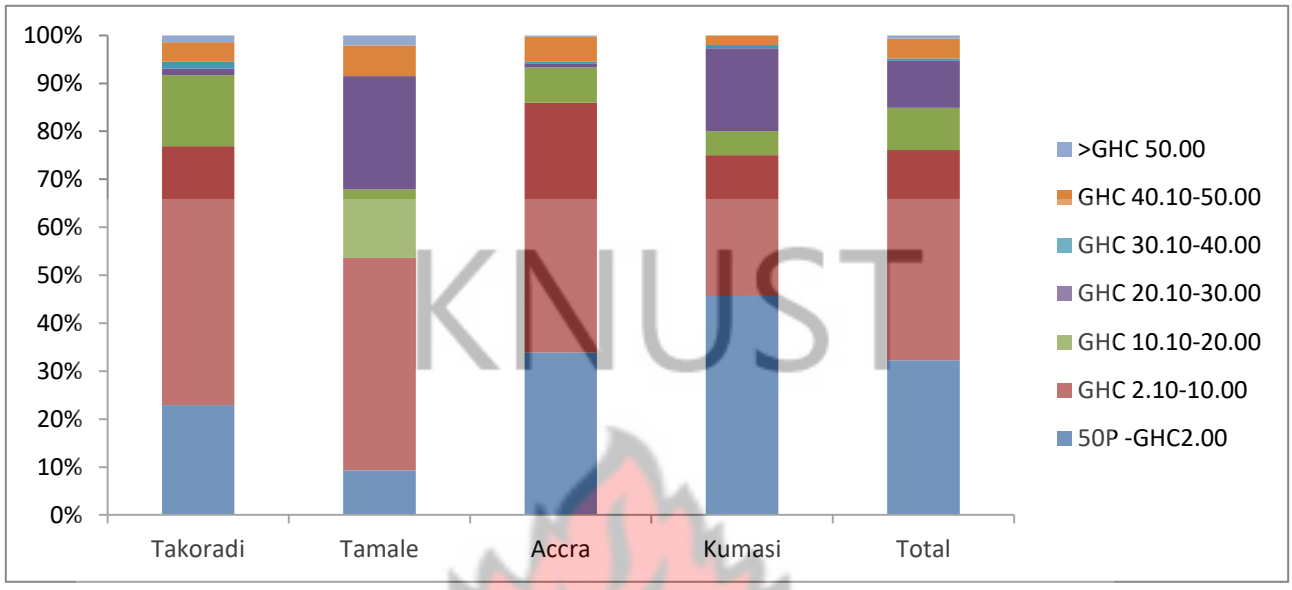


Figure 4.8a Amount households are willing to pay for treatment and disposal of waste

Source: Field data, 2017

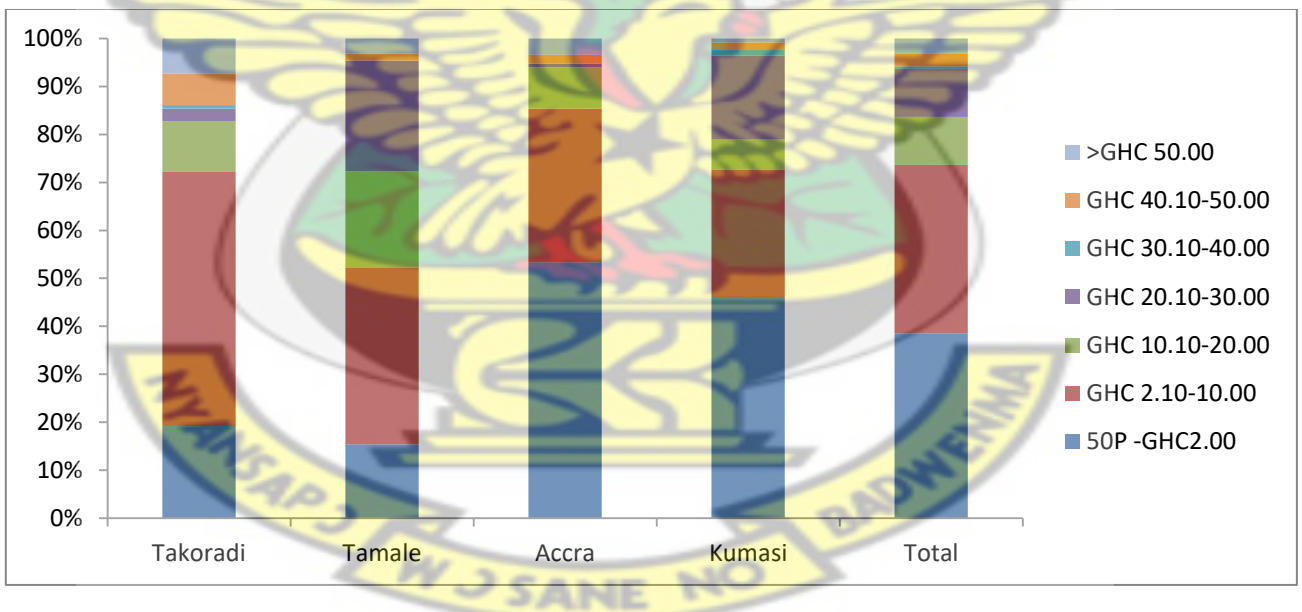


Figure 4.8b Amount household are willing to pay in addition for improved services

Source: Field data, 2017

4.4.3 Associations between socio-economic characteristics and willingness-to-pay for house hold solid waste management services

As shown in Table 4.10, age, educational level, employment status, rate of socio-economic status, description of residency and region of residence had significant association with the willingness to pay for SWM services. Willingness to pay for SWM was higher and lower among those with tertiary and no formal education respectively. The proportion of households who were willing to pay for SWM was also higher among the employed than the unemployed (54.8% versus 42.6%; p=0.018).

Table 4.10: Bivariable associations between socio-economic characteristics and willingness to pay for solid waste management services

Variables	Willingness to pay for improved services		P-value
	Yes (N=840)	No (N=720)	
	%	%	
Age in years, mean (SD)	37 (11.3)	35 (9.7)	0.021
Male gender			
– Male	53.3	46.7	0.361
– Female	54.3	45.7	
Educational level			
– No formal education	38.5	61.5	0.001
– Basic education	48.9	51.1	
– Senior High School	54.8	45.2	
– Post- Secondary	48.6	51.4	
– Tertiary	57.8	42.2	
Marital status			
– Married	51.9	48.1	0.167

– Cohabiting	56.3	43.7	
– Single	52.2	47.8	
– Widow/Divorce	45.5	54.5	
Employed			
– Yes	54.8	45.2	0.018
– No	42.6	57.4	
Area of Occupation			
– Government (Civil servants)	58.3	41.7	0.245
– Private	53.0	47.0	
– Self-employment (informal sector)	52.9	47.1	
Description of income level			
– Less than 500 GHC			
– 500-1000 GHC	54.7	45.3	0.081
– 1100-2000	61.1	38.9	
– 2100-3000	55.5	44.5	
– 3100-5000	52.7	47.3	
	66.1	33.9	
Rate of socio-economic status			
– Very rich	63.7	36.3	<0.001
– Rich	75.0	25.0	
– Moderately rich	52.4	47.6	
– Poor	33.3	66.7	
Residence			
– Urban	55.2	44.8	0.065
– Peri-urban	49.5	50.5	
Description of residency			

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– Estate	58.2	41.8	0.028
– New site	54.3	45.7	
– Inner-city/Old town	55.6	44.4	
– Slums/ Zongo/ Other	43.4	56.6	
Region			
– Western	52.7	47.3	0.009
– Northern	47.6	52.4	
– Greater Accra	52.5	47.5	
– Ashanti	59.5	40.5	

Source: Field data, 2017

4.4.4 Socio-economic predictors of willingness to pay for household solid waste management services

Table 4.11 presents results of the univariable and multivariable logistic regression analysis of socio-economic predictors of willingness to pay for improved SWM services. The multivariable analysis indicated that willingness to pay for SWM services could be predicted by educational level, marital status, and rate of socio-economic status, area of occupation and region of households. In the univariable analysis, having senior high school and tertiary level education were associated with higher odds of willingness to pay for the management of solid waste (OR, 2.19; 95% CI, 1.47-3.26, p<0.001).. In the adjusted model, having a senior high school education (aOR, 2.52; 95% CI, 1.485-4.30, p<0.01) and tertiary education (aOR, 3.30; 95% CI, 1.91-5.69, p<0.001) was significantly associated with higher odds of willingness so pay for SWM compared to those who had no form of education. As compared to civil servants, being self-employed was associated with 44% lower odds of willing to pay for improved SWM services (aOR, 0.56; 95% CI, 0.40-0.81, p<0.001)..

Table 4.11: Logistic regression analysis of socio-economic predictors of willingness to pay for household solid waste management services

Variables	Crude OR [95% CI]	Adjusted OR [95% CI]
Age in years	1.01 [1.00, 1.02]*	-
Male gender		
– Male	0.96 [0.79, 1.17]	-
– Female	1.00	
Educational level		
– No formal education	1.00	1.00
– Basic education	1.53 [0.96, 2.46]	1.76 [1.01, 3.06]*
– Senior High School	1.94 [1.26., 2.30]**	2.52 [1.48, 4.30]**
– Post- Secondary	1.51 [0.92, 2.49]	1.97 [1.08, 3.60]*
– Tertiary	2.19 [1.47, 3.26]***	3.30 [1.91, 5.69]***
Marital status		
– Married	1.00	1.00
– Cohabiting	1.20 [0.97, 1.47]	1.47 [1.13, 1.93]**
– Single	1.01 [0.56, 1.84]	3.61 [1.53, 8.52]**
– Widow/Divorce	0.77 [0.42, 1.43]	0.32 [0.12, 0.81]*
Employed		
– Yes	1.63 [1.09, 2.45]*	-
– No	1.00	
Area of Occupation		
– Government (Civil servants)	1.00	1.00
– Private	0.81 [0.60, 1.08]	0.56 [0.40, 0.81]**
– Self-employment (informal sector)	0.80 [0.61, 1.05]	0.75 [0.52, 1.08]
Description of income level		

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– Less than 500 GHC	1.00	1.00
– 500-1000 GHC	1.30 [0.95, 1.77]	1.15 [0.81, 1.64]
– 1100-2000	1.04 [0.76, 1.41]	0.72 [0.51, 1.04]
– 2100-3000	0.92 [0.59, 1.45]	0.70 [0.42, 1.15]
– 3100-5000	1.62 [1.02, 2.55]*	1.07 [0.63, 1.83]
Rate of socio-economic status		
– Very rich	1.00	1.00
– Rich	1.71 [1.00, 1.29]*	1.57 [0.84, 2.95]
– Moderately rich	0.63 [0.41, 0.94]*	0.64 [0.38, 1.08]
– Poor	0.31 [0.18, 0.53]***	0.28 [0.14, 0.51]***
Residence		
– Urban	1.26 [1.00, 1.59]*	-
– Peri-urban	1.00	
Description of residency		
– Estate	1.00	1.00
– New site	0.85 [0.63, 1.15]	0.94 [0.66, 1.34]
– Inner-city/Old town	0.90 [0.68, 1.19]	1.22 [0.85, 1.74]
– Slums/ Zongo/ Other	0.55 [0.37, 0.92]**	0.74 [0.46, 1.20]
Region		
– Western	1.00	1.00
– Northern	0.82 [0.59, 1.13]	1.05 [0.69, 1.58]
– Greater Accra	0.99 [0.74, 1.33]	1.04 [0.72, 1.50]
– Ashanti	1.32 [0.99, 1.76]	1.52 [1.04,2.22]*

*SWM, Solid Waste management; *p<0.05; **p<0.01; ***p<0.001*
Source: Field data 2017.

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4.5 Diseases Trend and their Relationship with Solid Waste Management Practices

This section of the results shows analyses of environmental sanitation related disease trends and waste generation in Ghana. Results were mainly produced from secondary data and review of literature of disease trends in Ghana.

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Figure 4.9 shows results of the suspected, presumed, and confirmed cases of malaria in Ghana from 2010 to 2016 as published by the World Malaria Report, 2017. The results shows an increasing trend of malaria cases from 2010-2016, with the highest incidence occurring in 2012. Further, analyses also shows that the trend of suspected malaria and resulting deaths has also been decreasing. Although the suspected malaria cases was similar from 2000 to 2012, it is more than doubled in 2012 before reducing in 2013 (Figure 4.10).

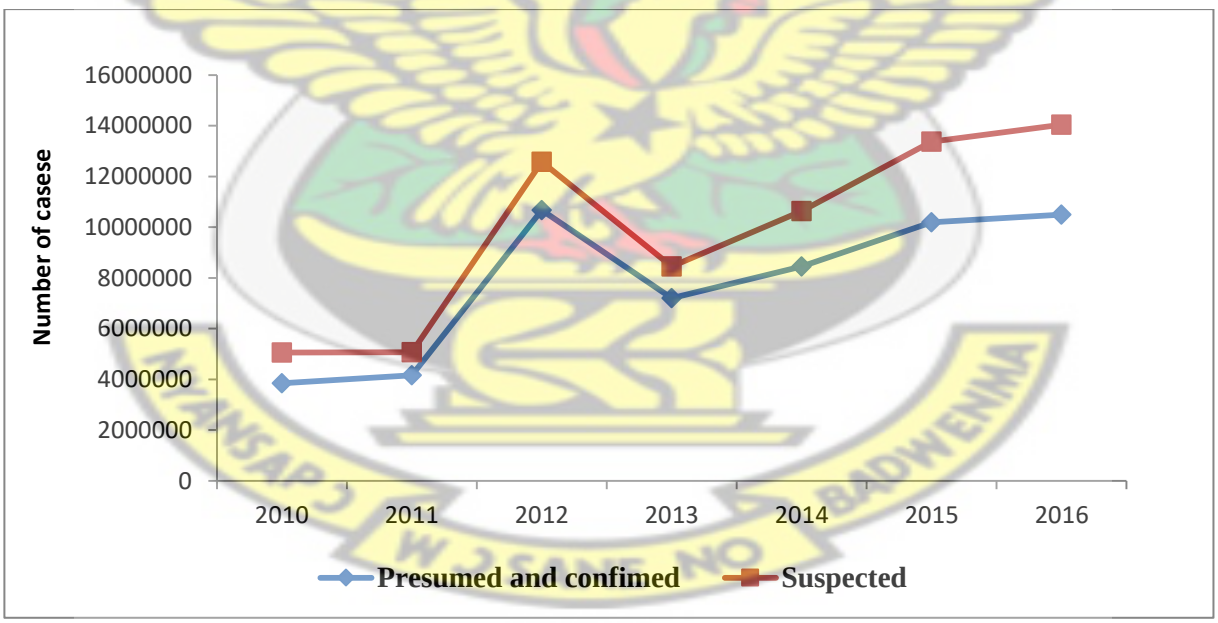


Figure 4.9: Presumed and confirmed malaria cases in Ghana from 2010 to 2016

Source: (World Health Organization, 2018).

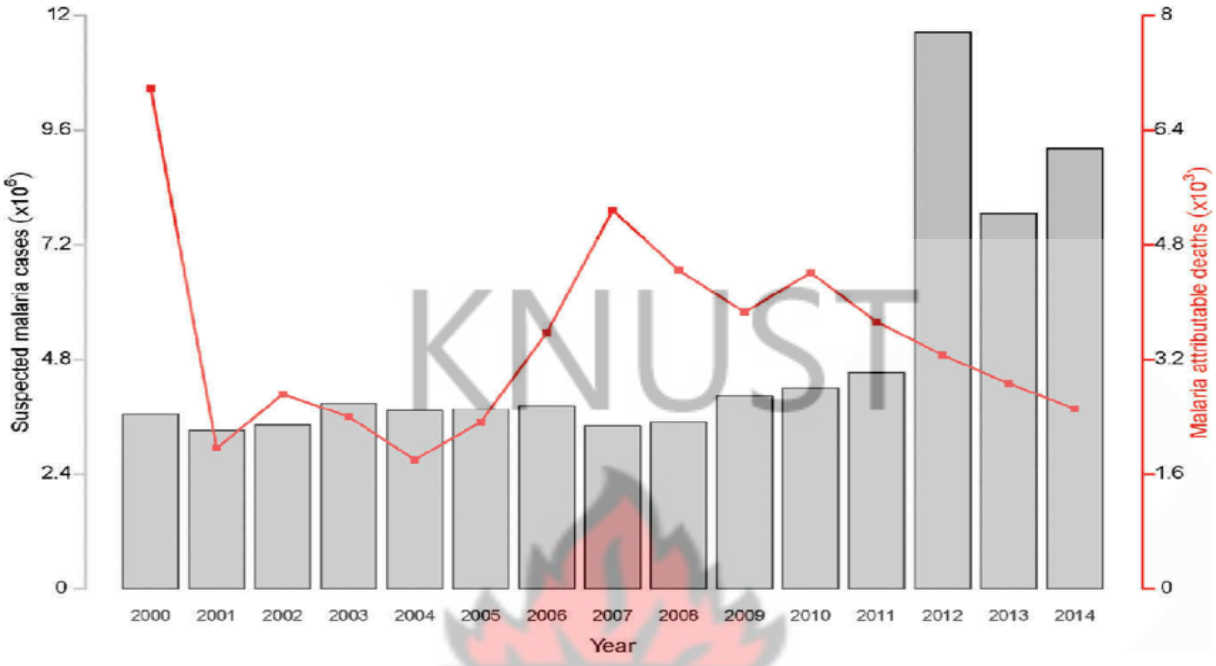


Figure 4.10 Suspected malaria and attributable deaths 2000-2014

Source: (World Malaria report, 2015)

An analysis of the District Health Information Management Systems (DHIMS) (Ghana Health Service, 2018) data in Ghana also showed an increasing in the cases of malaria in both the Western and Greater Accra Regions from 2013 to 2017 as illustrated in Figure 4.11. Similarly, diarrheal diseases increased in the Western Region within the same period whiles annual cases in the Greater Accra Region decreased slightly (Figure 4.12).

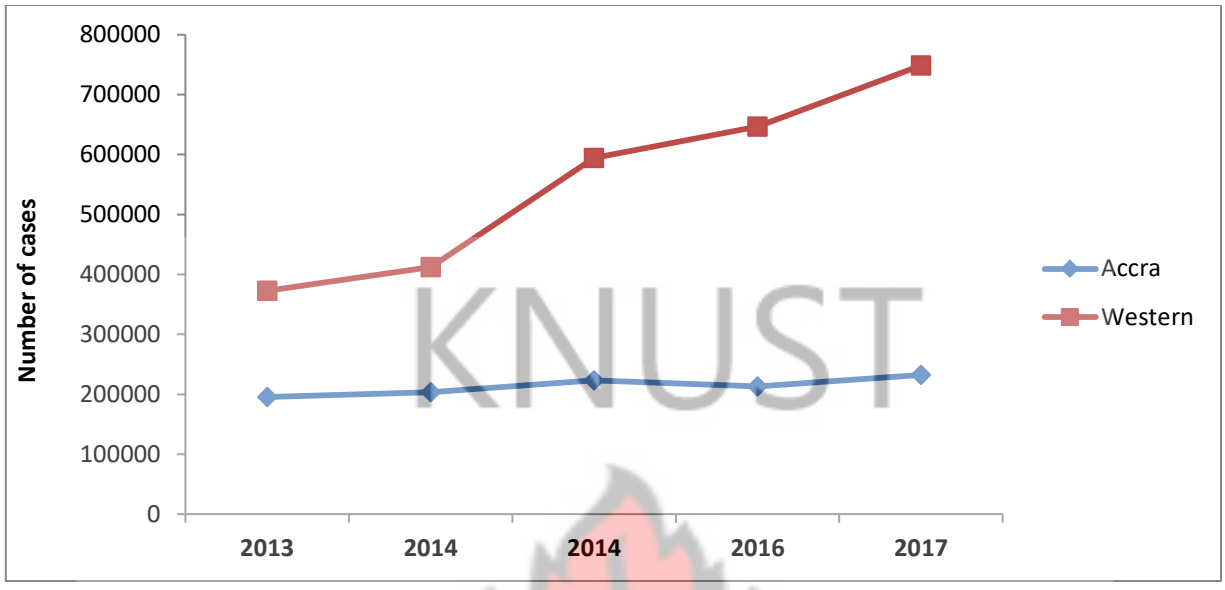


Figure 4.11: Number of malaria cases in the Western and Greater Accra regions

Source: DHMIS data (Ghana Health Service, 2018)

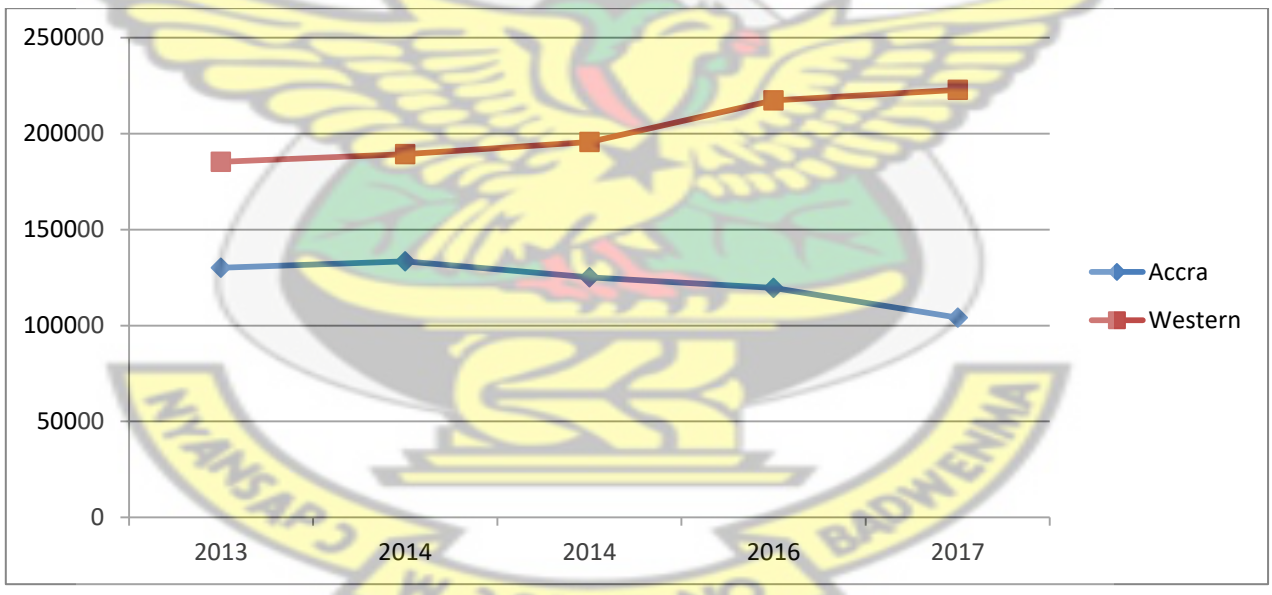


Figure 4.12: Number of diarrheal disease cases in the Western and Greater Accra Regions

Source: DHMIS data (Ghana Health Service, 2018)

Figure 4.13 also shows the trend in malarial and diarrheal diseases among children under five years in the Northern Region of Ghana. As shown, both diseases recorded an increase in the number of cases from 2014 to 2017.

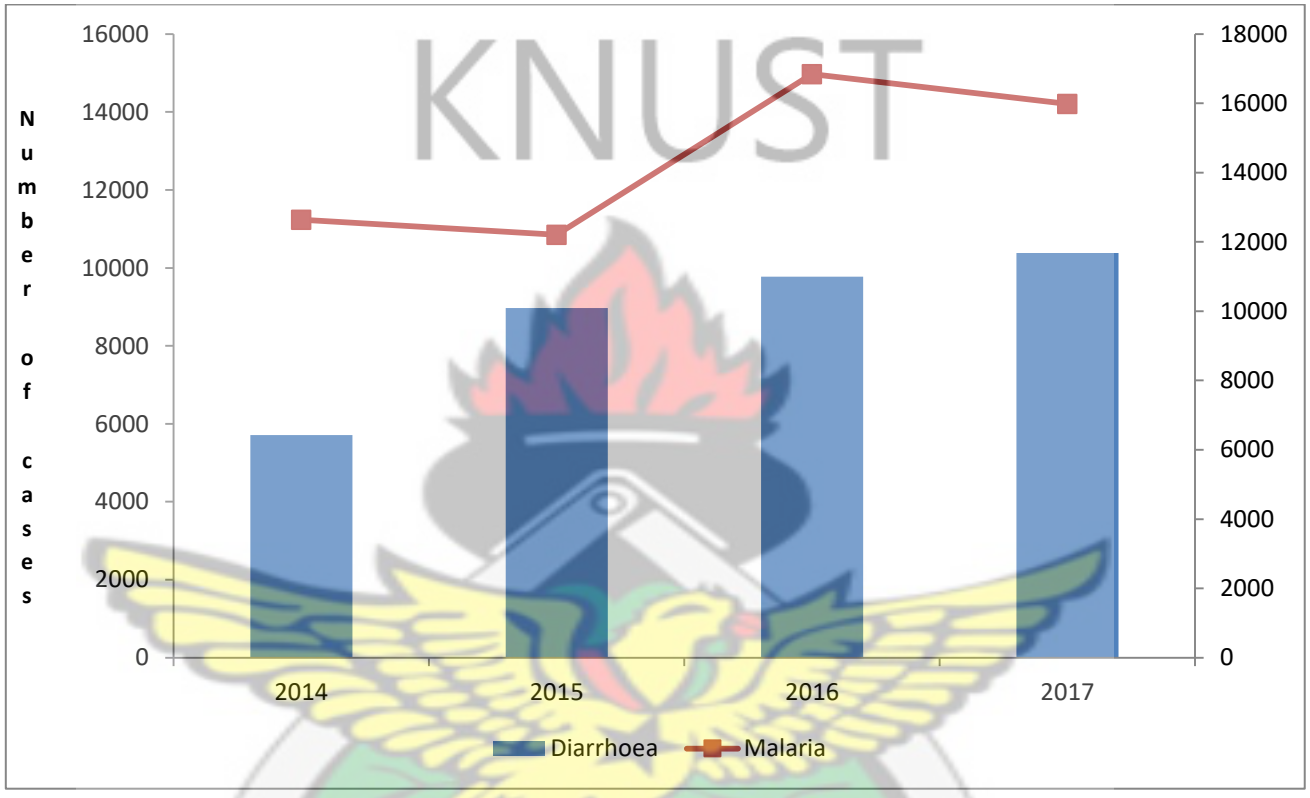


Figure 4.13: Malaria and diarrheal diseases among children under five in the Northern Region

Source: DHMIS data (Ghana Health Service, 2018)

Metropolitan health data was further analyzed to see the level of waste generation over the period of 2014 to 2017 (Figure 4.14). As shown, waste generation decreased slightly from 2014 to 2016 but increased again in 2017, with 77456.4 tonnes of waste generated in the metropolis in the last quarter of 2017, from 64646 tonnes in the first quarter of the same year. In total,

290229.6 tonnes of waste was generated in 2017 as compared to 241525.6, 267822.2 and 287600.32 in 2016, 2015 and 2014 respectively.

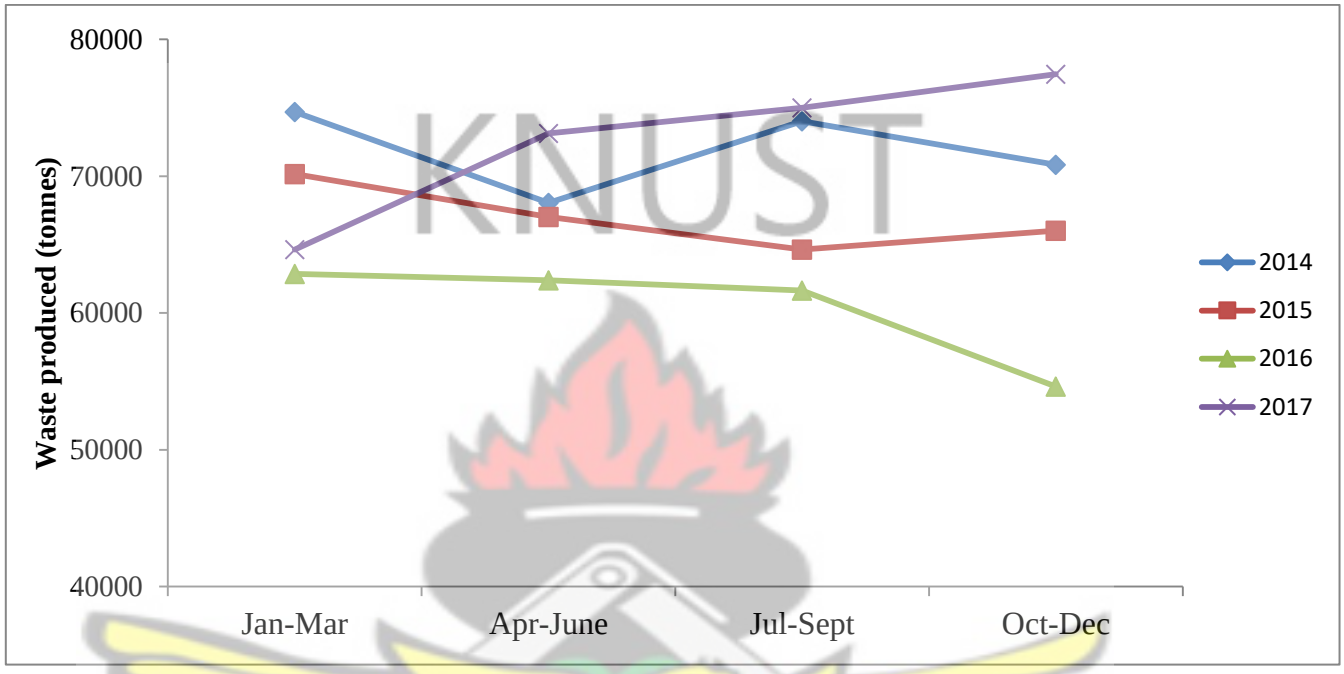


Figure 4.14: Waste generation in the Kumasi Metropolis from 2014 to 2017

Source: Metropolitan Assembly data (Kumasi Metropollitan Assembly, 2018)

4.6 Appropriate governance and financing structure

4.6.1 Challenges with the current governance structure for household solid waste management

The interviews with the stakeholders further revealed challenges in the current governance structure for municipal SWM. Some of the challenges disclosed by the respondents included;

irregularities in procurement processes (50%), lack of proper zoning of cities and urban areas (66.7%), lack of monitoring of operations of SWM companies (66.7%), weak enforcement of by-laws and sanctions (33.3%).

Most of the respondents (84.6%) disclosed that the views of the services providers are not taken into consideration in the review and arrangement of fee fixing and agreed that the involvement of an independent body/ authority would help to improve the current situation.

4.6.2 Sustainability Issues Related to the current finance system for household solid waste management

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Table 4.12 presents results of sustainability of the current payments and clients' willingness to pay. Majority of the service providers (53.8%) disclosed that clients very often default in payment of services rendered to them. All the firms stated that they are **NOT** able to collect all revenue from clients. Majority are however able to collect between 70 and 80% (53.8%) whiles 2 service providers (15.4%) indicated that they collect only 40%. The current modes of payment as stated are cash payment as they pick garbage (46.2%) and paying to an agent (69.5%0 and these were described as moderately effective (69.2%). The challenges associated with mode of payment included clients' unwillingness to pay (46%), lack of transparency from collection agents (15%), and clients not at home sometimes (23%) as detailed in Figure 4.15.

Out of 8 respondents, half of them (50%) stated that they review charges every two years whiles 2 (25%) indicated they review every year. According to majority of the firms (84.6%), charges are determined by the assemblies with less than half of the firms (46.2%) being involved in the fee fixing. Majority of the firms (84.6%) use software to capture clients' data and more than half of them (61.5%) monitor revenue collection by routine auditing. Most of the firms (69.2%) disclosed that the current revenue mobilization strategy is not sustainable for the business. The reasons for its unsustainability included clients reluctance to pay (44.4%), high operation cost (33.3%) and possibility of revenue collectors bolting with the money collected. Six of the firms

(46.2%) disclosed that clients complain about high service charges. Only 4 firms (30.8%) indicated that clients were willing to pay extra for improved services.

Table 4.12 Sustainability of current payment system

Variables	Frequency	Percentage
How often clients default in payment of services provided to them		
– Very often	7	53.8
– Sometimes	6	46.2
Able to collect all revenue from clients, No	13	100.0
Percentage of collection		
– 40	2	15.4
– 70-80	7	53.8
– 80-90	4	30.8
Mode of payment of service to clients*		
– Cash payment as we pick	6	46.2
– Pay to agent	9	69.5
– Pay at bank	1	7.7
Mode of payment effective		
– Exclusively effective	2	15.4
– Almost exclusively effective	-	-
– Effective	2	15.4

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– Moderately effective	9	69.2
– Not effective	-	-
How often is service charges review (n=8)		
– Every year	2	25.0
– Every two years	4	50.0
– Every three years	1	12.5
– Every four years	-	-
– Every five years	1	12.5
Who determines service charges		
– Waste company	2	15.4
– Waste management Contractors Association	-	-
– Metropolitan/Municipal/District Assemblies	11	84.6
– Ministry of Water and Sanitation	-	-
Involved in fee fixing (n=6)	6	46.2
Normally receive complaints from clients on service charges	7	53.8
Using software to capture clients data (n=11)	11	84.6
How monitor your revenue collection?		
– E-Tracker	3	23.1
– Mobile Task Force	2	15.4
– Routine auditing	8	61.5
Current revenue mobilization sustainable for the business		

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– Yes	4	30.8
– No	9	69.2
Reasons why it is not sustainable (n=9)		
– Clients reluctant to pay	4	44.4
– Liable to human manipulation	1	11.1
– High operation cost	3	33.3
– Revenue agents can bolt with cash	1	11.1
Clients complain about high service charges (n=6)	6	46.2
Clients willing to pay extra for improved service delivery (n=4)	4	30.8

Source: Field data, 2017

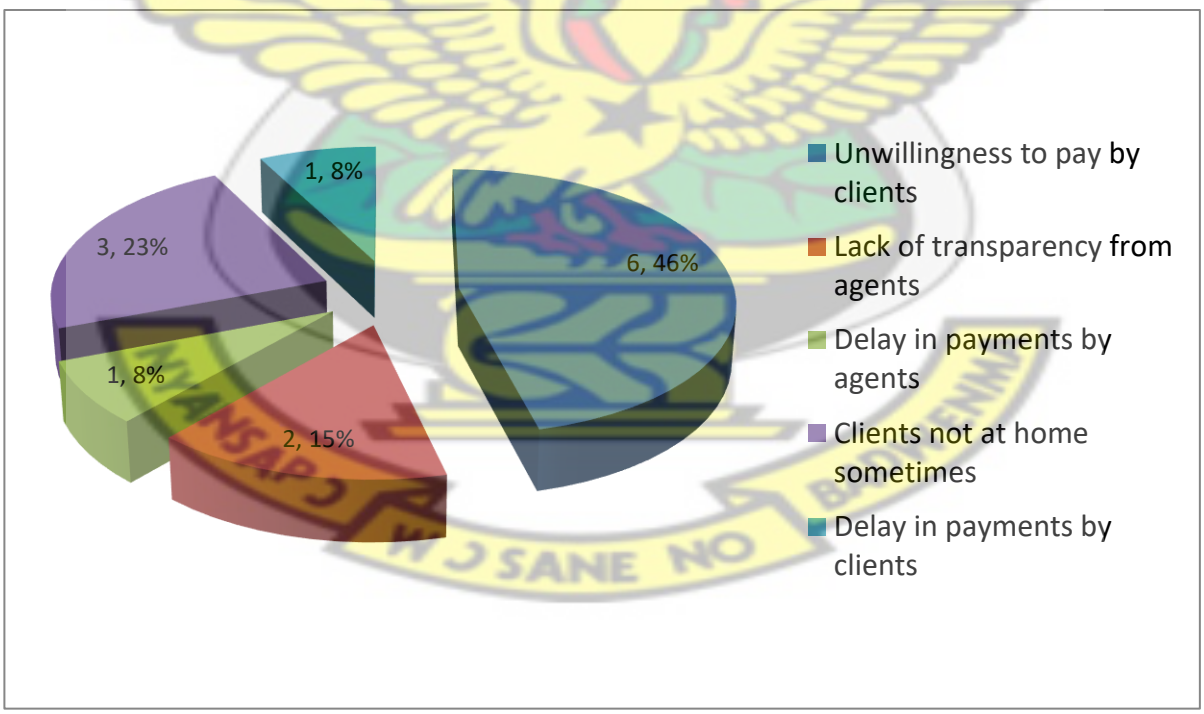


Figure 4.15 Challenges associated with current mode of payments

Source: Field data, 2017

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This chapter presents the discussions of major findings of the study. The discussions are outlined in line with the objectives of the study and are discussed in relation to relevant published studies in this and other settings.

5.1 Background Characteristics of Respondents

Socio-demographic characteristics of households are important predictors of households decision and waste management service utilization (Banga et al., 2011; Boateng 2015; Otoo et al., 2014). In this study, the background characteristics of the household heads were significantly different across the study sites. Majority of the household heads were younger and females, although in Takoradi and Accra, majority were males. Educational level was generally higher across sites with the exception of Kumasi, where only 25.5% and 7.8% had tertiary and secondary education respectively. Education level has been found as an important factor in determining household's wealth and subsequently their decision to utilize solid waste management services. It is believed that the educated will understand better health implications of poor environmental conditions and will therefore be willing to utilize SWM service, support policy implementations aimed at improving SWM and will be willing to pay for improved and additional services (Lau, 2016).

Residential type is also an important factor in SWM, especially in developing country settings. Provision of services to households depends to some extent on accessibility to communities and areas of residence, which also depend on the type of residence of the household. Type of residence varied significantly across study sites and these included estates, new sites, inner cities, old towns and slums. In Ghana, slum communities and zongos are for instance, not easily accessible and would make it difficult for SWM companies to reach households in those areas. An alternative strategy to reach those areas, therefore, needs to be explored to ensure universal access to SWM services in Ghana.

Most of the household heads were employed and with majority being skilled workers or employees. Majority of residents also described themselves rich. This shows that majority of the households were economically empowered to fully participate in waste management services decision and utilization. This relationship has been explored elsewhere and this study corroborate previous findings related to utilization and willingness to pay for SWM services in Ghana (Otoo et al., 2014).

5.2 Utilization of household solid waste management services in Ghana

This aspect of the study was mainly conducted to assess the level of utilization and factors associated with utilization of SWM services in Ghana. The main findings of the study was that relatively, majority of households utilize the services of SWM companies. 53.9%, 53.2%, 70% and 42.9% utilized SWM services in Takoradi, Tamale, Accra and Kumasi respectively. Utilization of SWM services was associated with age, educational level, marital status, area of occupation, residence, type of residency, rate of socio-economic status and duration of stay at residence.

In this study, 55.1% of the overall population utilized SWM services provided by private waste collection companies. Utilization was highest in Accra and lowest in Kumasi. However, a study conducted in an urban locality in the Ga East District of the Greater Accra Region reported a much lower level of utilization than that observed in this study, (Yoada et al., 2014). The high level of utilization of SWM services in this study could be attributed to increasing presence of private solid waste collection companies especially the informal operators. SWM services has grown to become a viable business venture in Ghana. Currently, there are more than 100 registered SWM companies in Ghana, with more than 10,000 informal ones (ESPA, 2017). Accra has the highest number of companies and informal operators. There are however gaps in the operational coverage of SWM companies with inadequate service provision especially in low income areas (Martin, 2011) as a result of inadequate financing, poor cost recovery and institutional weaknesses, negligence of both officials and residents and failure to properly define roles of stakeholders (Baabereyir, 2009).

Despite the relatively high level of satisfactions with services provided by the waste management companies, some participants expressed dissatisfaction with some aspects of the service provision. They disclosed that service provision did not adequately meet their needs. Container overflows, untimely collection, poor communication and high service charges were some concerns among study participants. These findings are consistent across other studies conducted to look into waste management in urban cities in Ghana, where participants expressed dissatisfaction with service provision (Amoah and Kosoe, 2014; Yoada et al., 2014). These challenges are attributed to lack of effective monitoring from local authorities, weak enforcement of environmental regulations, lack of definite schedules for waste collection, heavy

workload on services providers and lack of permanent waste disposal systems (Anarfi, 2012; Oteng-Ababio, 2011; Owusu and Kuitunen, 2003). These operational challenges act as major disincentives for many households to patronise services of waste management companies, regardless of their benefits.

Provision of receptacles for households was also not optimal in this study despite clients' willingness to pay for it. More than 60% of participants were not provided with receptacles by the waste management companies and had to store waste in polythene bags, buckets, baskets and aluminum containers; This was consistent with previous studies in Ghana (Amoah and Kosoe, 2014; Boateng, 2015; Boateng et al. 2016; Martin, 2011; Oteng-Ababio 2011; Yoada et al., 2014) and Zimbabwe (Musademba et al., 2011). In most urban cities in Ghana, storage of solid waste is quite universal in both low and middle-income areas, with high prevalence of use of cardboard boxes, polythene bags, and old buckets (Boateng ,2015; Boateng et al., 2016; Martin, 2011). Practical observation among middle-income households in the Kumasi Metropolis who claimed to be using standard containers revealed the use of impoverished galvanized containers (Boateng, 2015; Martin, 2011). The use of these litter bins has also been reported in a study conducted by (Amoah and Kosoe ,2014). A possible explanation could be the cost associated with standard refuse containers, which most households in low and middle-income countries could not afford.

Cost however, might not be a limiting factor for all households, especially in urban communities. In this study, most were willing to pay more for the provision of standard litter bins. In a similar study in Accra, most study participants disclosed that they would be happier and willing to pay more if litter bins were provided and there was regular collection of solid waste for the disposal sites (Yoada et al., 2014). Studies conducted in Kumasi (Awunyo-Vitor

et al., 2013) and Tamale (Alhassan et al., 2017) found that clients were willing to pay an average of GH₵8.50 (equivalent $4, August 2013) and a range of GH₵2 - GH₵25 (equivalent $0.5 - $12.5, June 2015) respectively for improved services. Similar findings have been reported in other urban cities in Ghana (Addai and Danso-Abbeam, 2014; Padi and Addor, 2015), Nigeria (Patrick *et a*l.,2017), Uganda (Banga *et al*., 2011) and Nepal (Bhattarai, 2015; Maskey and Singh, 2017). This suggests a unique opportunity for service expansion and improvement of waste management services in Ghana. Charging fees to clients is seen as an important element of an overall strategy for service sustainability. It has however been economically theorized that recovering more cost will lead to decline in demand for services, and possibly undermine efforts to provide services to low income clients. However, with the appropriate prediction of the impact of price change on utilization and revenues, city authorities can implement these price changes to enhance service sustainability.

5.2.1 Socio-economic factors associated with use of household solid waste management services

We found an influence of socio-economic status on the utilization of SWM services. Rating socio-economic position as poor was associated with low utilization of SWM services. Education, which is linked to socio-economic status (Jamison *et al*., 2006) was also associated with use of SWM services. Compared to those without formal education, having a tertiary education was associated with higher odds of utilizing of SWM services. The highly educated have higher income and improved socio-economic status (Jamison *et al*., 2006) and are therefore more likely to pay and utilize SWM services. Previous studies have shown that the use of SWM services is dependent on the ability to pay for the services (Addai and Danso-Abbeam, 2014; Awunyo-Vitor *et al*.,2013). Aside being economically empowered, the educated

have positive perceptions and are more likely to understand the health implications of indiscriminate waste disposal (Banjo *et al*., 2009; Purcell and Magette, 2010; Yoada et al., 2014). In Ghana, low education is believed to contribute to poor waste management practices (Yoada *et al*., 2014) and high education is positively linked to the willingness to pay for improved SWM services (Awunyo-Vitor *et al.*, 2013).

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The type of residence was also significantly associated with the utilization of SWM services in Ghana. Residing in an urban environment was associated with higher odds of using SWM services as compared to those who reside in peri-urban settlements. This finding corroborates with Boateng et.al. (2016), who also found that the location of the household significantly affects SWM in Ghana. SWM companies and municipal solid waste collection schemes of cities in developing countries generally serve only a limited part of the urban population, leaving the low income in urban areas and those living in rural areas (Zhu *et al*., 2007). This is attributed to the lack of financial resources and work force to cope with the increasing amount of waste generated by growing urban cities, leaving the SWM companies to limit operations to high income urban areas. A study conducted in Kenya for instance found that services of SWM companies were often centralized in the more affluent areas who were more likely to pay for their services due to inadequate man-power to cover entire cities (Henry *et al*., 2006).

Compared to those who reside in estates, residing in new sites, inner city or old town and slums or zongos was associated with lower odds of utilizing SWM services.

Dwellings in the inner cities and zongos make it difficult for SWM companies to operate within these settlements. Narrow streets in these areas may not have space for locating storage

containers and may be so narrow, treacherous or irregular for motorized collection, making it impossible to use vehicles. On the other hand, houses in New sites are considerably distance from the nearest accessible road and pose particular problems in receiving adequate waste services. SWM service providers with limited financial, technical and human resources are unable to extend their services to these areas, where there is not enough financial rewards to do so (Mwanthi et al., 1997). Parrot *et al* (2009), suggested the establishment of transfer stations through the collaboration of communities to reduce transport costs incurred by SWM companies whiles increasing services.

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5.3 Financing Options for Household Solid Waste Management

This study sought to investigate an appropriate governance and financing mechanism for household solid waste management. An appropriate financing and governance structure for household solid waste management leads to improved waste management processes and reduced disease burden. Solid waste management has characteristics of what is generally known as a "private good" and a "public good". Generally, individual client would like their wastes to be collected to a disposal site. Most of the households are willing to pay for this service either through a local tax or as a user charge system. Majority of the respondents in this study opted for user charging or polluter pays as an effective option for the current household solid waste management. A study conducted by the German Development Agency (2015), supports the user charge as an effective economic instrument for SWM. The assertion by GIZ (2015), in support of user charging as an option for SWM is based on the following characteristics of the user charging system that should be considered:

- Efficient
- Reasonable and fair
- Low cost and simple to administer
- Able to differentiate between and within user groups to enable the social scaling of tariffs
- Easily understandable by users
- Convenient for users with clear, simple and efficient payment mechanism
- Legally enforceable
- In line with the polluter pays principle

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This study established that service providers agreed to the fact that user charges as an option for SWM is moderately effective. They however complained of their inability to collect substantial revenue to cover their cost of operations due to poor mechanism of the mode of payments. A further discussion in support of the adoption of user charges as option for waste financing is to establish a billing system in line with a Pre–paid pay system. This system employs a direct charging that means charging the service in advance to avoid the risk of non-payments. The system requires the adoption of a suitable structure for the prepaid equipment (waste bags or stickers to be attached to each waste bag). An example of such system is being implemented in the Philippians. In the Philippians, a pre-paid (PAYT) system has been established that requires citizens to purchase one sticker per bin bag (up to 25 liters) for collection of residual and special waste only. Collection crew check and picks refuse attached with stickers. The system achieved reduction in waste generation but achieved small increase in cost recovery levels (GIZ, 2015). The indirect integrated billing system for user charging has also been suggested. This link user charges to an existing utility bill or tax instrument, such as property rate, water bills or energy

bills. The advantage of this system is that linking the charging to the register and billing system of a utility with high collection, can be more cost effective than setting up a separate direct charging system for waste services. This approach was adopted in Maputo, where the electricity provider collected the waste user charge in return for commission. Despite the payment of commission, this system cost less than setting up a separate collection mechanism for the user charges and was able to increase the collection rate by almost 100% (GIZ, 2015).

Adding the waste-management user charge to a local tax makes sense only if it has a high collection rate. In addition, property taxes are often collected annually, whereas SWM user charges are normally collected monthly. If the SWM user charge were linked to an annual property tax, the tariff would be relatively high to cover SWM costs. Paying such, a high user-charge in one go might not be acceptable and feasible for many citizens, especially the poorer sections of the community. Linking to a local tax means that the local authority would not need to pay a commission to the service provider.

Key among the challenges enumerated by the service providers in this study was intermittent closure of landfill or disposal site. This hinder the smooth operations of the business leading to loss of huge revenue. Construction of engineered landfill or in integrated compost plant by the ministry as a national policy in all the metropolitan assemblies will help improve waste management at the community level. This can be in the form of grant to the local assemblies who will intend collect disposal fee to maintain and pay for the capital cost. User charges alone are often not able to cover for the whole cost of SWM and, at the same time, stay affordable for citizens. Additional economic instruments at the state or national government levels should therefore be adopted. These complementary instruments offer great opportunities for ensuring

resource-efficient waste management by diverting waste from landfills and, at the same time, improving cost recovery (GIZ, 2015). Other options of financing proposed include the following:

- Advanced recycling fees, product taxes and other instruments supporting
- Extended producer responsibility
- Subsidies and Funds
- Tax exemptions
- Feed-in tariffs for energy from waste.

The study identified subsidies as an option for financing household waste management. Subsidy, in the form of supplying litterbins for residents especially those from poor communities free of charge can be adopted. This will compel households to subscribe to the services and prevent indiscriminate dumping. Appasamy and Nelliyat (2007), in support of this explained that conservancy taxes and user charges could be used to defray operating costs. However, capital cost of collection (vehicles and equipment), treatment and disposal may require external source of finance. In India, the government agencies have provided two types of support: (a) Subsidies and (b) Grants.

Lohri et al.(2014a), also added that diversified financial mechanisms is needed to cover different working steps of the SWM process to ensure financial sustainability. Three potential financing mechanism is suggested:

1. The ‘‘polluter-pays principle’’ (revenues from waste generators): The polluter, in this case the waste generator, covers all or a fraction of the costs of waste management.

2. The ‘‘cross-subsidy principle’’ (higher fees for special waste generators or more affluent generators; support by the national central budget or local municipal budget): This complements the polluter-pays-principle by using a variety of progressive tariff.
3. The ‘‘business principle’’ (revenues from waste processing):Costs are covered from sales of products and services; in the case of SWM, that would be waste products from waste-to-energy, recycling and material recovery. (Lohri et al., 2014a) .

5.4 Consumers' Acceptability, Ability and Willingness to Pay for Household Solid Waste Services

Waste management is an important developmental issue globally, especially in developing countries like Ghana. In developed countries, the involvement of the private sector has contributed immensely to effective waste management. In Ghana however, although private waste management companies have been involved in solid waste management for some time, the problem of solid waste management is far from being resolved. A key challenge of waste management in developing countries is sustainable financing (Kumar *et al*., 2017; Yukalang *et al*., 2017). Currently, the most available payment option for SWM is polluter or user pay. Waste management companies however do not realize enough from user payments, to be able to provide quality services owing to inability to collect all revenues from households and households' inability or unwillingness to pay for SWM services.

In this study, most households were willing to make additional payment for improved quality of SWM services, preferably increase in the frequency of lifting of garbage. Reasons for not willing to pay extra included low income and economic reasons, collection frequency not adhered to by waste management companies, the belief that Government should pay and

inadequate/poor service delivery. This corroborates findings from a study in the Kumasi metropolis where majority were willing to pay additional fees for improved service (Awunyo-Vitor *et al*., 2013). Similarly, their study reported some respondents' unwillingness to pay because they believe it is the responsibility of government.

Most of the households were willing to pay GHC10.00 to 20.00 (USD 2.3 to 4.8 at 2017 exchange rate of USD1 to GHC4.2) in addition for improved services. Similarly, in a study by Awunor-Vitor *et al* (2013), in the Kumasi Metropolis, households were willing to pay at least GHC5.00 or more to support improved waste management services. This suggests that, presently, an increment of up to GHC10.00 or more will be acceptable to majority of households if it is accompanied by improved services by waste management companies.

Currently, self-payments is the prevailing financing option for households in Ghana. In Europe, the polluter pay principle has been part of waste management legislation since 1975 (Regebro, 2010). This payment system is readily understood by users and in line with the 'polluter pays principle' (users producing more or more hazardous/non-recyclable waste have to pay more) (Federal ministry for economic cooperation and development, 2012). This type of user charge system could serve not only as a cost recovery instrument but also as a motivation to reduce the production of waste (Federal ministry for economic cooperation and development, 2012).

Some households in this study believed this payment option have effects on service delivery by encouraging indiscriminate dumping of waste, discouraging continuous payment and promoting arbitrary charging and poor service delivery. A setback of this payment system however is the inability to collect substantial revenue to cover the cost of operations due to poor mechanism of the mode of payments. In a study of financial sustainability of solid waste management in

Ethiopia (Lohri *et al*., 2014b), the efficiency of fee collection from households was only around 50%, with the total amount of revenues insufficient to cover the running costs of waste management. Their study suggested a detailed cost structure and cost-revenue analysis of waste management activities in order to enhance cost efficiency and balance the cost-revenues towards cost recovery. It is believe that with an effective revenue collection mechanism in place, the user charge or polluter pay system will be an effective financing option for SWM in Ghana and similar settings. Education of the populace on the use of electronic platforms for payment of user fees may improve revenue mobilization under this payment system. Public education has been found out to be a useful tool in promoting positive waste management behavior among households (Desa *et al*., 2012; Lau ,2016).

5.4.1. Predictors of willingness to pay for improved household solid waste management in Ghana

Educational level, marital status, area of occupation, and region of residence predicted willingness to pay extra for improved SWM services in Ghana. Having any form of education was significantly associated with higher odds of willingness to pay for SWM compared to those who had no form of education. Findings from this study corroborates previous studies from Ghana and other settings, that found an association between educational level and willingness to pay for improved SWM services (Addai and Danso-Abbeam, 2014; Naeem and Amin 2013; Nkansah *et al*., 2015). The highly educated have higher income and improved socio-economic status (Jamison *et al*., 2006) and are therefore more likely to pay and utilize SWM services. Aside being economically empowered, education leads to positive perceptions and ability to understand the health implications of indiscriminate waste disposal (Banjo *et al*., 2009; Purcell

and Magette 2010; Yoada *et al*., 2014). In Ghana, low education is believed to contribute to poor waste management practices (Yoada *et al*., 2014) and high education is positively linked to the willingness to pay for improved SWM services (Awunyo-Vitor *et al.*, 2013).

Previous studies have shown that the use of SWM services is dependent on the ability to pay for the services (Addai and Danso-Abbeam, 2014; Awunyo-Vitor *et al*., 2013). Households with high-income level would therefore be more willing to use SWM services and to pay for improved services. In this study, household heads who rated themselves poor had lower odds of willing to pay extra for improved SWM services. Similarly, studies conducted in Malaysia (Subhan *et al.*, 2014) and Sri-Lanka (Thirumarpan and Dilsath, 2016) reported an influence of household income on willingness to pay for improved SWM services. A similar study conducted among randomly selected households in Ethiopia also revealed that improved solid waste management is significantly related to income (Hagos *et al*., 2012).

5.5 Implication of Household Solid Waste Management Practices on the Trends of Environmental Related Diseases

Solid waste management is a demanding and challenging undertaking in all developing countries, with important implications for human health and well-being, environmental preservation, and sustainability (World Health Organization, 2016). Although the available scientific evidence on the waste-related health effects is not conclusive, it can be suggested that increasing poor environmental sanitation practices, lead to the adverse health effects. Data from the global burden of disease also show that in 2012 alone, poor water and environmental sanitation accounted for 842 000 annual deaths from diarrhea, and 1.5% of the global burden of disease (in Disability-Adjusted Life Years or DALYs) (Prüss-üstün *et al.*, 2002).

Poor environmental sanitation practices has been responsible for the transmission of many infectious diseases including cholera, typhoid, and diarrheal diseases.

This study reviewed the trends of environmental health reports, environmentally related diseases, waste generation and disposal trends in Ghana to present evidence of the possible impact of environmental health and waste management practices on public health in Ghana. Data from the World Malaria Report in 2015 shows an increasing prevalence of malaria from 2000-2015 (World Health Organization, 2015) despite the distribution of about 19.6million insecticide treated mosquito nets (ITNs) in the country between 2014 and 2016 (World Health Organization, 2018). The situation is similar across the West African sub region, with an increase in confirmed malaria cases from 6.9 million in 2010 to 40.6 million in 2016 (488% increase) although deaths decreased from 39 100 in 2010 to 18 700 in 2016 (52% decrease) (World Health Organization, 2018).

Further, a review of health information data in the two of the study sites shows an increase in the prevalence of malaria and diarrheal diseases over the past five years to 2017 (District Health Information Management System, 2018). Malaria also continue to be the number one out patient's department (OPD) disease with diarrhea persistently being one of the top ten diseases. In the Tamale metropolis, malaria and diarrheal diseases in children under five also increased from 2014 to 2017 (District Health Information Management System, 2018).

Although the association between waste generation and disease prevalence was not directly assessed in this study, previous studies have shown the increase in prevalence of malaria and diarrheal diseases could be attributed to poor environmental conditions. As its been previously discussed, waste generation in Ghana is currently on the ascendency with government and

private waste companies finding it difficult to deal with it. For instance, trend analysis shows increase in waste generation in the Kumasi Metropolis from 2014 to 2017. These waste generation and disease trends is a wakeup call to all stakeholders to strengthen efforts to reduce waste generation and adopt a sustainable financing mechanism that will ensure sustainability of waste management services in the country.

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5.6 Appropriate Governance and Financing Model for Household Solid Waste Management

The provision of good SWM services while ensuring financial sustainability of the system continues to be a major challenge for many cities in developing countries worldwide. In Ghana, private waste management companies have been part of municipal waste services for more than a decade. However, financial sustainability of these companies is a challenge, leading to inefficiencies and persistent waste management problems in the country especially in the big cities. This study set out to assess the level of utilization of SWM in the country, clients' usability and willingness to pay for SWM services, the financial options, governance structure and challenges associated with solid waste management in major cities in Ghana. Based on these findings and a review of existing literature, few suggestions are proposed for adoption by policy makers for an improved waste management in major cities in the country and other similar settings.

Currently, the main financing option for household solid waste management in Ghana is the user fee. Although this has been suggested as an effective way for full cost recovery by waste management companies and municipal authorities, inability to effectively collect revenue leads

to losses and financial management problems. Service providers in this study bemoaned difficulties in revenue mobilization with households often defaulting. Some service providers were able to collect only 40% of user fees with some clients unwilling to pay. Majority of the service providers also opined that the current revenue mobilization strategy is not sustainable for the waste management business, reasons being reluctance of clients to pay, high operation cost and the possibility of revenue collectors bolting with the money collected and the poor governing structure of the waste management system.

On the other hand, some clients also complained of high user charges, untimely collection of their waste, leading to discontinuation of engagement of the services of SWM. Another challenge identified in this study is the disposal and treatment of the waste. Methods of waste disposal are mainly sanitary landfills and open dumpsite. There are occasions where dumping sites are closed to waste management service providers, creating problems of overflow of litterbins. The country as at this moment lacks waste minimization, recycling and reuse strategies. This suggests the need for increased investment in waste minimization resources by the government to reduce the waste burden and contribute to effective waste management.

The stakeholders in this study further revealed challenges in the current governance structure for municipal SWM, including irregularities in procurement processes, lack of proper zoning of cities and urban areas, lack of monitoring of operations of SWM companies and weak enforcement of by-laws and sanctions. This is consistent with the study by Oduro-Kwarteng et. al (2017), which found out that the current governance structure for SWM in Ghana is weak, a situation that has allowed elected local government officials to become involved in illegal collection of user charges (Oduro-Kwarteng *et al*., 2017).

These challenges clearly suggest the need for a finance and governance model that would enhance effective revenue collection, full cost recovery and maximization of profit by service providers to enhance effectiveness in waste management. Oduro-Kwarteng *et al* (2017), who recommended an improved and integrated SWM system that involves all actors of governance, also suggested this.

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There remain questions of how user charges are determined and whether the polluter pay principle is properly applied. In the subsequent section, I propose a framework for waste management and its financial sustainability.

5.6.1 Innovations for sustainable household solid waste management

A. Current approach to municipal household solid waste management system

The diagram below describe the current system of household waste management. With this system, the Metropolitan assembly through the waste management department zone and contract service providers to collect and disposed waste at an approved site for disposal. The various waste management companies register clients who are willing to subscribe to the services and pay for the collection. This system has been in existence with a number of challenges from administrative to operational as identified in the study results. Most especially challenges with disposal sites, revenue mobilization, education and sensitization of clients, which are left in the hands of the service provider. Most of the service providers are unable to collect more than 50% of their revenues due to operational and administrative lapses on the part of the municipal assembly who also fixes fees for the collection. There is therefore the need to adopt a holistic system for effective and sustainable municipal waste financing and management.

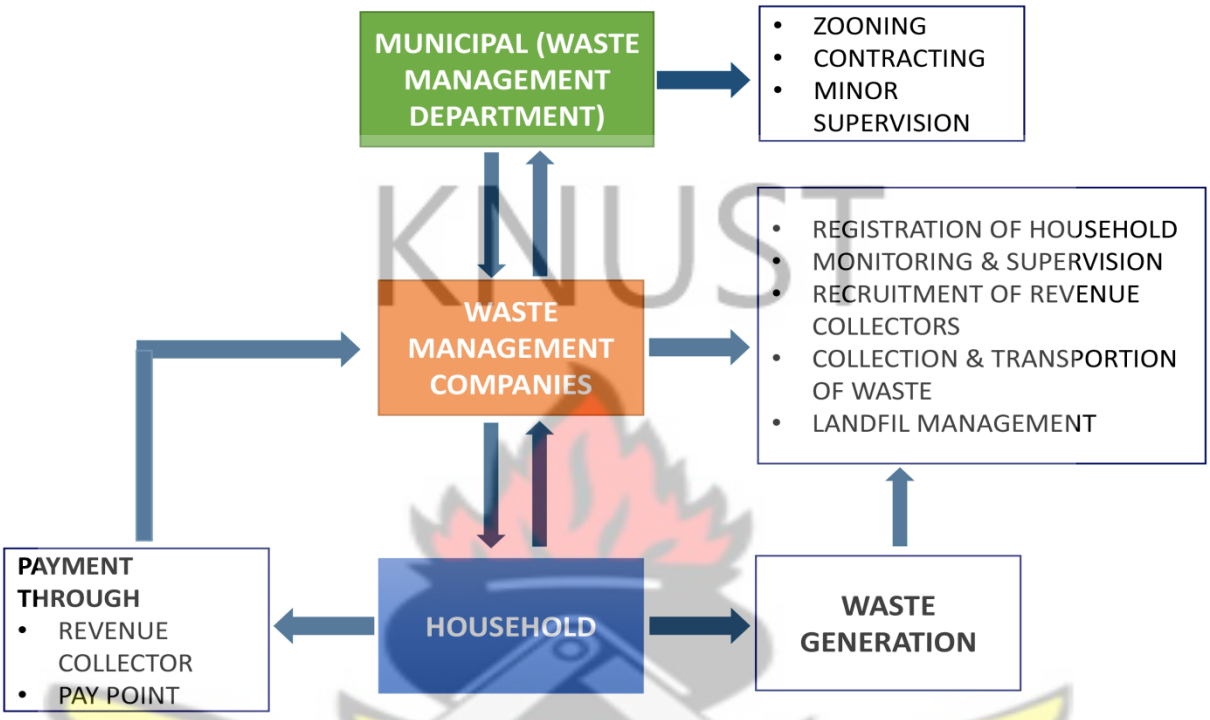


Figure 5.1 Current (existing) household waste management framework in Ghana

Source: Author's construct, 2017.

B. *Proposed financing and governance model for household solid waste management*

This study identified various challenges in the financing and governance of household SWM in Ghana. This included irregularities in procurement processes, lack of proper zoning of cities and urban areas, lack of monitoring of operations of SWM companies and weak enforcement of by-laws and sanctions. Most of the firms interviewed could not fully recover their cost of services due to inadequacy of the payment structure and lack of appropriate mechanisms for cost recovery.

Based on the challenges with the current household SWM system and an empirical evidence from this study, a new model is proposed to improve SWM in Ghana. The proposed model take into consideration the following:

- Determination of the current and future costs of the local SWM
- Determination of costs recovery policy and objectives
- Designing a user charging regime
- Public information dissemination and consultation
- Establishment of a legal base for the implementation of the cost recovery and revenue collection
- Implementation and monitoring of cost recovery system

Key features in the framework are:

- Independent Authority
- Municipal Assembly (Waste management Department)
- Service providers (Environmental Service Providers Association, ESPA)
- Households/ Clients who generate the waste

The independent Authority is a group of people nominated by the approval of all key actors to serve as an advisory body for the municipal waste management process for an agreed period as agreed in their constitution. Among their mandate should include but not limited to the following:

- Raise funds through user charging, donor funds, grants and other sources
- Ensure fairness in charges

- Ensure prompt payment to service providers
- Sanction poor performing waste companies/ineffectiveness
- Stop service delivery and application of bye laws on clients for non-payment
- Fee fixing in consultation with municipal assembly, service providers and clients/household
- Ensure sustainability of MSW financing and management processes

The municipal assembly is the mandatory body by law to oversee waste management activities in the municipality. Among the mandates proposed by this system include but not limited to the following:

- Provision of technical advice to independent advisory body, service providers and other actors
- Zoning of municipality and contractual agreement to recognize waste companies in consultation with independent advisory body
- Monitoring and evaluation of entire system
- Fee fixing in collaboration with independent advisory board
- Enforcement of the laws and education of the populace
- Getting periodic feedback from public to the board

Service providers are contractors or waste management companies who are doing business. They should be identified and registered as existing companies with the capacity to undertake the waste management contract.

Their mandates should include but not limited to the following:

- Operate within assigned contractual zone
- Provide effective service delivery based on contractual agreement
- Submit bills to advisory board and assembly for vetting and approval for payment on monthly basis
- Ensure adequate training of staff
- Ensure effective communication to clients
- Introduce innovations to the waste management processes

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Household /Clients are community members who generate waste on daily basis, needs the services of waste companies for their waste to be collected and pay in returns.

Among their mandate include but not limited to:

- Subscribing to the SWM services
- Provide approved refuse container for storage
- Pay for the approved service charge timely
- Report any challenge in connection with service agreement
- Propose any other innovative way of waste management that is convenient

Developing the proposed Governance and financing model

Interaction with the stakeholders further revealed challenges in the current governance structure for municipal household SWM. These include no inclusivity (84.6%) of the service providers disclosed that their views are not considered in the review and arrangement of fee fixing), role conflict among Metropolis, Municipal and District Assemblies, (MMDAs) and Sector Ministries - no independent body/ authority to regulate or oversee the various actors, a role

which is currently being played by the MMDAS who are also actors. There is absence of public health dimension and a single source funding (user charges) fraught with high receivables. This culminates in the overall sub-optimal level of utilization of SWM services (55%). However, about half (53.7%) of households are willing to make additional payment.

Other key findings were irregularities in procurement processes (50%), lack of proper zoning of cities and urban areas (66.7%), lack of monitoring of operations of SWM companies (66.7%), weak enforcement of by-laws and sanctions (33.3%).

Based on these key findings, the study modelled a comprehensive governance structure (Figure 5.2) to address the current situation and also to fulfill sustainable waste management requirements; (i) infrastructure, (ii) all the stakeholders involved and (iii) all the strategic aspects, including the political, health, institutional, social, economic, financial, environmental and technical facets, this can only be archived through good governance (UNEP 2015).

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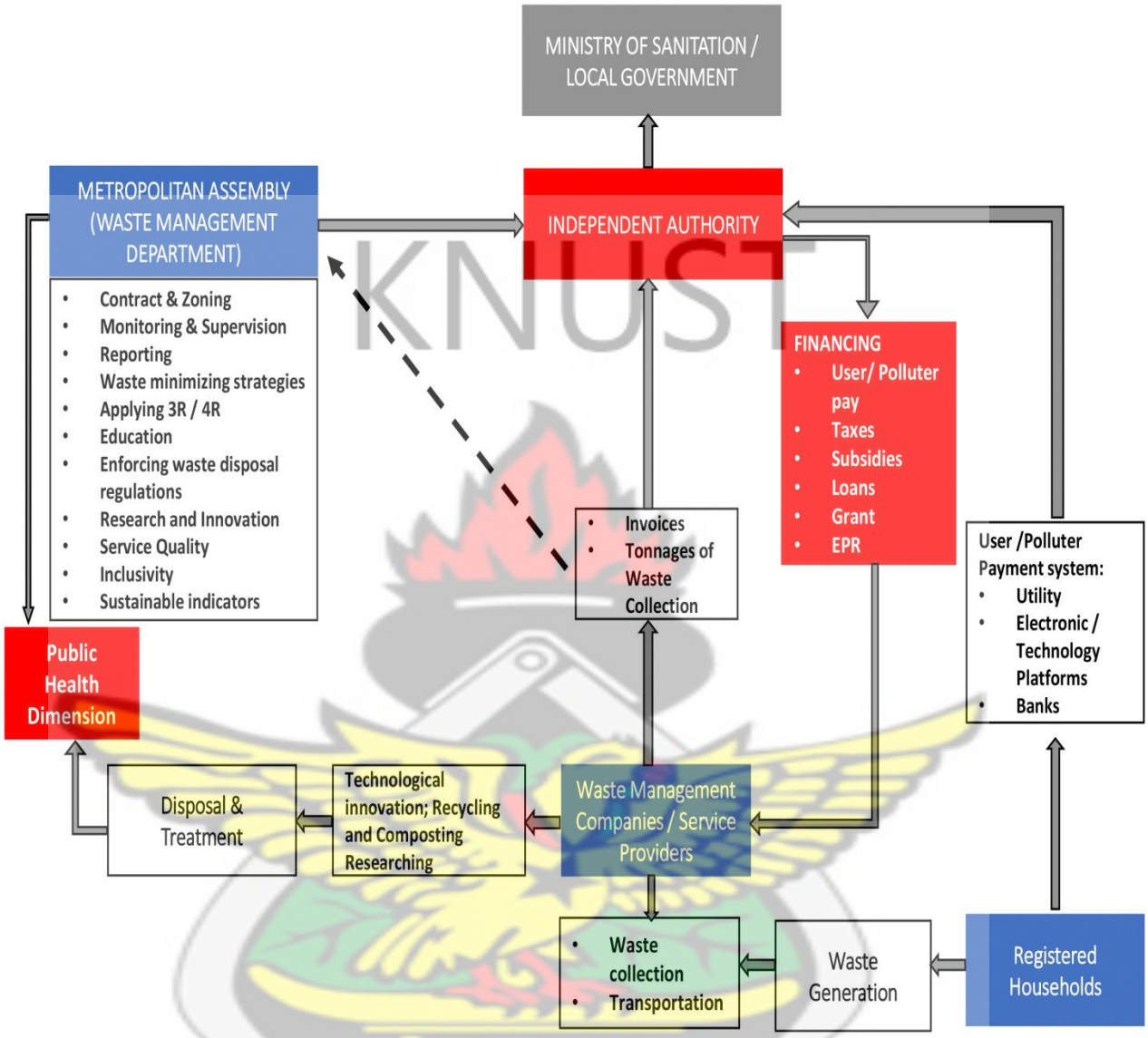


Figure 5.2: Proposed Governance and financing model for household solid waste management

C. Governance and financing for household solid waste management

This study identified user/ polluter pay as an effective option for financing municipal household solid waste management in Ghana.

To address the overdependence on user charges, as it is evident that the user charges alone cannot meet the capital-intensive funding source for the entire waste management value chain, the study suggest the broadening of the funding base as shown in Figure 5.2.

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User pay as adopted should be able to cover the entire waste management financing. Efficient mechanism should be adopted to ensure optimal revenue collection. Cross subsidization as an additional option is important to cover for the identified poor communities whiles the rich pay little higher to cover for that. Loans and grants should be applied for the construction of an integrated disposal and treatment facility to eliminate the interruption caused by intermittent closure of landfill site. Compost derived from production of manure can be sold to augment the payment of the facility in a long term. This will in turn generate employment and ensure clean and safe environment. Taxes can be imposed on properties within the metropolises to subsidize for the disposal and treatment as well as pay for poor communities. Recycling fund can be created as a pool of fund generated to pay for recyclables and subsidize for households who practice waste minimization.

Extended Producer Responsibility (EPR) as an option for financing can be applied on the production of specific goods that needs special care in terms of collection, disposal and treatment. This can be in the form of a levy or tax imposed on such goods to be paid by consumers of such products.

Appasamy and Nelliyat (2007), who suggested different ways of financing SWM to be able to cover the cost incurred, support this. They suggested that traditionally in public finance, there are four ways of financing local public goods and which could be applied to SWM financing:

1. Local taxes such as the property tax.
2. User charges which are levied on various urban services
3. Grants from higher levels of government (Central, State Governments)
4. Loans from the Capital Market, from Government/Financial Institutions or international agencies like the World Bank.

With increasing economic and urban population growth, resulting in increase in the quantity of waste to be managed and associated cost of solid waste management, it has become necessary to consider various financing options to cater for these escalating costs (Appasamy and Nelliyat, 2007b).

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CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

This section presents the conclusion of the study based on the key findings and make recommendations for improving the current waste management situation in the country for improved public health.

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6.1 Conclusion

6.1.1 Utilization of Solid Waste Management Services in Ghana

There was a sub-optimal level of utilization of household SWM services in the Metropolitan Assemblies in Ghana (<60%) except Accra which recorded (70%). Utilization of household SWM services was associated with socio-economic characteristics and type of residency. This finding provide an insight into the important predictors of utilization of SWM services and how type of residency is associated with utilization of SWM services.

6.1.2 Financing option and challenges associated with revenue collection

The current payment option for household SWM is user fees. Existing payment option poses challenge to service providers in effective revenue collection and full cost recovery.

The current payment option and the mode of payment is characterized by high defaulting rate and delay payments among households. The current payment option for SWM - user fees discourages some households from continuous use of SWM services. Mode of payment of the service charges are through collectors and pay point outlet. Majority of the service providers were unable to collect up to 70% of their revenue and have huge receivables.

6.1.3 Willingness to pay additional fees for improved household solid waste management

Majority of households (53.7%) were willing to pay extra (GHC10-50) for improved SWM services in the four metropolis. Educational level, marital status, region of residence and rate of socio-economic status predicted the willingness to pay for improved SWM services in Ghana.

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6.1.4 Implication of solid waste management practices on the trends of environmental sanitation related diseases

This study has also demonstrated a rising prevalence of environmentally related diseases including malaria and cholera, which is accompanied by poor management of solid waste. Analysis of data from global and national estimates of malaria suggest a linkage between increasing poor environmental waste practices and increasing environmental health related challenges. A forecast of the current trend of environmental related diseases further shows an exponential increase in the prevalent of environmental related diseases if appropriate interventions are not employed to tackle the household waste management practices.

6.1.5 An optimal governance and financing model for household solid waste management in Ghana

The governance structure for solid waste management in the four metropolis is weak and does not support sustainable/effective and optimal waste delivery services. The structure lacks an independent authority that regulate the system, does not consider public health dimension and issues of inclusivity in the waste management. Power is centered on the metropolitan assemblies without inclusion of key actors in decision-making process.

6.2 Recommendations

Based on the findings of this study, the following recommendations are made to improve waste management services as well as the financial sustainability of service providers:

Ministry of *Local Government / Metropolitan Assemblies*

- The ministry of local government should assist the Metropolitan Assemblies to supply litterbins to households in poor communities as a form of subsidy to compel them to subscribe to household SWM services and discourage indiscriminate dumping and burning of waste as a short-term measure.
- The ministry should support the Metropolitan Assemblies with logistics to embark on education and enforcement of laws on environmental sanitation.
- The local government should assist the assemblies to implement a digitize address system in the communities. This will enable service providers to implement effective waste collection and revenue mobilization.
- The ministry of local government should embark on training and sensitization of local decision makers on the need to implement SWM system that adopt an economic instrument approach for sustainable SWM.
- The local government through the assemblies should sensitize households on waste minimization strategies such as the practice of 3Rs (reduce, recycle, re-use).
- Again, the ministry should adopt an innovative financing option that is inclusive such as a combination of cross subsidy, taxes, grants, loans to sustain financing of waste management services as a long-term measure.

- It is recommend for the consideration of a payment system where households with high income, pay a little higher to subsidize for households with low-income as applied the in NHIS.
- It is recommended for the piloting of the governance and financing model structure proposed in one of the study areas.

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Ministry of Sanitation

- The Ministry of Sanitation should come out with plans and programs that sort to bring inter- ministerial collaboration for effective implementation of polices.
- The Ministry of Sanitation should assist the Metropolitan Assemblies in construction of compost plants and pay back through tipping fee collection.

Service Providers

- It is recommended to service providers to ensure effective service delivery and prevent container overflows to motivate household subscribe to the services and pay on time.
- It is further recommended to service providers to employ effective revenue mobilization systems through ICT innovations and other electronic approaches to improve revenue mobilization.

Clients/Customers/household

- It is recommended to households to appreciate the importance of poor waste management practices and the health implications.

- It is recommended to clients to involve themselves in decision-making processes for solid waste management.

- It is further recommended to households to insist on effective service delivery by service providers and report non-compliance of service agreement to the authorities for non-payments and sanctions.

Further studies

- Based on these study findings, further research into perception and acceptability of waste minimization strategies among Ghanaians is recommended.
- Further study to understand the entire cost of the SWM processes is recommended.
- The operational challenges of SWM companies, municipal and metropolitan assemblies, although beyond the scope of this study, are important areas for further research.
- It is further recommended that an operational research is conducted on the governance and financing for municipal/metropolitan solid waste management.

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APPENDIX A- QUESTIONNAIRE FOR CLIENTS

KWAME NKRUMAH UNIVERISTY OF SCIENCE AND TECHNOLOGY/COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF HEALTH POLICY AND ECONOMICS

Title: Governance and *Financing Mechanisms for Household Solid Waste Management in Urban and Peri-urban Settings of Ghana*

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Questionnaire for clients

Good Morning/Afternoon, I am ……, a research assistant at the School of Public Health/Kwame Nkrumah University of Science and Technology. I will be conducting interview with you on the subject "financing mechanism for municipal solid waste management in urban and peri-urban settings of Ghana". Please note that this study is a PhD research work and aim to provide evidence to strengthen the financing mechanism for municipal solid waste for clients like you. Please feel at ease to express your candid responses based on the instructions provided. Thank you

Principal Investigator:

Co-Investigators: Dr. Peter Agyei-Baffour +233244049594

Respondents ID……..

Date: ……. /……./2017

Instruction

Please kindly respond to the questions by circling or ticking against the right response – apply all to multiple responses choices

QN. A	SECTION A: BACKGROUND INFORMATION	RESPONSE (LABELS)
ID	**Region/Suburb**	**[1] Ashanti Region** **[2] Greater Accra** **[3] Takoradi** **4. Tamale**
A1	Gender:	[1] Male [2] Female
A2	Age	…… (in years)
A3	Highest education	[1] Never been to school [2] Basic education (Primary & JHS) [3] Senior High School [4] Post- Secondary (training/vocational) [5] Tertiary (Diploma & Degree) [10] Other, please specify
A4	Marital status	[1] Single [2] Married [3] Co-habitation [4] Widow [5] Divorce
A5	Area of occupation	[1] Government (Civil servants) [2] Private [3] Self-employment (informal sector)
A6	Major employment	…… *Tips (teacher, manager, apprenticeship…)*
A7	Description of Employment	[1] Skilled [2] Semi-skilled [3] Unskilled
A8	How much do you earn from all economic activates in a month?	…… (in GHC)
A9	How much do you spend out of this amount in a month?	…… (in GHC)
A10	Place of Residency	[1] Estate [2] New site [3] Inner-city [4] Old town

		[5] Slums [6] Zongo [7] Other (specify)……
A11	Description of residency	[1] Urban [2] Peri-urban
A12	How long have you live in your community	**…… (**in years**)**
A13	Number of dependents	**…… (**in persons**)**
QN. B	**SECTION B: QUALITY OF SERVICE AND UTILIZATION**	
B1	How do you dispose off your refuse?	[1] Door - Door collection by a contractor [2] Dispose off in a gutter/drain [3] Send to a communal container site [4] Other (Specify) ……..
	If your answer to question (B1) is [1], proceed to th following questions	
B2	What is the name of the contractor?	**……..**
B3	Do you have agreement/contract with the contractor	[1] Yes [2] No
B4	What type of equipment do they use to collect your waste?	[1] Compaction truck [2] Tricycle machine [3] Skip truck [4] Push cart [5] Wheelbarrow
B5	What equipment would you prefer to be used to pick your refuse?	[1] Compaction truck [2] Tricycle machine [3] Skip truck [4] Wheelbarrow
B6	Do services provided by contractors adequately meet your needs?	[1] Yes [2] No
B7	If yes TO B6, how would you rate your satisfaction with the services?	[1] Not at all satisfied [2] Slightly satisfied [3] Moderately satisfied [4] Very satisfied [5] Extremely satisfied
B8	If yes TO B6, What are you satisfied with or like about the services of the provider?	[1] Regular and timely lifting [2] Prompt feedback [3] Moderate fee charged [4] Other (specific)
B9	If no TO B6, what are your displeasures?	[1] Container overflow [2] Indiscipline of staff [3] Poor communication [4] High service charge

		[5] Other (Specify)
B10	How often do service providers pick your refuse?	[1] Once a week (weekly) [2] Twice in a week [3] Once in a month [4] Other (Specify) ……
B11	How often do you prefer your waste to be picked?	[1] Daily collection [2] Once a week [3] Once a month [4] Twice a week [5] Other (specify) ……
B12	Do contractor provide you with receptacles?	[1] Yes [2] No
B13	If yes, do you pay for it?	[1] Yes [2] No
B14	If no, what containers do you use to store your refuse?	[1] Polythene bag [2] Normal bucket [3] Wooden basket [4] Other (specify)
B15	Do you wish that the contractor provides you with a bin?	[1] Yes [2] No
B16	If yes, are you willing to pay for the bin?	[1] Yes [2] No
B17	Were you involved in the selection of your service provider?	[1] Yes [2] No
B18	Would you prefer to change the service provider?	[1] Yes [2] No
C	**SECTION C: SUSTAINABILITY INDICATORS (WILLINGNESS/ABILITY TO PAY)**	
C1	Do you pay for disposing off your waste?	[1] Yes [2] No
C2	If yes to C1, how much do you pay for solid waste collection/management?	…… (in GHC)
C3	Is it worth paying for the services of waste collection/management?	[1] Yes [2] No
C4	How much are you willing to pay on top of the existing charge?	…… (in percentage)
C5	How do you pay for the services?	[1] Revenue collector [2] Pay point outlet [3] Walk to service providers' office [4] Through bank
C6	Are you satisfied with the mode of payment?	[1] Yes [2] No

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C7	If no, what is your preference payment mode?	[1] Add to Electricity bill [2] Add to Water bill [3] Add to Property rate [4] Taxation [5] Other (specify) ……
C8	Who do you think should pay for your waste collection?	[1] Local government/Assembly [2] Community [3] Taxation [4] Self-payment [5] Other (specify)……
C9	Are you prepared to pay something towards the treatment and disposal of waste?	[1] Yes [2] No
C10	If yes, how much are you willing to pay in addition to collection charges?	…… (in GHC)
C11	If No, whom do you think should pay for treatment and disposal	[1] Municipal Assembly [2] Service Provider [3] Through tax [4] Other (specify) ……..
C12	How will you rate yourself on the socioeconomic status?	[1] Very rich [2] Rich [3] Moderately rich [4] Poor [5] Very poor
C13	Which income level is applicable to you	a. Less than 500 GHC b. 500-1000 GHC c. 1100-2000 d. 2100-3000 e. 3100-5000 f. 5100 and above
C14	On the average how much do you earn monthly?	…… (in GHC)
C15	Is this the only income available to your family	1.Yes 2.No

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C16	If No how much do you get from other source	a. Less than 500 GHC b. 500-1000 GHC c. 1100-2000 d. 2100-3000 e. 3100-5000 f. 5100 and above
C17	What is your average expenditure in a month?	…….. (in GHC)
	How much do you budget for utility	……..(in GHC)
C18	Do you own a car?	[1] Yes [2] No
C19	Do you own the apartment you live in?	[1] Yes [2] No
C20	If yes, how much do you pay	…… (in GHC)
C21	Are you willing to make additional payments for improved quality of services? *(ie adding a bin lining, increased frequency of lifting)*	[1] Yes [2] No
C22	How much are you willing to pay as additional charge for improve quality of services?	…….. (in GHC)
C23	If yes what will be your motivation to pay extra	[1] Increased in frequency of lifting [2] Adding bin liner [3] Effective communication [4] Provision of free receptacle [5] Other (Specify)……..
C24	If no what prevents you from paying extra	…….. (*tips:*
QN. D	**SECTION D: FINANCING OPTIONS FOR SOLID WASTE MANAGEMENT**	
D1	In your opinion, what should be the financing sources for solid waste management?	…….. (*Tips taxs, user charges, government, assembly subsidy etc)*
D2	What is the current financing option for your household waste?	[1] User charges [2] Through taxes

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		[3] Subsidy from assembly [4] Government grants [5] Other (Specify) ……
D3	Is the current financing option effective?	[1] Yes [2] No
D4	Does the current financing option have effect on the service delivery?	[1] Yes [2] No
D5	If yes, how does the financing option affect service delivery?	…….. [tips, limit continues service use, poor service delivery,
D6	If no, suggest other alternate financing option?	……..
D7	How will you rate the quality of solid waste management services in your locality?	[1] Very poor [2] Below average [3] Average [4] Above average [5] Excellent
D9	If yes to D8, why do you think it so?	……..
D10	Have you heard about the polluter pays principle?	[1] Yes [2] No
D11	Would you recommend for it implementation?	[1] Yes [2] No
D12	Have you heard about the 3Rs(Reduce, Recycle, Re-use,)	[1] Yes [2] No
D13	If yes, do you practice it?	[1] Yes [2] No
D14	If no to D12, do you want to practice it if you find it important?	[1] Yes [2] No
D15	Do you think the 3R concept can help solve solid waste financing challenges	[1] Yes [2] No
D16	How will this approach solve the challenges in financing solid waste?	……
D17	Would you recommend promoting the 3R concept?	[1] Yes [2] No
D18	What is your overall suggestion to strengthen financing option for solid waste in your locality?	……..

THANK YOU!!!

APPENDIX B- QUESTIONNAIRE FOR WASTE MANAGEMENT

SERVICE PROVIDERS

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KWAME NKRUMAH UNIVERISTY OF SCIENCE AND TECHNOLOGY/COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF HEALTH POLICY AND ECONOMICS

Title: Governance and *Financing Mechanisms for Municipal Solid Waste Management in Urban and Peri-urban Settings in Ghana*

QUESTIONNAIRE (SERVICE PROVIDERS)

This questionnaire is to assist in assessing appropriate financing mechanisms for solid waste management in urban and peri urban communities in Ghana. This is an academic exercise. Respondents are therefore assured that information provided would be kept confidential. Kindly answer the various questions based on the instructions provided. Thank you for cooperating.

Section A: Profile of the Organization/Representative

Name of company	
Position of Staff	
Area of operation	
Number of years in the company	
Academic qualification	
Number of Staff under you	

2. Years of existence of company in the waste management field: ……

3. Nature of Company

a) Sole proprietorship b) Limited Liability Company c) Partnership

4. Area of Specialty

a) Only Solid Waste b) Only Liquid Waste c) Both solid and liquid waste

Others (Specify ……

6. Number of employees……

7. Specific Services Provided

Functions carried out (Tick as many as apply)	Tick
Solid waste management service to domestic premises	
Solid waste management service to commercial/trade premises	
Solid waste management service to industrial premises	
Communal waste collection services	
Street sweeping	
Drain/sweeping	
Landfill management	
Other please state	

8. Do you have a valid contract with the assembly to collect/manage households waste?

a. Yes b. No

9. If yes, how was the contract given……..

……..

……

10. If yes what is the duration of contract……..

……

QUALITY OF SERVICE AND UTILIZATION

11. Do you experience employee turnover

a) Yes b) No

12. How would you rate employee turnover?

a) Never b) Occasional c) Moderate d) High e) Very High

13. Identify the cause(s) of employee turnover

a) Financial issues b) Health c) Poor Motivation d) Apathy of the nature of work

Storage Methods

14. Do you supply bins to your clients

a. Yes b. No

15. Type of Storage Bin used	Tick
Individual metal bins	
Individual plastic bins	
240 litter bins	
Communal containers	
120 litter bin	
Plastic rubber bin liner	
Other (Please State)	

16. How often are these containers used	Tick
Exclusively used	
Almost exclusively used	
Frequently used	
Sometimes used	
Never used	

17. How often are these containers collected	Tick
Daily	
Weekly	
Twice a week	
Monthly	
When full	
other (Please state)	

18.Average volume of waste collected	Quantity
Daily	
Weekly	

Monthly	
Other (specify)	

19. How many clients do you have……

20. Disposal Method	**Tick**
Open dumping	
Controlled tipping (with occasional soil cover)	
Sanitary landfill (with daily cover)	
Dumping indiscriminately	
Crude dumping method	
Other	

21. Do you experience intermittent closure of disposal site?

a. Yes b. No

22. If yes how long does it take……..

23. What are the causes of closure of site?

a.……..

b. ……..

c.……

d.……

Nature of Equipment and Vehicles Used

24. Equipment for primary Collection (from households/community)	**Tick**
Wheel barrow	
Push carts	
Compactor	
Tricycles	
Skip truck	
Roll on /off	
Other (Please state)	

26. Vehicles type	Number of vehicles	Condition (tick)		
		Good	Fair	Bad
Tipping trucks with sliding cover				
Compactor vehicles				
Open truck with tipping mechanisms				
Open trucks without tipping mechanisms				
Skip trucks				
Tipper truck				
Tractor				
Roll on off truck				
Other (Please state)				

Problems Encountered in Solid Waste Management Service

On a scale of 1-4, indicate the extent to which you agree with the following as constituting challenges in your solid waste management service (scale: 1- very serious, 2-serious, 3-Not so serious, 4-No problem at all)

27. Challenges	1	2	3	4
Inadequate service coverage				
Lack of financial resources				
Inadequate trained personnel				
Inadequate vehicles				
Lack of equipment				
Old vehicle/equipment frequent breakdown				
Lack of legislation				
Lack of enforcement measures and capability				
Lack of planning				
Rapid urbanization outstripping service capacity				
Uncontrolled proliferation of squatter settlements				

Difficult to locate and acquire landfill sites				
Poor cooperation by government agencies				
Poor response to waste minimization (reuse/recycling)				
Lack of control on hazardous waste				
Low level of education of staff				
Noncompliance to safety rules by staff				
Poor attitude of the public towards solid waste disposal				
Poor revenue mobilization/collection				
Lack of contractual agreement				

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Section C: Examining the current financing options for municipal solid waste management:

Kindly answer appropriately to the questions stated below

28. In your opinion, how do think solid waste management should be financed?

……

……

29. What are the current financing options for house hold waste collection/management? (Services provided)

User charges/Polluter pays principle

Through taxes

Subsidy from assembly

Government grants

Property rate

a. Others Specify……

30. Is the current financing option effective?

a. Yes b. No

31. Can you suggest other alternate financing option?

……

……..

……

32. Do you pay for disposal/dumping fee?

a. Yes b. No

33. If yes, how much do you pay?

……..Ghc

34. If no, who pays for it?

a. Municipal/district assembly

b. Local government

c. Donor funded

d. Others specify……

35. Do you charge clients for dumping/disposal fee?

a. Yes b. No

36. Do you think it is appropriate to pay for dumping fee?

a. Yes b. No

37. Whom do you think should pay for dumping/ disposal fee?

……

……

……..

38. What is the mode of payment of services rendered to clients?

…….

…….

…….

39. Is it appropriate for you?

a. Yes b. No

40. Can you suggest other method that will be appropriate for the business?

……

……..

……..

41. How do you price your collection charges?

a. Charge per bin

b. Charge per ton

c. Charge per collection frequency

d. All of the above

e. None of the above

f. Others specify……

42. How much do you charge for collection……Gh

43. Does it meet your operating cost?

a. Yes b. No

44. Do you often make loses.

a. Yes b. No

45. If yes, what is the percentage of loss……

46. What may be the cause(s) of loss?

a. Default in payment by clients

b. Inefficiency of staff

c. High taxes

d. Frequent breakdown of equipment

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e. Low charges

d. High cost of spare parts

e. Others state…….

47. Who determines the charges for you?

……

……

……

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48. Do you have inputs in the determination of charges?

a. Yes b. No

49. Do you think it is appropriate to collect service charges as part of other utility charges?

a) Yes b) No

50. What is the source of your funding?

a) Donor Funded b) Government Funded c) Bank Loans d) Service charges

e, All of the above

f) Specify any other……

51. If A or B was your answer for 47 above then specify how you receive such funds

a) Periodically b) Occasionally c) No time-bound d) Very rare

52. If C was your answer for 47 above then specify nature of repayment of loans

a) Payment of principal only b) payment of principal with an interest

c .Others state……

53. Do you educate your clients on the 3RS?

a). Yes b) No

54. Do you think it is necessary to promote that concept?

a) Yes b) No

55. Any other Relevant Comments

.....
.....
.....
.....
.....

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SECTION D: SUSTAINABILITY (ABILITY AND WILLINGNESS TO PAY)

56. How often do clients default in payment of services provided to them?

a. Very often

b. Sometimes

c. Not at all

57. Are you able to collect all revenue from clients?

b. Yes b. No.

58. What is the percentage of collection?

59. What is the mode of payment of services by client?

a. Cash payment as we pick

b. Pay to agent

c. Pay at bank

d. Others (specify)

60. Is the mode of payment effective?

a. Exclusively effective

b. Almost exclusively effective

c. Effective

d. Moderately effective

e. Not effective

61. What are the challenges associated with mode of payments

……

…….

62. How often is service charges review?

a. Every year

b. Every two years

c. Every three years

d. Every four years

e. Every five years

f. Other specify

63. Who determines your service charges?

a. Waste company

b. Waste management Contractors Association

c. Metropolitan/Municipal/District Assemblies

d. Ministry of Water and Sanitation

e. Others (specify)

64. Are you involved in the fee fixing?

a. Yes b. No

65. Do you normally receive complaints from clients on service charges?

a. Yes b. No

66. What are some of the complaints...?

……

……

67. Are you using a software to capture your client data?

a. Yes b. No

68. How do you monitor your revenue collection?

a. E-Tracker

b. Mobile Task Force

c. Routine auditing

d. Other (specify)……

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69. Is your current revenue mobilization sustainable for the business?

a. Yes b. No

70. Why do you think the current revenue mobilization is not sustainable for the business?

……

……

……..

71. Do clients complain about high service charges?

a. Yes b. No.

71. Are they willing to pay extra for improved service delivery?

a. Yes b. No

SECTION E: GOVERNANCE STRUCTURE

What is the governance structure for the municipal solid waste management?

44. What are the challenges associated with the current waste management structure

45. Do you think is appropriate to have an independent body/authority to coordinate the waste management activities.

46. Does the current governance structure consider the views of service providers and other stakeholders' aside the MMDAs?

47. Do you see the current governance structure effective to solve the financing, operational and administrative challenges of municipal waste management?

48. Does the assemblies seek your views in the fee fixing arrangement?

49. How often do you review fees and charges for waste collection?

50. What arrangement have been put in place by the assemblies to assist service providers to recoup their revenue from clients

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THANK YOU VERY MUCH FOR YOUR TIME



APPENDIX C – INTERVIEW GUIDE FOR STAKEHOLDERS

KWAME NKRUMAH UNIVERISTY OF SCIENCE AND TECHNOLOGY/COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF HEALTH POLICY AND ECONOMICS

KNUST

Title: Governance and *Financing Mechanisms for Municipal Solid Waste Management in Urban and Peri-urban Settings of Ghana*

INTERVIEW GUIDE FOR STAKEHOLDERS

Introduction

This questionnaire is to assist in assessing appropriate financing mechanisms for solid waste management in urban and peri urban communities in Ghana. This is an academic exercise. Respondents are therefore assured that information provided would be kept confidential. Kindly answer the various questions based on the instructions provided. Thank you for cooperating.

SECTION A: BACKGROUND INFORMATION

Name of Organization	
Position of Staff	
Area of operation	
Number of years in the organization	
Number of Staff under you	
Level of education	

2. Years of existence of organization in the waste management field:

3. Specify your portfolio/Rank

4. What role do you play in solid waste management?

5. How many waste contractors do you have?

6. Are they all registered?

7. How many are registered?

8. What is the average tonnage of waste generation per day?

9. What is the average tonnage of waste collection?

10. What is the waste composition in percentage? **Probe for:**

Type of waste	%	% of collection
Organic		
Plastics		
Paper		
Metal		
Others		

11. What is the structure of waste management in your municipality**? (Probe for Contractual to service contractors, Municipal assembly taking over, Joint operation)**

12. What are the challenges with the current system of operation?

13. What is your average annual budget in Ghana Cedis for solid waste management?

14. Are you able to access all?

15. What percentage is accessible?

16 What is the institutional arrangement for waste management in your assembly?

Section B: SERVICE QUALITY AND UTILIZATION

17. How will you rate the performance of the various waste companies? (**Probe for Very poor, poor, satisfactory, good, very good, excellent)**

18. What do think are the major challenges encountered by contractors?

19. Per your assessment what contributes to your answer in question 17 above? **(Probe for Regulation, waste management policy, finance, passion for the Job)**

20. What monitoring procedures have you put in place to check their performance?

21. How often do you meet as stakeholders?

22. What are some of the critical issues raised?

23. How are the issues resolved?

SECTION C: CURRENT FINANCING OPTION

24. What is the current financing arrangement for solid waste management?

25. How best do you think solid waste management contractors be funded **(Probe for Donor, Government, Bank Loans, Internally Generated)**

26. What is the mode of payment for service rendered by waste contractors?

27. Who pay for the services rendered?

28. How regular are do service providers receive payment

29. Do you owe waste contractors?

30. Do you charge contractors for dumping fee?

31. Who pay for the treatment and disposal of solid waste?

32. Do think the current financing option is sustainable?

33. Would you recommend any changes in the national policy on solid waste management? Why?

34. Which Act of Law governs solid waste Operations in Ghana……

35. Aside the national policy, are there any local policies.

36. How best do you think solid waste management can be done in Ghana?

37. Are there taxes on solid waste management operations?

38. What are the effects of these taxes on the business of waste contractors?

39. Do you recommend that these taxes be scrapped?

40. Do promote waste separation/4RS in your municipality

41. Would recommend the promotion of 4RS as an option of financing

42. How sustainable is the current financing options for waste management in Ghana? (A**llow respondent to speak as much as s/he can)**

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SECTION E: GOVERNANCE STRUTURE FOR MUNICIPAL WASTE MANAGEMENT

43. What is the governance structure for the municipal solid waste management?

44. What are the challenges associated with the current waste management structure

45. Do you think is appropriate to have an independent body/authority to coordinate the waste management activities.

46. Does the current governance structure consider the views of service providers and other stakeholders' aside the MMDAs?

47. Do you see the current governance structure effective to solve the financing, operational and administrative challenges of municipal waste management?

48. Do you include service providers in your fee fixing arrangement?

49. How often do you review fees and charges for waste collection?

50. What arrangement have been put in place to assist service providers to recoup their revenue from clients

51. What sanctions have you put in place for default payments waste collection and poor service delivery?

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APPENDIX D – SUBMITTED ARTICLES

Waste Management & Research - Manuscript ID WMR-18-0378

Waste Management & Research <onbehalfof@manuscriptcentral.com> Tue, May 15, 2018 at 9:37 PM
Reply-To: jmacdonald@iswa.org
To: apampamsco@yahoo.com, agyeibaffourp@gmail.com, daniel.dboateng@gmail.com, grockson@yahoo.com, eduseiak@gmail.com

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15-May-2018

Dear Authors

Your manuscript entitled "Title: Utilization of waste management services in Ghana; a nationwide survey" has been successfully submitted online and is presently being given full consideration for publication in Waste Management & Research (WM&R).

Your manuscript ID is WMR-18-0378.

Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc.manuscriptcentral.com/wmr and edit your user information as appropriate.

The submitting author of the paper can also view the status of your manuscript at any time by checking their Author Center after logging in to https://mc.manuscriptcentral.com/wmr.

As part of our commitment to ensuring an ethical, transparent and fair peer review process SAGE is a supporting member of ORCID, the Open Researcher and Contributor ID (https://orcid.org/). We encourage all authors and co-authors to use ORCID iDs during the peer review process. If you already have an ORCID iD you can link this to your account in ScholarOne just by logging in and editing your account information. If you do not already have an ORCID iD you may login to your ScholarOne account to create your unique identifier and automatically add it to your profile.

Thank you for submitting your manuscript to WM&R.

WM&R Editorial Office

5468381.v1 (Research Article)

Title	Household willingness-to-pay for improved solid waste management services in four major metropolitan cities in Ghana
Journal	Journal of Environmental and Public Health
Issue	Regular
Manuscript Number	5468381 (Research Article)
Submitted On	2018-08-05
Author(s)	Kofi Sekyere Boateng, Peter Agyei-Baffour, **Daniel Boateng**, George Nana Kwesi Rockson, Kofi Akohene Mensah, Anthony Kwaku Edusei
Editor	
Status	Under Review

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APPENDIX E - ETHICAL REVIEW OF RESEARCH PROTOCOL APPROVAL

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

KNUST

Ref: CHRPE/AP/225/18

23th April, 2018.

Mr. Kofi Sekyere Boateng
Department of Environment
and Occupational Health
School of Public Health
KNUST-KUMASI.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Financing Mechanism for Municipal Solid Waste Management in Urban and Peri-Urban Settings in Ghana."***

Proposed Site: ***Kumasi, Accra, Takoradi and Tamale.***

Sponsor: ***Principal Investigator.***

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 20th November, 2017 from the Kumasi Metropolitan Assembly indicating approval for the conduct of the study in the Metropolis (study site).
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning 23th April, 2018 to 22nd April, 2019 renewable thereafter. The Committee may however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Yours faithfully,

Osomfo Prof. Sir J. W. Acheampong MD, FWACP
Chairman

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