UNIVERSITY OF GHANA BUSINESS SCHOOL

MSC CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

THESIS TOPIC:

ASSESSING THE CHALLENGES OF SOLID WASTE MANAGEMENT IN GHANA: A CASE OF TEMA METROPOLITAN AREA

BY

LAWREE OPPONG BEMAH

(10640001)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE CLIMATE AND SUSTAINABLE DEVELOPMENT DEGREE

JUNE, 2018

DECLARATION

I hereby declare that this project is the results of my own effort and original work and that no part of this work has been submitted in this University or any other institution for any degree whatsoever.

....

LAWREE OPPONG BEMAH **DATE**

CERTIFICATION

I certify hereby that this project work was supervised in accordance with the procedures, rules and regulations of this University.

…… ……

DR. ALBERT AHENKAN **DATE**

(SUPERVISOR)

ABSTRACT

The study sought to assess the challenges of solid waste management in Ghana, a case of Tema Metropolitan area. Specific objectives were identifying the main source of waste generated in the Tema metropolis, assessing waste management methods available to the Metropolitan Assembly and also recommend practical interventions to ensure sustainable waste management. Descriptive cross-sectional research design was used for the study. The missed methods approach was adopted for the study restricting itself to nine communities in the Tema Metropolis. Purposive sampling was used to select institutions necessary for the study. However, multiple sampling methods including simple random sampling, systematic and purposive sampling was employed for the study. The study found out that malaria is the leading disease among the households with 53% of household members suffering from it within the past 12 months than any other disease. The study also noticed that no household was practicing waste separation in the study irrespective of their income and educational level. Further, the study also discovered that for all respondents, they noted that solid waste management was a challenge in the metropolis due to logistical and financial constraints faced by the Metropolitan Assembly. It is recommended that the TMA practiced the integrated solid waste management approach. The approach covers waste prevention, reduction, re-use, recycling, energy recovery, treatment and disposal. To cater for finances, the study recommends that TMA expands its revenue sources to include property and house taxes, city cleaning tax, fees for passing building plans, levies on advertisement, signboards and billboards as well as license for different trades and rents from the properties owned by the Assembly.

TABLE CONTENT **PAGE**

CHAPTER ONE: BACKGROUND OF THE STUDY

CHAPTER TWO: THEORITICAL AND LITERATURE REVIEW

List of tables **Page**

CHAPTER ONE

BACKGROUND OF THE STUDY

1.0 Introduction

The management of solid waste is one of the difficulties confronting city managers across the globe. Among others factors such as expanding populace levels, bouyant economy, quick urbanization and the ascent in the standard of living have incredibly quickened the rate of waste generations in the city (Guerrero, Maas, & Hogland, 2013). In developing countries for which Ghana is not an exception, Metropolitan, Municipal and District Assemblies are usually responsible for waste management in the cities. In their quest to achieve this objective, they normally face challenges in giving a viable and proficient framework to the occupants.

1.1 Background of the Study

Managing Municipal Solid Waste (MSW) has turned into a noteworthy issue worthy to worry about for some developing and developed countries, particularly as population increases. The issue turns out to be considerably more exacerbated even more as the same number of countries keep on urbanizing quickly. Urbanization is a modern fact of life. In the developed countries, growth of towns and cities is a common phenomenon with about 75% of populace situated in urban centers (UN HABITAT, 2001). From the UN's perspective, the world's urban populace will develop in excess of a billion people in the period of 2010 and 2015 with Africa and Asia albeit overwhelmingly rural, confronting a touchy statistic move as their urban populaces increases from 35 percent to more than 50 percent in the following 30 years (United Nations, 2008). Notwithstanding the common feature of urbanization in various countries all over the globe, rapid urbanization, especially the increased escalation of large cities, towns and its accompanying issues

of lacking health, poor sanitation, urban ghettos and degradation of the environment causes great challenges to many developing countries (UNEP, 2008).

Ghana like other developing nations has throughout the years experienced issues in metropolitan managing strong waste with respect to infrastructural and specialized sloppiness. As the Government of Ghana seeks to achieve the SDGs stated by UN on September 15, 2015, the goal to achieve better sanitation by 2030, has a ripple effect on poor strong waste management in Ghana which intend has a defect to the achievement of the Goal 6 which stress on ensuring clean water and sanitation by the year 2030 as being prioritized by the government in National Issues (Addaney et al 2015).

At this point it suffices to define Waste as any materials that are put aside or thrown away because they are of no significant use to the owner any longer. Solid waste includes food, cans, plastics, garbage, refuse and other unwanted materials that have been exhausted of their usefulness. Improper disposal practices, however, can result in serious and widespread pollution. Indiscriminate disposal of squanders is a typical practice in numerous African nations. For instance, Ayotamuno and Gobo (2004) in their investigation on sanitation in Nigerian found out that urban communities called attention to that unpredictable disposal of waste had turned into a typical practice in numerous urban communities in the nation and that the practice is seen as a source of pollution.

According reports of the Organization for Economic Co-operation and Development OECD (2008), managing solid waste is a standout amongst the most imperative worldwide difficulties to manage today and have shown that despicable and non-feasible disposing of waste causes dangers to human health and environmental condition. Inappropriate capacity and disposing of waste can

come into the fruition of tainting of nourishment, gear, consumable water and may deliver reproducing of pests (South African Bureau of Standards, 2001). Hence, there is the need to effectively and efficiently manage solid waste generated waste, including liquid waste.

The challenge of MSW is multifarious. Many scholars and institutions, including various Non-Governmental Organizations and the United Nations (UN) champion an integrated perspective in managing MSW (Chikarmane, 2012; Joseph, Rajendiran, Senthilnathan, & Rakesh, 2012; Premakumara, Abe, & Maeda, 2011; Okot-Okumu, & Nyenje, 2011). Over the long haul the main assurance is the collection of waste will out-strip is managing waste. All through the western world there are never again enough advantageous gaps in the grounds into which to tip undesirable issue (Gourlay, 1992). The developing nations additionally do not have the proper storerooms, treatment innovations, and great strategies for transfer for its waste.

In developing countries, governments are still grappling with fundamentals of managing waste. Although, managing waste is a significant concern in developing countries characterized with different means of waste disposal, it is noted that open dumping is the most widely recognized methods for disposing waste (Medina, 2010; Abul, 2010; Remigios, 2010; Das, & Bhattacharyya, 2013). In Ghana, the Local Government Act 462 of 1993 provide legal basis for waste management. In addressing issues to waste management and general sanitation in Ghana, the National Environmental Sanitation Policy (NESP) adopted a policy in the year 1999 which was revised in 2010 to make managing waste the responsibility of the Metropolitan, Municipal and Districts Assemblies (MMDAs) as inculcated by private participation in managing waste. Despite efforts of MMDAs in waste management, the volume of waste generation especially in the urban centers is a major concern Ghana (Ahmed & Ali, 2003).

Waste management challenges in developing countries are dissimilar from developed countries. This stems from the fact that the very composition of waste in developing countries is dissimilar from developed countries (Panayotou, 2016; Garlapati, 2016; Thyberg & Tonjes, 2016).

Before one can look at singular issues in managing MSW, it is critical to comprehend the political system in which governments should oftentimes work in developing nations. With expanded urbanization, interest for products and ventures will undisputedly increase. Metropolitan, Municipal and District tax and charge incomes, in any case, are not liable to ascend as fast as the populace. This is because of the way that out of the general population moving to the city, the dominant part is probably going to be poor transients from country zones looking for business, unfit to contribute essentially to the incomes of the region. In spite of the fact that they may request barely less administrations because of their lower level of utilization, they are likely (at any rate at first) to gather in poor people, all the more thickly populated regions, intensifying the health and sanitation issues postured by their regularly spontaneous networks. This along these lines extends the gap of discovering answer for the strong waste managing problem.

1.2 Problem Statement

Municipal Solid Waste Management (MSWM) persists as an inexorably difficult test for occupants and experts in Sub-Saharan African (SSA) urban areas (Scarlat, Motola, Dallemand, Monforti-Ferrario, & Mofor, 2015; Mohee & Simelane, 2015; Okot-Okumu & Nyenje, 2011; Din & Cohen, 2016). The direction of this condition has at this point been all around mapped: the size of urbanization and populace development (from both movement and common populace increment) and its resultant increments in generating refuse has required the interest for an enhanced level of managing waste benefit, which usually, is deficiently given by city specialists as well as private part contractual workers.

In Ghana, a major problem of waste management is inefficient waste collection particularly in poor urban networks, where occupants adapt to reject piles laying uncollected for up to weeks and furthermore on occasion by consuming it or dumping it in streams and stale drains, all of which draw in malady conveying nuisance like pests and offer ascent to genuine public and ecological health risks (Oteng Ababio, 2013)

Public Private Partnership(PPP) have in this way developed as promising supporters for capturing the waste management situation be that as it may, has been less fruitful due the powerlessness of government to satisfy its budgetary commitment to the private firms appointed to gather and dispose squander in their separate purview (Addarney et al, 2015).

Collecting waste and transporting it though the novelty in managing waste has demonstrated to be a disarrayed network. Although, there is private participation in the waste collection system, waste collection in the urban areas such as Accra, Kumasi, and Tamale in the Northern region has been a substantive concern because of the large volume of waste generation (Mensah A.et al.2005). With respect to funding in helping managing waste, in developing countries which includes Ghana, 80–90% of the monetary allowance allocated for managing waste is spent on accumulation while in developed nations under 10% is spent on gathering services (Memon, 2010). As the cost of land builds, it turns out to be progressively troublesome for regions to site landfills near urban zones, while transportation costs turn into a noteworthy imperative to developing landfills at a far off area (Memon, 2010), compounding the issue. It is therefore of no doubt that the private companies contracted to manage waste in the cities are doing their best to complement the efforts of the MMDAs, however liquid waste is visibly seen choked in the drains with all manner of plastics as well as heaps of garbage at different locations of the cities left uncollected.

Tema Metropolis, one of the ten districts in the Greater Accra Region of Ghana which is grouped into twenty-six communities is known as an industrial city with a lot of commercial activities for which reason a lot of waste is generated on daily basis. Commenting on the menace of plastic waste, in 2017 the Head of Department of Managing Waste at Tema Metropolitan Assembly (TMA) made a revelation that Tema produces about 800 metric tons of solid waste everyday with 26 percent being plastic waste (Ghana News Agency, November 8, 2017).

The improper waste disposal and the inadequate collection of waste have made living conditions intolerable in the urban areas. The poorer regions in the urban communities are the most drastically averse to disposing waste safely of their household solid waste (Palczynski, 2002), hence greatly affected by its insidious social and health impact (Oteng-Ababio, 2011).

Despite the extent of research on managing waste in the country, it suffices that, the dimensions/elements in the waste management systems as discussed by UN-HABITAT (2010) has not been fully integrated into the waste management system in Ghana. Specifically issues on stakeholder involvement in waste management and likewise phases of development or stream of materials from the generation focuses towards treatment and last transfer and the angles or "focal points" through which the managing waste framework is investigated is a worry (Müller and Scheinberg, 2002; Müller et al., 2002; Zurbrügg et al., 2005; Zuilen, 2006; UN-HABITAT, 2010; Wilson et al., 2009; Scheinberg et al., 2010, 2011). Thus in essence the waste management in Ghana is yet to appreciate the full integration regarding the components of managing waste frameworks as depicted as far as generating waste and detachment, gathering, exchange and transport, treatment, reusing and finally disposing.

The study therefore, seeks to use Tema one of the districts in the Greater Accra Region, to distinguish the central difficulties of managing waste in Ghana and prescribe functional intercessions to guarantee compelling and sustainable management of waste framework.

1.3 Objective of the Study

To access solid waste management challenges in the Tema Metropolis and how waste can be managed sustainably in the metropolis.

1.4 Specific Objectives

Specifically, the study seeks to:

1. Identify the main source of waste generated in the Tema Metropolis.

2. To assess waste management methods available to the Metropolitan Assembly.

3. Recommend practical interventions to ensure sustainable waste management.

1.5 Research Questions

The study is driven by the following research questions

1. What are the main sources of solid waste in the Tema Municipality?

2. What waste management challenges are the Tema Municipality facing?

3. What are the practical interventions available to ensure sustainable waste management in the study area?

1.6 Scope of the Study

The proposed study will cover the demarcated area (zone) designated as the Tema Municipality. It concentrates on the ways of managing domestic solid waste at house-to-house levels and how the municipal office coordinates it. It emphasized on the gap that was created within the chain of management and not necessarily the physical facilities. The study assessed the residents' income

levels, their level of education, their compromising ability and their willingness to contribute towards the effective management of waste in the municipality.

1.7 Significance of the Study

The proposed study is relevant in three main areas: practice, research and policy. For practice, the study hopes to bring to the fore the hidden facts that have made the management of solid waste in the municipality difficult. The study will also create awareness and stimulate debate on waste management issues. It is hoped that the discourse will generate options for dealing with waste management.

In terms of research, the study will contribute empirically verifiable data and knowledge on solid waste management particularly from a developing country context. For policy, the study will hopes to distill useful ways and methods of addressing waste This will be useful to the government, policy makers, and stakeholders in the environmental management sector and all those interested in urban sanitation management.

1.8 Organization of the Study

This study will be organized in five main chapters. The first chapter introduces the study and covers the background of the study, what constitutes the research problem research purpose, research objectives, research questions, scope of the study, significance of the study, and organization of the study. Chapter two is the literature review. The chapter presents a review on extensive related theoretical and empirical literature. This covers the methods of managing solid waste, waste management in Ghana, the private sector participation in solid waste management and the problems faced by municipalities in developing countries. Chapter three, which focuses on the methodology, considers the research design, research population, sample size, and sampling technique. Subsequently, the sources of data, data collection instrument(s), methods of data

collection, mode of data analysis, as well as, issues regarding the testing of validity and reliability of the research instrument. The chapter concludes by presenting the research ethical considerations. Chapter four discusses the data analysis of the study, and presents an analysis of the data collected. In addition, a discussion of the findings in relation to literature reviewed is presented. Finally, chapter five is dedicated to summary and conclusions presentation, based on the findings elicited from the data analysis. Subsequently, implications of the study, limitations, and recommendations for future studies are addressed.

Table 1. 1 Time Schedule

Months	Data Collection	Data Analysis	Finalizing Write up/Submission
Jan-Feb			
March- April			
May			

Table 1. 2 Budget

ITEMS	EXPENDITURE (GH¢)
BOOKS	4,000
TRAVEL	2,500
ACCOMMODATION	5,000
PRINTING	1,100
TOTAL	12,600

CHAPTER TWO

THEORITICAL AND LITERATURE REVIEW

2.1 Introduction

One of a kind element of the world and a stressing circumstance today is the disposable culture, along these lines delivering immense measures of strong waste. Advancement in natural estimation procedures obviously demonstrates that request on the world's resources isn't supportable and must be tended to promptly (York et al., 2004). The literature review looks at the underpinning studies of waste management, empirical evidence on effects of improper disposing of solid waste management in the country specifically Ghana, and a conceptual frame work on waste management.

2.2 Formal theory of urban solid waste management

According to Pahjola & Pongracz (2002), a strong establishment for a formal hypothesis of managing waste is as far as steady building block; that are, dialect, applied plans, models and sentence frameworks. It is further explained by Pahjola & Pongracz (2002) that models used in waste management have usefulness which makes it conceivable to recreate managing waste. Subsequently usefulness is executed as shared correspondence of articles speaking to reality that is, exercises and things followed up on. Also, Niiniluoto (1995) argues that application of new scientific specialties developed by the identification of human expressions and innovations in waste management is essential as the viability of such guidelines is tried by logical techniques and clarified by logical hypotheses. Hempel (1965) therefore explains in his work that hypothesis will dependably be thought of as defined within a semantic system of a reasonable logical structure, which decides specifically the tenets of deductive surmising.

Notwithstanding several literatures on waste management, it is argued by Pahjola and Pongracz (2002) that no conceptual framework has been developed in recent times that can be called the theory of managing waste. This therefore calls to mind if there can be any theory of managing waste and the gain such theory will bring to bear on waste management. It is therefore noted that the designing of theory on managing waste is an approach concerning the scientification of managing waste with the purpose of providing holistic understanding of managing waste, gives explanations and definitions of all waste interconnected conceptualization as well as offer a formal theoretical philosophy of managing waste.

The theory of managing waste therefore seeks to eliminate issues emerging from confined knowledge, obscure ideas and absence of nonexclusive models and prompt the two controls of waste related exercises in the public eye through practical advancement (Hempel, 1966). Similarly, Tudor (1982) examine the hypothesis of managing waste regarding the general building block of hypothesis that include dialect (fundamental and consistent terms), calculated plans (frameworks of terms chose from inside the dialect), models (comprehensive records of how things work and sentence frameworks (interrelated arrangements of suggestions of exact reference).

Pahjola & Pongracz (1999) asserted that managing waste ought to be understood as a framework composed of tangible things, human activities and links between and among the tangible things and human activities. The authors discuss that the physical things in such a system seek advice from waste connected materials and process devices like producing agricultural land and house instrumentality whereas the human activities embody any activities that area unit suffering from, and that have a sway on the physical things. Hence the whole system is thus referred to as managing waste system.

According to Pohjola & Pongracz (2001), the greatest benefits of formalizing managing waste would not be picked up in tackling disconnected managing waste issues yet rather when coordinating waste into a bigger setting. Towards the scientification of overseeing waste, the supporting hypothesis includes the usage of usefulness as common correspondence of items speaking to the real world, which are exercises and things acted on (Pahjola & Pongracz, 2002). The approach is therefore essential to take cognizance of the process design methodology by literature in order to consider managing waste issues as of now at the procedure configuration stage and furthermore direct concentration toward the waste minimization at the generation site. It is evident that the practical formalization of waste management would yield gains in the long run as discussed in the model designed in the work of Tudor (1982) concerning waste management that emphasize functionality which is embodied in the structure of a thing.

2.3 Definitions of solid waste and its types

Solid or Strong waste is comprehensively characterized as including non-risky mechanical, business and local reject including family unit natural junk, road sweepings, doctor's facility and institutional rubbish, and development waste; for the most part slime and human waste are viewed as a fluid waste issue outside the extent of civil strong waste (MSW). Schubeler (1996) calls attention to that albeit certain sullied medicinal waste and perilous mechanical waste are excluded by definition, in numerous countries these are in reality part of the metropolitan waste stream and "unique measures" must be utilized to urge their partition and to moderate their potential destructive impacts.

Martin Medina (1998) expressed that, Municipal Strong Waste (MSW) alludes to the materials disposed of in the urban regions for which regions are typically considered in charge of

accumulation, transport and lastly disposal. MSW incorporates family waste, institutional waste, business squanders, and development and decimation flotsam and jetsam. In developing nations, MSW likewise contain shifting measures of mechanical squanders from little enterprises and also dead creatures, and fecal matter.

Solid Waste Management (SWM) is characterized as the control, age, stockpiling, gathering, exchange and transport, handling and transfer of strong waste steady with best practices of general wellbeing; monetary and budgetary, managerial, legitimate and ecological contemplations (Othman, 2002) Municipal waste is for the most part delivered by family units, however comparative squanders from sources, for example, business, workplaces and open organizations are incorporated. The measure of civil waste produced comprises of waste gathered by or for metropolitan experts and discarded through the waste administration framework (Eurostat, 2012). Waste may be classified as industrial, agricultural, commercial, mineral, domestic, and hospital waste. Industrial waste involves materials or substances that come from the industry and are hazardous, toxic to human life. It includes empty oil containers and scraps.

Hazardous waste refers to a substance that could endanger life if released into the environment and improperly treated, disposed- off or managed. It includes lubricating oil, paint containers and fluorescent tubes. It may be flammable, poisonous, teratogenic or even radioactive. According to Smith and Enger (2000), the United States Environmental Protection Agency defines hazardous materials as having one or more of the following characteristics: ignitability, corrosiveness, reactiveness and toxicity.

Mineral waste involves waste arising from mining activities or the waste that are disposed off at mining sites. It may include empty acid containers, metal scraps, used lead and acid batteries, and

used rubber tyres, waste lubricating oil. Cyanide boxes and bags for instance, are classified as combustibles while metal scraps and metal cans are classified as non-combustibles.

Domestic or family squander emerges from homes and furthermore incorporates refuse or waste from schools. This type of waste for the most part includes bundling papers, plastics, materials, glass, metals, and newsprint and sustenance remains. Clinical waste is that, that arises from therapeutic, nursing, dental, veterinary and pharmaceutical examination care, instructing or research. This type of waste incorporates human or creature tissue, blood or other body liquids, discharges, medications or pharmaceutical items, swabs, dressings, syringes, needles on sharp instruments. This sort of waste is usually harmful when one comes into contact with it unless rendered safe (Jones, 1995).

2.4 Solid Waste Management

In recent times, managing waste solid has behoove one basic worry in natural issues (Mazzanti & Zoboli, 2008). This phenomenon is especially disturbing particularly in urban regions encountering quick populace development and furthermore the measure of waste produced is expanding quickly (Kathiravale & Mohd Yunus, 2008). According to the (PDDESAUNS) Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2009), it is assessed that out of the total populace of 6.8 billion, about portion of the populace are situated in the urban zones. Thus, the density of the populace at a particular location is proportional to the waste generated therefore necessitating the need for effective management (Mazzanti & Zoboli, 2008).

Certainly, growth of urban areas as well as industrialization come along with new ways of life and conduct which likewise essentially influences the composition of waste for the most part from

natural to engineered material which last longer on account of plastic and other bundling material (Idris et al., 2004). Correspondingly, Electronic waste is gathering force recently and create as much as 20-50 metric tons yearly (UNEP, 2006).

With the growing demand and needs on waste management, the current waste, management system is becoming complex as such the available facilities are unable to cope with needs and demands. Best approaches are therefore needed to be implemented in order to avert the dangers associated with solid waste whiles thinking about natural, social and financial aspects (Aye and Widjaya, 2006). In so doing, the drivers of the maintainable managing waste as clarified by Agamuthu et al, (2009) which comprise of human, monetary, institutional and natural aspects should be considered. The research is of the view that each driving gathering ought to be considered in neighborhood setting since overseeing strong waste for a particular society may contrast from others. In the case of African countries, in addressing waste management issues, there is the need to address concerns on absence of information, inconsequential monetary assets, huge diverse of amount and waste composes amongst urban and provincial regions, absence of specialized and HR, low level of mindfulness and social abhorrence towards waste (Couth & Trois, 2010).

It is imperative noting that the differences in managing solid waste are not only distinctive between nations yet in addition among same regions inside a similar nation especially because of complex geography, frail authoritative structures and the low wage (Berkun et al., 2005). The introduction of the Integrated Sustainable Waste Management (ISWM) in 1995 was aimed at improving earlier systems that disregard remarkable highlights of a given society, economy and condition (Van de Klundert, 1999). As indicated by Van de Klundert (1999), the administration framework ought to be dynamic and proceeds in light of new bits of knowledge and encounters. Consequently, the

issues of absence of strategies, coordination, perilous managing of waste, consistency, motivations and markets for reused material and furthermore cleaner creation exertion must be tended to (Boyle, 2000).

Data from developing countries indicates that the true quantity of waste that is been land crammed is sincerely decreasing for the cause that more waste are incinerated, composted or recycled. On the brilliant side, Lomborg (1998) is high quality that such areas desires are ample to cater for the amount of waste generated by means of the world. However, the project is the location as no one needs to remain close to landfills.

2.5 Solid waste generation

To have tremendous strong managing waste system, waste era is the most imperative factor to consider. Waste generations vary substantially across international locations as a result of culture, public recognition and administration (Hazra & Goel, 2009; Wagner & Arnold, 2008; Magrinho et al, 2006). Literature suggests that mostly developed countries generate extra waste than developing countries (Kathiravale & Mohd Yumus, 2008). For instance, Asain and African countries generate waste in the vary of 0.21-0.37 tons/capita/year in contrast to European countries that generate higher amount of waste in excess of about 0.38-0.64 tons/capita/year (Intergovernmental Panel on Climate Change [IPCC], 2006).

It is evident that waste technology is associated with the monetary popularity of a country. Whiles developed nations are faced with high waste generation, developing nations additionally have challenges with the implementation gadget (Hazra & Goel, 2009; Bai & Sutanto, 2002). These challenges according to Agamuthu et al (2009) include vulnerable enforcement, lack of technology and ineffective policy implementation. Developing nations consequently experience low and irregular collection of waste, uncontrolled of air and water pollution in open dumping areas, the

breeding of flies and vermin, and the mismanagement of scavenging things to do (Latifah et al., 2009).

2.6 Solid waste disposal

To determine the most efficient and sustainable waste disposal options, literature suggests that timely information is needed on waste generation. This is because improper waste disposal would likely cause pollution. Best practices for solid waste management are therefore implemented to avert pollution since pollution is noted to be a threat to human survival and other living organisms (Morra et al, 2009; Liu & Morton, 1998). Additionally, pollution would also destroy the ecosystem as well as disrupt the natural cycle and also the climate on earth (Raga et al., 2001). Literature suggests several means of disposing waste in order to suit the nature of waste and the preference of a particular country or locality.

In choosing the right technology, arguably economics and environmental aspects of waste disposal option are mostly the major concern (Aye & Widjaya, 2006; Daskalopoulos et al, 1997). Whiles some countries in the world have made significant success in eliminating land filling , such as Korea and Singapore, other countries including Ghana are still having problems with open dumping and open defecation (Agamuthu & Fauzial, 2010; Shekdar, 2009; Bai & Stanto, 2002).

Notwithstanding the advancement in many waste disposal options, landfills still are the most prominent system applied across the world (Shekdar, 2009; Harmer, 2003). Research shows that most landfills operated still remained primitive although a lot of development had been possible in the land filling system as well as the regulations on the type of waste that can be treated at landfills is stringent (Hamer, 2003). Among the major problems resulting from improper landfill operation are health deterioration, accidents, flood occurrences, pollution of surface and

underground waters, unpleasant odor, pest infestation and also gas explosion (Ayomoh et al., 2008). Interestingly, though the impacts from other alternative means are still unanswered thus subject to critics (Hamer, 2003).

For some of the developed world who have enough financial input and are considering energy recovery from waste incineration as the best option and is been practiced in most of the developed countries (Papageorgiou et al., 2009, Kleiss & Hnura, 2006). Notwithstanding the benefits of incineration, the technology is associated with several other risks. These risks include the generation of carcinogent and toxic compound and dioxin0 and end product of incineration that needs further treatment (Hamer, 2003). Apart from incineration, as technology evolves other countries also prefer waste minimization to waste treatment for example in the case of landfill or incineration (Bai & Sutanto, 2002, Boyle, 2000).

2.7 Public and Private sector actors in solid waste management

Apart from the private sector, the private zone also performs a guge role in strong managing of waste in developing countries. Although, the public organizations particularly the MMDA's (Metropolitan, Municipal and District Assembles are confront with challenges that restricts them to operate fully in a stable management of waste (Ahmed & Ali, 2003), the rigid laws under which the public institutions operates as nicely as the need to employ the services of committed citizens to sweep the road, load and unload waste and clean the drains to be executed manually poses serious challenge to public agencies.

The scenario is further compounded by means of politicians who use the SWM carrier as a way of exerting have an impact on their ingredients despite the problem of low productiveness of staff, insufficient supervision and insufficient equipment in the public sector. On the other hand

the casual personal zone complements the work of the public sector in SWM in all developing countries. Salahuddin and Shamim (1992) defined the informal sector as financial activities that have non-permanence, and casualties, outside the scope of existing enterprise regulations or government regulations. Although the things to do of the casual zone are unregulated with the aid of the authorities agencies, Ali (1999) argues that they exist and function due to response of market forces or other socio-economic activities. The casual area in SWM encompasses waste pickers (Chaturvedi, 1998): itinerant or stationary waste buyers, small-scale recycling industry, large-scale recycling industry, CBOs, NGOs and micro-enterprises (Carson et al., 1995). Ali and Ahmed (2013) posit that the actors in the informal area are essential in the management of strong waste in every economy. Public Private Partnership (PPP) is a higher alternative to full privatization. This is because below the partnership, the public and private entities count on some stage of accountability and possession of sanitation services delivery. The non-public institutions brings on board dynamism in provider delivery get entry to finance technological know-how, managerial efficiency and entrepreneurial skills (Ahmed and Ali, 2003). The public zone also brings on board social responsibility, environmental awareness, nearby knowledge and job generation. Though the thinking of public-private partnership looks bright, Kolzow (1994) is of the view that public private partnership is a shared dedication to pursue frequent desires and is greater than just occasional meetings between the Municipal Assemblies and the non-public organizations. The system demands an enabling environment to foster unity, have confidence and working relationship. Additionally, Baud & Shenk (1994) posit that SWM approach should be viewed as a city planning trouble or a public health difficulty while the personal and public institutions execute their responsibilities.

2.7.1 Theoretical background of PPPs in relation to Solid Waste Management

Theories attributable to Public Private Partnerships in respect to solid waste management (SWM) can be seen through a review of sociological, economic and managerial theories. The ensuing discussions throw more light on these theories as discussed in the literature review.

2.7.2 Sociological Theories

Sociological theories tries to give an explanation for why societies characteristic the way it does through focusing on the relationship between the more than a few institutions that make up society. One key characteristic of social theories is that structural functionalism is generally considered as being supportive of the status quo. Thus the social stratification is suited and efforts have to no longer be made to trade such arrangements. Another key attribute of social theory is that it views society as constantly striving to be at a nation of equilibrium, which suggests there is an inherent pressure within human societies to stick collectively (Friedkin and Noah, 2004).

Abuyuan (1999) explains that public-private-partnership can be seen via the lenses of sociological theories based totally on functionalism and accepted systems. Interdependence is a central theme in functionalism. It refers to the parts of society sharing a frequent set of principles. Thus, institutions, corporations and humans are all interdependent with one another. The functionalism principle explains that institutions have to continue to exist through adapting to changing situations with the aid of potential of interdependence on the different branches of its partners. The functionalism theory in addition suggests that all the distinct businesses and institutions in society are interdependent hence when one organization in society changes, different institutions accommodate that exchange by means of altering as well, even though the remaining is to gradual typical change (Friedkin and Noah, 2004). In that regard, public-private-partnerships in solid waste

management can be fantastic underneath this theory if all partners are regarded as phase of a complete organisation that can provide services. This is because, as partners, they can be seen as interdependent organs of a large agency with every companion having a exclusive characteristic working in order to achieve the common intention of fantastic provider delivery.

On the contrary, the structures concept makes its analysis from three distinctive viewpoints. That is machine members of the family to determine the nature of relationship between ranges of factors of a system; gadget effectiveness to choose how nice are relationships amongst a number of elements of a gadget for the complete gadget to survive. In addition it is to make choicest use of resources; and machine dynamics to look into what forces a machine to exchange and the path in which the exchange occurs (Ahmed & Ali, 2003). This principle relates to public-private-partnership for solid waste administration due to the fact it is indispensable that there is clear definition of the roles and duties of all actors in the public-private-partnership for fantastic strong waste management taking into issues the power and weaknesses of every partner.

2.7.3 Economic Theory

Another essential theory in relation to Public Private Partnership's (PPP) history to stable waste administration apart the Sociological concept is the Economic theory. According to Larkin (1994), there is the need for choice economic association due to the growing fee of carrier delivery. Similarly, Cox (1996) argues that most personal entities are set up for profit in contrast to the public region agencies. In that sense, the property rights theory and the trust that it is the right of ownership that creates incentives to excel (Hart, 1998) are emphasized in the monetary theories with public-private-partnership. In connection to the sociological theory, the new monetary association termed mixed economic system (Hull and Jhern, 1983) noted in Larkin (1994) will

pave way to lively participation of the public and private region in service delivery. From the view point of the monetary concept however, it is fundamental that the mixed economic system concept, which is quintessential to Public-Private-Partnership for stable waste administration and simple service, ought to be provided to all residents and earnings can't totally be the motive. Similarly, each actors in the Public-Private-Partnership can't withdraw from the partnership on account that the strategy lingers on public fitness and public correct dimensions.

2.7.4 Management Theories

Contrary to the usual exercise the place every zone in strong waste management restrained itself to its very own activities, presently corporations have to realize that a lot price can be created with the aid of co-operating with others outdoor of its sphere. Drawing classes from the sociological idea defined through Abuyuan (1999) and Friedkin and Noah (2004), the administration method demands that win-win conditions are created rather than a win lose situation in service transport (Saxton, 1997) cited in Aickenhead (1999). The system calls for co-operation amongst the players. Hence, the employer ought to draw price internet from the standpoint of itself and from different players.

Similarly, co-operation is preferred under the management theories as a substitute of viewing others inside the enterprise as opponents or rivals they ought to be seen as complements (Aickenhead, 1999). Sometimes it may additionally be difficult for the public region to delegate strength to the personal quarter whiles extreme competition amongst the private carrier carriers in strong waste administration can make the possibility less lucrative. The state of affairs therefore needs careful planning and participation from all actors in the public-private partnership.

2.8 Solid Waste administration in Ghana

The excessive population and it related increase in urbanization and financial activities in Ghana especially Accra, has had an effect on society's waste stability very prominent. The metropolis of Accra produces over 760,000 tons of MSW yearly and over 200 metric thousands daily (EPA, 2002). The Accra Metropolitan Assembly incurs around two billion Cedis for every month (about $227, 000) on waste accumulation and around 12 billion Cedis for every a year on managing city solid. This amount does not in any case, provide food for around 30 for each penny of strong waste in the city.

Private participation in waste administration is fundamental due to the reality the public place organizations especially the Metropolitan, Municipal; District Assemblies are faced with challenges that restrict them to function entirely in secure waste management (Ahmed & Ali, 2003). The rigid legal guidelines under which the public location groups operates as well as the need to rent extra human beings to avenue clearing, stacking and emptying waste and deplete cleaning which are done physically pose serious project to public zone agencies. In optimizing private region involvement as mentioned with the aid of the usage of Lartey et al, 2018, modern-day complexities skilled by way of town authorities in waste administration has necessitated the active participation of private actors in the waste management system.

Johannessen and Boyer (1999) determined that the graph and improvement of unfaltering waste organization connected sciences and practices that go for augmenting the yield of valuable stock from squander, as exact as limiting the natural impacts have had next to zero thought in the African district. They furthermore found that at the nationwide and metropolitan levels, Ghana has now presently not found a way to build, work, or save sterile landfills. It is underneath the World Banks

urban natural sanitation task that Ghana created plans to develop its first clean landfills in Accra, Kumasi and Takoradi all in Ghana.

The insufficient data on evaluation and portrayal of waste; wellbeing, social, money related and natural effect of civil stable waste organization is a built up rate in Ghana in one of a kind in the Tema Municipality. The issue is exclusively exacerbated by method for capacity of inadequate financing. The waste administration framework so far in Ghana has no longer amazing coordinated unprecedented options as arrangement treatment, and supply for re-utilize, reprocessing and remaining transfer. The workstation has given adequate space to adjust to future weights (increment in squander amounts and arrangement). It is also appropriate in Ghana the region squander administration contributions are for the most part wasteful and incapable. It is evaluated that 83% of the populace dump their reject in either authorized or unapproved sites in their neighborhood, and because of powerless capacity to deal with consistent waste, unsanitary stipulations are made. Despite the fact that these shortcomings have been credited to absence of coordination and monetary administration, individuals' state of mind towards managing waste have to no longer be ignored.

2.9 Solid Waste Management Challenges confronted by means of municipalities in growing nations

Indeed, in many nations of the world, consisting of Africa, the privatization of waste administration choices is often viewed as the only feasible option, and doubtlessly affords higher exceptional of service at aggressive prices, permitting the authorities location to focus on the roles of monitoring and enforcement of services. The African Development Bank’s tips for waste administration kingdom that private agencies may additionally moreover play a role in vastly enhancing sturdy waste administration choices in Africa. However, it need to be referred to that in contrast to

improvement us of a models, the African fashions required expanded involvement of the communities in the process. Private companies in the strong waste administration place in growing countries face cutting-edge problems. Collection, transporting and disposing of Municipal strong waste represents a massive expenditure for third world cities however exceptional troubles aside from finance are described as insufficient provider insurance and operational wasteful aspects of administrations; restricted use of reusing exercises; insufficient organization of risky and wellness waste. The amount of waste containing strong, fluid and vaporous are for the most part thought to create all through the globe because of improve in the total populace, expanding industrialization, creating urbanization and rising prerequisites of living.

Quick urbanization, floating imbalance, and the battle for money related development; in excess of a couple of monetary, social, financial, and political scenes; administration, institutional, and responsibility issues; and global impacts have made locally particular, specialized and non-specialized difficulties of huge intricacy (Marshall and Farahbaksh, 2013). The accompanying areas investigate these logical components and the difficulties they existing for SWM structures in the developing scene.

2.9.1 Urbanization, inequality, and monetary growth

Urbanization has detonated with magnificent pace and scale in give day numerous years "the greater part of the total populace currently abiding in urban focuses" (Tacoli, 2012), as overall zones and even individual urban communities battling to be forceful in the universal commercial center (Cohen, 2004). This fast, spontaneous blast has brought about a scope of intemperate land utilize arranging and infrastructural challenges that have disabled the limit of national and metropolitan governments to extend SWM benefit stages at the cost they are requested. This, in mix with staggeringly slow and wasteful institutional structures, has seriously affected the fine and

procure of SWM decisions in numerous districts of the world; one that is anticipated to bother later on. The truth that about the majority of the world's people development is anticipated to occur around the local area territories (Cohen, 2004) from now until 2050, then again that an entire parcel of which will take region on the planet's poorer districts. Correspondingly, Tacoli (2012) has raised worries about making city destitution and the inadequacy of nationwide and city governments to outfit administrations to the occupants of their developing urban communities. Numerous additional people will be pushed into ghettos, the area clean requirements are horrifying and squander administrations are non-existent. The scope of people living in ghettos is currently assessed at around 828 million and creating in relevant numbers even despite the fact that 200 million ghetto tenants have moved out of ghetto super stipulations (UNFPA, 2011).

Invariably, the SWM needs of these high-thickness, low-wage settlements are insufficiently served or neglected inside and out even in spite of the fact that these territories have the amazing requirement for these administrations considering that there is no house among the thickly stuffed lodging for squander internment or fertilizing the soil and they are tons less in a part to make exchange game plans to discard squander (Coffey and Coad, 2010). Accumulation can likewise in addition currently not be done in these impromptu settlements because of an absence of room for decline holders, tight roadways, soak angles, and unsurfaced streets that far reaching gathering cars can't control (Coffey and Coad, 2010; Henry et al., 2006). In this way, squander is dumped into open spaces, on get section to streets and in conduits the place issue vectors breed (Coffey and Coad, 2010; Konteh, 2009). Squander stops up channels, becoming overflowed, dormant nurseries for mosquitoes conveying intestinal sickness and dengue fever. Creatures and waste pickers disseminate the waste, and leachate from trash stacks permeates into soil and conduits. This has brought about tainted sustenance, water, and soil, genuine ecological and wellness

suggestions, by and large for the most defenseless, for example, youths and the elderly (Coffey and Coad, 2010; Tacoli, 2012). This scope of ecological corruption can likewise adversely affect the economies of these global areas that be checked painstakingly on tourism (Henry et al., 2006).

2.9.2 Cultural and Socio-economic

The structure and working of SWM structures are headquartered on the personal conduct standards and fundamental states of mind of the populace as perfectly fine that are formed by means of utilizing the social setting (Schübeler, 1996). The generous scope of social and ethnic associations that regularly exists quickly expands to urban communities, even with the character of private networks, obviously impacts districts' abilities to execute SWM strategies (Schübeler, 1996). Open intrigue and mentalities toward waste can affect the whole SWM framework, from family unit stockpiling to detachment, movement in squander lessening, reusing, interest for gathering administrations, ability to pay for SWM administrations, resistance to proposed spots of waste offices, the amount of waste in the boulevards, and speedier or later achievement or disappointment of a SWM machine (Henry et al., 2006; Schübeler, 1996; Yousif and Scott, 2007; Zurbruegg, 2003).

The social and financial setting additionally impacts the waste organization created by means of the utilization of a populace (Schübeler, 1996, Coffey and Coad, 2010; Marshall and Farahbakhsh 2013). Sometimes, retail retailers offer suppers that is by and large pre-arranged, while in others, shimmering meat or monster parts of sparkling veggies and natural product altogether modify the waste structure. Cooking and warming with vigorous fuel impacts the waste arrangement with the asset of pushing off articles that would in some other case be disposed of, for example, paper, and contributing hot, grating fiery remains to the waste pass (Coffey and Coad, 2010). Nearby engineering, for example, mud block lodging and unpaved floors can propose vast segments of

earth and soil enter the waste stream, while clean practices can influence the amount of excreta in the waste (Coffey and Coad, 2010).

Financial notoriety at the nearby and family organize affect squander piece, higher education will build the paper content material of waste, and wealthier organizations regularly pick to dispose of extensive enduring devices as opposed to repairing them (Coffey and Coad, 2010). Reusing and reuse is influenced by method for contrasts in how social organizations rate questions that would in some other case enter the waste stream. Regularly a ton of the natural waste is bolstered to domesticated animals, and items like dinners and drink compartments are reused in the family unit (Coffey and Coad, 2010). Casual reusing is completed by methods for squander pickers, who value a super arrangement of what might perhaps in some other case enter the waste course (Coffey and Coad, 2010; Schübeler, 1996; UN-HABITAT, 2010; Wilson, 2007).

Social desires for squander gathering are furthermore organized on squander creation, and in this way on cooking and dietary patterns. On the off chance that huge segments of smell creating suppers, for example, angle are expended, squander grouping costs are foreseen to be higher general (Coffey and Coad, 2010; Jha et al., 2011). Transfer is furthermore apparently impacted by means of social states of mind. Some social associations reliably discard squander in the reasonable holders, while others see the road as an amazing transfer area. Householders and town officers alike may have no leisure activity in regardless of whether squander is dumped unlawfully or dispatched to an appropriate transfer office, as protracted as it is killed from the city quarter (Coffey and Coad, 2010). In some city regions, the imperative point of convergence is in any case on nourishment, asylum, security and employments; waste will develop to be a priority just when

these all the more simple needs have been met (Konteh, 2009), and completely turns into an inconvenience when open wellness or natural damage affect these needs (Wilson, 2007).

2.10 Conceptual Framework

The conceptual framework for this study will undertake the waste administration hierarchy model. The waste administration framework premised on "Lansink's Ladder" developed in 1981 by way of a Dutch baby-kisser Ad Lansink (Raven, 2007) serves as the prototype for the present day framework for waste management in many waste related areas such as regulation and numerous projects, initiatives and also strategies. The cutting-edge framework is a five-step hierarchy of waste administration as well as waste treatment alternatives ordered in accordance to what is best for the environment (UK Department of Energy and Climate Change and Defra, 2011).

The framework consists of set of regulations for waste administration planning, qualified waste series and therapy (Neubeuer, 2007). The framework is really helpful and strategic for perception how management strategies can be used to have an impact on materials as they waft at some point of the cloth lifestyles cycle (U.S EPA, 2009). The framework is in a similar fashion an approach used in the Integrated Solid Waste Management (ISWM) (**Fig 2.1**). The framework is used in managing all sources of waste: prioritizing waste avoidance and minimization, practicing segregation, merchandising the 3Rs (Reduce, Re-use, and Recycle), implementation of protected waste transportation, and additionally therapy such as disposal in a built-in manner with an emphasis on maximizing resource efficiency (UNEP, 2011).

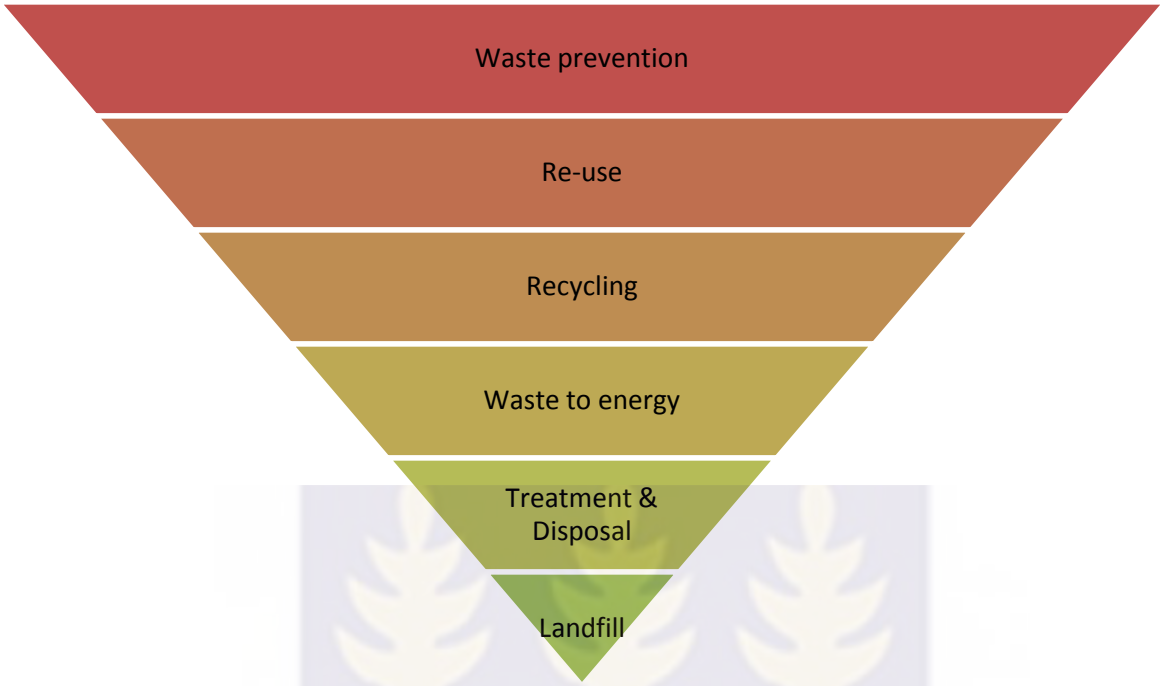

Figure 2. 1 Waste Management Hierarchy

Source: Waste Management Hierarchy (U.S. EPA 2012b)

2.11 Conclusion

This chapter reviewed the literature on municipal solid waste management problems, discussions regarding solid waste management. By categorizing the waste management system into different perspectives, it has helped to identify the lapses in the waste management system through the use of the conceptual framework on waste management hierarchy.

CHPATER THREE

METHODOLOGY

3.0 Introduction

The first part of this chapter presents the study area, types of data to be collected, data collection methods, sampling methods as well as sample size. The second part presents the method of analyses for each objective. The scope of the study is also presented in chapter three.

3.1 Description of the study area

The Tema Metropolis was created from the erstwhile Tema Municipality in 2007 with the promulgation of Legislative Instrument (LI) 1929. In 2012, the Kpone-Katamanso Sub Metropolitan Council was carved out of the Tema Metropolis to establish the Kpone Katamanso District. The Tema Metropolis has three Sub-Metropolitan Councils namely; Tema West, Tema East and Tema Central (Ghana Statistical Service, 2010).

3.1.1 Physical Features

Location and size Tema Metropolis is a coastal district situated about 30 kilometers East of Accra, the Capital City of Ghana. It shares boundaries in the northeast with the Dangme West District, southwest by Ledzokuku Krowor Municipal, north-west by Adentan Municipal and Ga East Municipal, north by the Akuapim South District and south by the Gulf of Guinea. The Ashaiman Municipal is an in-lock enclave within the Tema Metropolis. The Metropolis covers an area of about 87.8 km2 with Tema as its capital. The metropolis lies in the coastal savannah zone (Ghana Statistical Service, 2010).

The Greenwich Meridian (i.e. Longitude 0º) passes through the Metropolis, which meets the equator or latitude 0° in the Ghanaian waters of the Gulf of Guinea. The Metropolis proximity to the sea with its low lying terrain which projects into the sea makes it a natural endowment for a

harbor. This evidently informed the decision of the construction of the Tema Harbor in 1957, making the Metropolis "the Eastern Gateway of Ghana" (Ghana Statistical Service, 2010).

3.1.2 Topography

The topography of the Tema Metropolis is generally flat and forms part of the coastal plains. The terrain of the district barely rises up to 35m above sea level. The almost flat nature of land has made it flood prone but this also makes it a good agricultural/developmental terrain. However, the only major constraint to this strength is the erratic rain fail pattern in the region (Ghana Statistical Service, 2010).

3.1.3 Climate

The Metropolis lies in the coastal savannah zone and therefore enjoys a dry equatorial climate. The rainy season is usually from April to July (major rainy season) and from September to November (minor rainy season). The highest amount of rain is experienced in May, June and early July. Temperatures are high all year round with significant daily and seasonal variations (Ghana Statistical Service, 2010).

Tema being an industrial hub, some areas have been demarcated to serve as greenbelts as a result of the absence of forest reserves (zones) to control the micro climate of Tema (climatic condition in relatively small area). However, the number of industries and waste generated has been increasing in the Metropolis without a corresponding increase in afforestation to absorb excess carbon mono-oxide generated by the factories (Ghana Statistical Service, 2010). Also, areas reserved as green belts are being encroached upon. This has led to changes in weather condition with its associated effects, such as, loss of biodiversity and erratic rainfall pattern.

3.2 METHODOLOGY

The methodology for the study will cover the research design, population, sample and sampling technique procedure, instrumentation, for data collection, ethical considerations and data analysis

3.2.1 Research Design

Zikmund, Babin and Griffin (2012) define a research design as "a detail blueprint used to guide the implementation of a research study towards the realization of its objectives". Zikmund et al.'s definition of research design also emphasize on the methods and techniques for gathering and analyzing data. Thus, a research design is mainly about deciding on a best research approach or methodology to obtain the data. It is therefore a blueprint of a detailed plan on how the research was completed.

The study is a descriptive cross-sectional in nature and previous cross sectional studies have mainly employed the survey strategy (Easterby-Smith et. al., 2012; Bughin et al., 2010). The choice for this research design therefore became necessary not only due to the explanatory nature of the study but also because it has been suggested to be suitable for analyzing such phenomena, situations, and problems by considering a cross-section of the population at one point in time (Litvin et al., 2008; Hakim, 2000). This study will adopt the mixed research design that is the use of both quantitative and qualitative methods towards achieving the research objectives of the study. The study will sample the opinions of people within the Tema Municipality regarding waste management as well as officials and management of TMA who are in charge of waste management issues.

3.2.2 Population

Population refers to any collection of specified group of human beings or non-human entities (Koul, 2002). The targeted population for the study will include household heads in the

municipality, solid waste management officials in the metropolis, especially those at the metropolitan, officials of Zoom lion and workers of the sanitation unit in the Metropolitan Assembly, the Ghana Health Service and the Environmental Protection Agency (EPA). These different categories of study participants will be used because of variations in availability, knowledge and experience in waste management, access to waste disposal facilities as well as differences in attitudes to waste handling and disposal practices.

3.2.3 Sample size

A total of 101 respondents were involved in the study. This is based on the population of the study area. Nine communities were be used, and in each community 10 respondents formed part of the sample totaling 90 respondents. The rest of the 10 respondents constituted officials of solid waste management within the metropolis. This figure is about ten percent of the total population. Royse, (1991), states that the general rule for selecting a sample for a survey should be ten percent of the population. The composition of the sample was not based on percentages for males and females because random sampling (where everyone had equal chance of being chosen) will be mainly used. Nwana (1992) suggests that if the population is few hundred a 40% or more sample size will do; if several hundred a 20% sample size will do; if a few thousands a 10% sample size will do; and if several thousands 5% or less sample size will do. Also, the sample size needs to be large enough to ensure that it is theoretically possible for each cell in the analytical table to have at least five cases fall in it. Hence, the stated sample size for the population is large enough to have at least five cases in each cell.

3.2.4 Sampling technique

Multiple sampling methods were adopted. The methods used included simple random sampling, systematic and purposive sampling. Simple random sampling (lottery method) was used to select the communities in the metropolis while systematic sampling was employed to select the

households for the study. Under the systematic sampling, the total numbers of household in the metropolis were identified and random number table was used to select the first household bearing the sample size in mind. The first respondent or (n^{th}) number selected constituted the interval for which subsequent households were selected until the sample size was attained. Furthermore, a simple random sampling technique was employed to select members of the households. According to Patton (1990), the quality of the sample affects the quality of the research generalizations. Patton further explains that obtaining an unbiased sample is the main criterion when evaluating the adequacy of a sample. Patton identifies an unbiased sample as one in which every member of the population has equal opportunity of being selected in the sample. Also, purposive sampling was used to select the officials of the Waste Management Unit in the Metropolis. Sarantakos (2013) explains that purposive sampling allows the researcher to choose subjects who in his or her opinion are relevant to the research.

3.2.5 Data collections methods and research instruments

The selected method for primary data collection was done under the form of semi-structured and in-depth interviews by using a questionnaire. According to Saunders (2003), the use of interviews and questionnaires help to collect valid and reliable data relevant to the research questions and objectives as well as provides first-hand and new information regarding the topic under study. Finally, they encourage respondents to talk and go more deeply into the issue of concern. Adopting a mixed methodology, the researcher administered questionnaires to households and also conduct face to face interviews with management of TMA who are in charge of waste management in the study area. At the household level, questionnaires were used to solicit information from respondents whilst interview guides were used at the institutional level. Whilst the questionnaires for the households were in a structured form due to the numbers involved, semi-structured

interview was adopted at the institutional level to allow room for furthering probing, clarification or any follow up questions that was necessary in achieving the objectives of the study.

3.2.6 Questionnaire

Questionnaire items were in four sections. Section 'A' consisted of items that sought to gather information concerning respondents' background. Section 'B' constituted items seeking to gather data on the waste management practices at the households. Section 'C' was made up of items that sought to find out the relationship between improper waste management and health. Section 'D' comprised of items that sought to determine the problems associated with the solid waste management in the households and some suggested solutions to the problems.

3.2.7 Structured Interview

An interview guide was also designed to engage the management of Tema Metropolitan Assembly (TMA) in some sort of dialogue so that they would be able to express themselves beyond Yes or No responses regarding solid waste management in the Metropolis. Additionally, the interview also sought to find out the problems management face in their waste management efforts and the possible solutions to these problems.

3.3 Data analysis plan

Quantitatively, descriptive statistic (mainly frequencies and percentages) were generated from the answers elicited from the research questions. Also the Statistical Product and Service Solution model was used for the data analysis of the questionnaires.

Qualitatively, the SPSS software helped in the thematic analysis of the responses that was elicited from the management of TMA included in the study. The interviews were tape recorded after approval by the interviewee, and responses were transcribed and analyzed based on emerging themes.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter focuses on solid waste management practices in the Tema Metropolis. It examines the socio-economic characteristics of respondents, assess waste management methods available to them in the metropolis, the opinion of residents on solid waste management situation in the metropolis as well as opinion of solid waste management at the institutional level specifically TMA.

Also, the study finds out about solid waste management practices of residents with Tema metropolis, willingness to pay for waste collection services, effects of poor solid waste management. The section also considers recommended garbage disposal methods and concludes by analyzing the suggestions made by residents towards improving solid waste management in the Tema metropolis.

4.1 Socio-demographic characteristics of respondents

This section highlights the socio-demographic background of the respondents who participated in the study. Specifically, issues studied include sex of respondents, educational status, occupation, monthly income of respondents, length of time a respondent has been living in a house, housing arrangement, ownership status as well as family type.

The variables listed have significant implications on solid waste management process in the metropolis. Females constituted 61% of the respondents for the study as shown in table 1, whiles the male respondents constituted 39%. The higher percentage of females is due to the fact that socially, females deal with sanitation issues more directly including sanitation related challenges

compared to their male counterparts. This was revealed during the survey where at the selected households, most **households** preferred their females speaking.

Table 4. 1 Sex of respondents

Sex of respondents	Frequency	Percent
Male	39	39.0
Female	61	61.0
Total	100	100.0

Source: Field survey, 2018

The study also focused on the level of educational attainment of respondents as against their monthly income shown in table 2.

Table 4. 2 Educational status of respondent against income of respondent

Educational status of respondent		Income of respondent				Total
		less than 500	500-1000	1100-1500	1600+	
	None	3	1	0	0	4
		7.3%	3.0%	0.0%	0.0%	4.0%
	Primary	3	4	0	1	8
		7.3%	12.1%	0.0%	6.2%	8.0%
	J.H.S	7	3	4	0	14
		17.1%	9.1%	40.0%	0.0%	14.0%
	S.H.S	25	16	3	5	49
		61.0%	48.5%	30.0%	31.2%	49.0%
	Tertiary	3	9	3	10	25
		7.3%	27.3%	30.0%	62.5%	25.0%
	Total	41	33	10	16	100
		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

From table 2, majority of the respondents within the income brackets less than 500 (GH) and 1600+ (GH) had attained educational level up to the secondary school level, that is 49%. This was followed by 25% of the respondents within the same income range who had attained education up to the Tertiary level.14% of the respondents also within the income bracket less than 500 (GH) and 1600+ had education up to the Junior school level with 8% of the respondents ending their education at the primary school level. Those who had never being to school before within the same income brackets constituted 4%.

It is imperative to note that education influences the thoughts, actions and attitudes of individuals in whatever they do. Hence, those with higher educational backgrounds are much conscious of their actions and activities in the environment with regards to environmental cleanliness and best waste disposal practices. Additionally, they are also well informed about the dangers associated with poor sanitation on the environment.

Table 4. 3 Occupation of respondent against income of respondent

Occupation of respondent		Income of respondent				Total
		less than 500	500-1000	1100-1500	1600+	
	Unemployed	27	9	4	5	45
		65.9%	27.3%	40.0%	31.2%	45.0%
	Private employee	11	23	4	3	41
		26.8%	69.7%	40.0%	18.8%	41.0%
	Government employee	2	1	2	7	12
		4.9%	3.0%	20.0%	43.8%	12.0%
	Other	1	0	0	1	2
		2.4%	0.0%	0.0%	6.2%	2.0%
	Total	41	33	10	16	100
		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

From table 3, majority of the respondent within the income bracket 500-1600+ (GH) who were unemployed constituted 45%. Those who are in the Private employees within the same income bracket constituted 41%. 12% of the respondents within the same income bracket were government employees whiles 2% of the respondents were into other brackets and necessarily government or private employees. The study revealed that respondents who are private employees and constituted the majority were also into trading, manufacturing and agricultural activities and as such generates much waste which does have effect on the environment if not managed well.

Table 4. 4 Length of stay in the house against income of respondent

Length of stay in a house	income of respondent				Total
	less than 500	500-1000	1100-1500	1600+	
Less than 1 year	5 12.2%	6 18.2%	1 10.0%	6 37.5%	18 18.0%
1-5 years	7 17.1%	7 21.2%	4 40.0%	2 12.5%	20 20.0%
6-10 years	6 14.6%	1 3.0%	0 0.0%	2 12.5%	9 9.0%
11-15 years	8 19.5%	4 12.1%	2 20.0%	1 6.2%	15 15.0%
16 years or more	8 19.5%	5 15.2%	1 10.0%	1 6.2%	15 15.0%
Born here	7 17.1%	10 30.3%	2 20.0%	4 25.0%	23 23.0%
Total	41 100.0%	33 100.0%	10 100.0%	16 100.0%	100 100.0%

Source: Field survey, 2018

From table 5, a substantial percentage of all the income brackets except those who had lived in a particular house for less than a year had enough knowledge to enable them to comment objectively on the management of solid waste within the metropolis. Majority which is about 23% were those born in a particular house and had lived there for a very long time. Also, about 20% of the respondents had lived in a particular house for at least 5 years, whiles those who had lived in a particular house for at least 15 years and beyond 16 years respectively were 15% each. Similarly, 9% of the respondents constituted those who had lived in a particular house for at least 10 years.

Table 4. 5 Housing arrangement against income of respondent

Housing arrangement		income of respondent				Total
		less than 500	500-1000	1100-1500	1600+	
	Privately owned	27	22	7	11	67
		65.9%	66.7%	70.0%	68.8%	67.0%
	Rented form	10	8	3	5	26
		24.4%	24.2%	30.0%	31.2%	26.0%
	Rented from rented housing agency	1	2	0	0	3
		2.4%	6.1%	0.0%	0.0%	3.0%
	Rented for individual	3	1	0	0	4
		7.3%	3.0%	0.0%	0.0%	4.0%
	Total	41	33	10	16	100
		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

Table 4.5 reveals that majority of the houses within the given income brackets (less than Ghs 500 and 1600+) were “privately owned” and constituted 67%. Similarly, 26% of the houses were

"rented houses" whiles 3% of the houses were rented from "rented housing agencies". Additionally, 4% of the houses were equally "rented for individuals".

Table 4. 6 Ownership status against income of respondent

Ownership status	income of respondent				Total
	less than 500	500-1000	1100-1500	1600+	
Owner	21	22	4	10	57
	51.2%	66.7%	40.0%	62.5%	57.0%
Tenant	20	11	6	6	43
	48.8%	33.3%	60.0%	37.5%	43.0%
Total	41	33	10	16	100
	100.0%	100.0%	100.0%	100.0%	100.0 %

Source: Field survey, 2018

A substantial percentage of the respondents in the income bracket less than 500 and 1600+ (Gh) who actually owned these houses constituted 57% whiles 43% of the respondents were tenants in these houses.

Table 4. 7 Housing details against income of respondent

Housing details	Income of respondent	Total

	less than 500	500-1000	1100-1500	1600+	
Thatched	6	6	1	0	13
	14.6%	18.2%	10.0%	0.0%	13.0%
Zinc Roofed	35	27	9	16	87
	85.4%	81.8%	90.0%	100.0%	87.0%
Total	41	33	10	16	100
	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

Table 7 shows that 87% of the respondents who are in the majority and are in the income brackets less than 500 and 1600+ (Ghs) have their houses roofed with Zinc whiles 13% had their houses roofed with thatched.

4.2 Solid waste management practices of residents within Tema metropolis

This section looks at various waste management practices undertaken by residents in the metropolis as well as how these practices are effectively carried out.

4.3 Volume of solid waste generated in the household daily

To assess the volume of solid waste generated by households within the metropolis, respondents were asked to show the volume of solid waste generated daily in their households. Their responses are shown in table 8.

Table 4. 8 Volume of solid waste generated in the household daily against income of respondent

Volume of solid waste generated in the household daily (number of bucket full, size 34)	income of respondent				Total
	less than 500	500-1000	1100-1500	1600+	
1/2	8	7	3	2	20
	19.5%	21.2%	30.0%	12.5%	20.0%
1/4	17	17	3	6	43
	41.5%	51.5%	30.0%	37.5%	43.0%

1	16	9	4	8	37
	39.0%	27.3%	40.0%	50.0%	37.0%
Total	41	33	10	16	100
	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

From table 4.8, it can be seen that the total volume of waste generated by households is generally low per day. The maximum volume of waste generated was 1; that is a size of a full 34 bucket which weighs about 2 kilograms per household per day. From the table, it came to light that a substantial section of the household averaging 20% of these households generated half bucket of waste daily. Also, 43% of the households were noted to generate a quarter of the 34 bucket daily with 37% of the households generating 1 full size 34 bucket daily. The conclusion is that households generate a substantial kilogram of waste depending on one's income.

Table 4. 9 Storage receptacle available for solid waste in a house against income of respondent

storage receptacle available for solid waste	income of respondent				Total
	less than 500	500-1000	1100-1500	1600+	
1	34	29	9	12	84
	82.9%	87.9%	90.0%	75.0%	84.0%
2	7	4	1	4	16
	17.1%	12.1%	10.0%	25.0%	16.0%

Total	41 100.0%	33 100.0%	10 100.0%	16 100.0%	100 100.0 %

Source: Field survey, 2018

In response to the availability of storage facility for storing household waste generated, it was disclosed that 84% of the respondents in the four income category had storage receptacles in their houses whiles 16% of the respondents in the same income categories did not have any storage receptacle in their houses as shown in table 9. From the disclosure, it indicates that the higher number of respondents who had waste bins in their houses was an indication that majority of them were aware of the implications of indiscriminate disposal of waste. For instance, it may attract flies, rodents and cockroaches which are disease transmitting vectors.

In response to how household waste generated is disposed, 19.8% of the respondents within the four income categories indicated that they dispose their solid waste in a nearby communal container whiles 6% of the respondents within the same four income categories dispose their solid waste into a hole dug in the house and bury it or burn it. 2% of the respondents in the given income category also indicated that they dispose their solid waste into an open space or on the street whiles another 2% also disclosed that they dispose their solid waste by other means but did not mention those means. Notwithstanding, majority of the respondents that is about 71% confirmed to the fact that their solid waste are handled by private waste collectors in the metropolis as shown in table 4.10

Table 4. 10 Means of disposing household solid waste against income of respondent

Means of disposing household solid waste	income of respondent	Total

	less than 500	500-1000	1100-1500	1600 +	
Dispose it at a nearby communal container	6 14.6%	7 21.2%	2 20.0%	4 25.0 %	19 19.0 %
Dispose it in a hole dug in the house and bury it or burn it	2 4.9%	3 9.1%	0 0.0%	1 6.2%	6 6.0%
Dispose it on an open space or on the street	2 4.9%	0 0.0%	0 0.0%	0 0.0%	2 2.0%
Private waste collectors handle it	29 70.7%	23 69.7%	8 80.0%	11 68.8 %	71 71.0 %
Other	2 4.9%	0 0.0%	0 0.0%	0 0.0%	2 2.0%
Total	41 100.0%	33 100.0 %	10 100.0 %	16 100.0 %	100 100.0 %

Source: Field survey, 2018

The result as from the table shows that the higher number of respondents who had their waste handled decently by the private waste companies is an indication that they are very much of the associated dangers with improper disposal of solid waste in the metropolis.

The outcome of the study also confirms an observation made by Onibokrom & Kumuyi (2004), that in developing countries, the disposal of solid waste is by way of illegal dumping on vacant lands, dumping alongside roads or railway lines, into storm drains or by burying or burning on the compounds of their households.

4.3 Frequency of solid waste disposal

From table 11, it was revealed that majority of respondents constituting 45% disposed their solid waste once a week whiles about 24% also disposed their waste every day. Similarly, 21% of the respondents indicated that they dispose their waste once in every two days whiles another 8% of the respondents reveled that they dispose their solid waste once a month. Notwithstanding that, about 2% of the respondents disclosed that they disposed their waste more than once in a week.

Table 4. 11 Frequency of solid waste disposal income of respondent

Frequency of solid waste disposal	income of respondent				Total
	less than 500	500-1000	1100-1500	1600 +	
Everyday	12	10	0	2	24

	29.3%	30.3%	0.0%	12.5 %	24.0 %
	11	5	2	3	21
Once in two days	26.8%	15.2%	20.0%	18.8 %	21.0 %
	18	13	7	7	45
Once in a week	43.9%	39.4%	70.0%	43.8 %	45.0 %
	0	4	1	3	8
Once in a month	0.0%	12.1%	10.0%	18.8 %	8.0%
	0	1	0	1	2
More than once in a week	0.0%	3.0%	0.0%	6.2%	2.0%
	41	33	10	16	100
Total	100.0%	100.0 %	100.0%	100.0 %	100.0 %

Source: Field survey, 2018

4.4 Means of conveying solid waste to the final disposal site

Although there are many ways by which solid waste can be conveyed to the dumping site the study took consideration of some key means as shown in table 4.11. From the study, it was noted that the Truck was the major vehicle used in carrying waste to the final disposal site representing 75% followed by the use of tricycle which had 19%.

Table 4. 12 Vehicle used for clearance of solid waste

Vehicle used for clearance	Frequency	Percent
truck	75	75.0
tricycle	19	19.0
lorry	5	5.0

any other	1	1.0
Total	100	100.0

From the study, 60% of the respondents indicated that they do not enjoy any means of solid waste collection by the government (TMA) in the areas although they pay taxes to the state. Nonetheless, 40% confirmed of enjoying some services from the government (TMA) in their areas as shown in table 4.12.

Table 4. 13 if household enjoy any services of solid waste collection or disposal from the government

Waste management services enjoyed by households from the government	Frequency	Percent
Yes	40	40.0
No	60	60.0
Total	100	100.0

Source: Field survey, 2018

Similarly, respondents were asked of their opinions concerning the current waste management services rendered to them by TMA. The results shows that 76% of the respondents are not satisfied with the service rendered by the TMA whiles 24% were content with the services provided by TMA.

Table 4. 14 Respondents satisfaction with the current solid waste collection and disposal service provided by TMA

Respondents satisfaction with waste management services by TMA	Frequency	Percent
Yes	24	24.0
No	76	76.0

Total	100	100.0

Source: Field survey, 2018

In terms of financing solid waste management in the metropolis, respondents were asked whose responsibility it was to finance it. Whiles 27% suggested that it was the responsibility of TMA, a substantial percentage of the respondents agreed that it was both the responsibility of the households and the TMA.

Table 4. 15 Respondents opinion on who is responsible to properly manage solid waste in TMA in terms of financing

Respondents opinion on who is responsible to properly manage solid waste in TMA in terms of financing	Frequency	Percent
TMA	27	27.0
Household only	5	5.0
Both	68	68.0
Total	100	100.0

Source: Filed survey, 2018

From the revelation disclosed by respondents in table 4.15, they were further asked to indicate which of the two categories effective managing solid wastes in the metropolis were. And outcome shows that they perceive the private waste management companies are more effective compared to TMA. This is shown in table 16.

Table 4. 16 Opinion of respondents on who is ideal to handle solid waste in the metropolis

Opinion of respondents on who is ideal to handle solid waste in the metropolis	Frequency	Percent
TMA	47	47.0

	Private waste management companies	53	53.0
	Total	100	100.0

Source: Field survey, 2018

4.5 Willingness to pay for waste collection

In response to whether households were willing to pay for waste collection services provided by the waste management companies, 78% of the respondents from all the four income groups indicated their willingness to pay for waste management services in the metropolis as shown in table 17.

Table 4. 17 Household willing to pay for solid waste management service against income of respondent

Is your household willing to pay for solid waste management service?		Income of respondent (GH¢)				Total
		less than 500	500-1000	1100-1500	1600+	
	Yes	30	28	6	14	78
		73.2%	84.8%	60.0%	87.5%	78.0%
	No	11	5	4	2	22
		26.8%	15.2%	40.0%	12.5%	22.0%
	Total	41	33	10	16	100
		100.0%	100.0%	100.0%	100.0 %	100.0 %

Source: Field survey, 2018

Respondents who were willing to pay for waste management services by the Metropolitan Assembly and its allied agencies were asked how much they were ready to pay in a month. 50.6% were willing to pay GH¢35 a month whiles 21% were also willing to commit GH¢45 a month. Also, 12.3% of the respondents also noted their willingness to pay GH¢55 monthly. Additionally, 3.7% of the respondents were willing to pay GH¢100 a month as shown in table 18.

Table 4. 18 How much respondents were willing to pay (in Ghana Cedis) in the following categories against income of respondent

How much respondents were willing to pay (in Ghana Cedis) in the following categories	income of respondent				Total
	less than 500	500-1000	1100-1500	1600+	
35	20	9	2	10	41
	64.5%	30.0%	33.3%	71.4%	50.6%
45	5	9	2	1	17
	16.1%	30.0%	33.3%	7.1%	21.0%
55	2	5	1	2	10
	6.5%	16.7%	16.7%	14.3%	12.3%
65	3	5	1	1	10
	9.7%	16.7%	16.7%	7.1%	12.3%
100	1	2	0	0	3
	3.2%	6.7%	0.0%	0.0%	3.7%
Total	31	30	6	14	81
	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

From the table, it could be seen that majority of the respondents from ll the four income groups were willing to pay Ghs 35 per month. This suffices that irrespective of one's income level, they were not ready to pay more for waste management services as majority of the respondents from all income groups said they could afford Ghs 35 towards waste management services monthly.

4.6 Illegal dumping of solid waste in the metropolis

Respondents were asked if they had noticed any problem of illegal dumping of solid waste in any specific location within the metropolis. From the study it was disclosed that areas such as the central market, community 1 and 4 behind the public school had waste indiscriminately littered there which is a worrying situation as shown table 19.

Table 4. 19 Notice of any problem of illegal dumping of solid waste or any specific location within TMA

Notice of any problem of illegal dumping of solid waste or any specific location within TMA	Frequency	Percent
Yes, where	59	59.0
No	41	41.0
Total	100	100.0

Source: Field survey, 2018

4.7 Effects of solid waste management in the metropolis

As a way of assessing the effects of poorly managed solid waste in the metropolis on the health of citizens, respondents were asked to indicate the diseases members of their households including themselves had suffered as a result of poor sanitation. It could be seen from the table 4.19 that 42% of the households had suffered from malaria followed by 28% cholera cases. Typhoid fever recorded 12%, followed by 8% cases of cold and diarrhea each respectively. Gastro-enteritis and jaundice cases recorded 1% each respectively.

Table 4. 20 Assessment of how solid waste affect the health condition against income of respondents

	income of respondent	Total

Assessment of how solid waste affect the health condition		less than 500	500-1000	1100-1500	1600+	
	typhoid fever	2 4.9%	6 18.2%	1 10.0%	3 18.8%	12 12.0%
	Malaria	19 46.3%	14 42.4%	4 40.0%	5 31.2%	42 42.0%
	Diarrhea	5 12.2%	2 6.1%	0 0.0%	1 6.2%	8 8.0%
	gastro-enteritis	1 2.4%	0 0.0%	0 0.0%	0 0.0%	1 1.0%
	Cholera	11 26.8%	8 24.2%	3 30.0%	6 37.5%	28 28.0%
	Jaundice	1 2.4%	0 0.0%	0 0.0%	0 0.0%	1 1.0%
	common cold	2 4.9%	3 9.1%	2 20.0%	1 6.2%	8 8.0%
	Total	41 100.0%	33 100.0%	10 100.0%	16 100.0%	100 100.0%

Source: Field survey, 2018

As a result of this revelation the study further asked the respondents to indicate the disease themselves and their households have suffered over the last 12 months. From table 4.20, malaria still recorded 53% as the leading disease in the metropolis followed by 15% cases of common cold. 14% was recorded for cholera cases whiles 9% was recorded for diarrhea cases. Typhoid cases recorded 6% whiles' jaundice and gastro-enteritis recorded 1% and 2% each respectively.

Table 4. 21 Number of household been affected by the following water borne disease in the last 12 months as a result of Municipal solid waste against income of respondent

Number of household been affected by the following water borne disease in the last 12 months as a result of Municipal solid waste		income of respondent				Total
		less than 500	500-1000	1100-1500	1600+	
	typhoid fever	1	3	2	0	6
		2.4%	9.1%	20.0%	0.0%	6.0%
	Malaria	27	18	1	7	53
		65.9%	54.5%	10.0%	43.8%	53.0%
	Diarrhea	3	3	1	2	9
		7.3%	9.1%	10.0%	12.5%	9.0%
	gastro-enteritis	1	0	0	0	1
		2.4%	0.0%	0.0%	0.0%	1.0%
	Cholera	4	6	1	3	14
		9.8%	18.2%	10.0%	18.8%	14.0%
	Jaundice	0	0	0	2	2
		0.0%	0.0%	0.0%	12.5%	2.0%
	common cold	5	3	5	2	15
		12.2%	9.1%	50.0%	12.5%	15.0%
	Total	41	33	10	16	100
		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Field survey, 2018

In conclusion, most of the respondents had their household members suffering from malaria than any other diseases. This confirms the statistics from the Tema Metropolitan Health Directorate in 2017 which shows that out of the top 10 OPD cases under the year of review, malaria recorded the highest with cases of over 27, 379 compared to other case such as hypertension, diabetes, acute eye infection, rheumatisms and other joint pains, gynecological conditions, dental carries, acute ear infection, diarrhea and acute respiratory tract infections.

4.8 Respondents' perception on TMA waste management services

The TMA is responsible for managing all forms of waste generated within the metropolis. Respondents were therefore asked the extent to which they agree whether MSW controls are usually effective, whether TMA should be doing less to control MSW in one's area or whether greater controls should be placed on those who make the municipality dirty. From the survey, 34% of respondents as shown in table 22 who constitute the majority strongly disagreed that MSW controls are usually effective by TMA whiles 29% of the respondents also strongly agreed that MSW controls were effective. Similarly, 14% of the respondents also disagreed concerning MSW controls effectiveness whiles 10% respondents agreed also that MSW were usually effective. That notwithstanding, 13% of the respondents were undecided on the issue.

Table 4. 22 Effectiveness of MSW controls

Effectiveness of MSW controls	Frequency	Percent
strongly agree	29	29.0
agree	10	10.0
undecided	13	13.0
disagree	14	14.0
strongly disagree	34	34.0
Total	100	100.0

Source: Field survey, 2018

On the issue of whether greater controls be placed on those who make the metropolis dirty, a substantial percentage of respondents constituting 83% strongly agreed that greater controls be placed whiles 12% of the respondents equally agreed in the same vein. Meanwhile, 2% of the respondents strongly disagreed on the issue whiles 3% of the respondents were undecided on the issue as shown in table 4.22.

Table 4. 23 Greater controls placed on indiscriminate littering

Greater controls placed on indiscriminate littering	Frequency	Percent
strongly agree	83	83.0
Agree	12	12.0
Undecided	3	3.0
strongly disagree	2	2.0
Total	100	100.0

Source: Field survey, 2018

With regards to the issue of whether TMA should be doing less to control MSW in one's jurisdiction and rather pave way for private participation, 54% of the respondents strongly disagreed which was supported by another 24% of the respondents who also disagreed on the issue. However, 14% of the respondents strongly agreed on the issue which was supported by another 4% of the respondents who also agreed same on the issue. Only 4% of the respondents were undecided on the issue as shown in table 4.23

Table 4. 24 TMA should be doing less to control MSW in your area

TMA should be doing less to control MSW in your area	Frequency	Percent

strongly agree	14	14.0
Agree	4	4.0
undecided	4	4.0
disagree	24	24.0
strongly agree	54	54.0
Total	100	100.0

Source: Field survey, 2018

As a way of supporting measures in reducing metropolitan solid waste (MSW) in one's area, respondents were asked of their opinion on whether they will opt for stronger water control fines, restrict open dumping sites, increased penalties for those who violates rules and regulations of TMA or metropolitan solid waste should be treated before discharging.

From the survey, 84% of the respondents agreed that stronger water pollution control fines should be in place which was supported by another 10% of the respondents who agreed same on the issue. However, 3% was recorded each for those respondents who were undecided or disagreed respectively as shown in table 4.24

Table 4. 25 Stronger water pollution control fine

Stronger water pollution control fine	Frequency	Percent
strongly agree	84	84.0
Agree	10	10.0
Undecided	3	3.0
Disagree	3	3.0
Total	100	100.0

Source: Filed survey, 2018

In the case of waste dumping issue, 87% of the respondents in table 4.25 strongly agreed that TMA should restrict open dumping sites which were supported by another 6% of the respondents who agreed same on the issue. However, 4% and 3% was recorded each for those respondents who either were undecided or strongly disagreed on the issue respectively.

Table 4. 26 Restrict open dumping sites

Restrict open dumping sites	Frequency	Percent
strongly agree	87	87.0
Agree	6	6.0
Undecided	4	4.0
strongly disagree	3	3.0
Total	100	100.0

Source: Field survey, 2018

As a matter of increasing penalties for those who violate rules and regulations of TMA regarding waste management, table 4.26 indicates that 87% of the respondents strongly agreed to it which was further supported by 12% of the respondents who also agreed same on the issue. However, 1% of the respondents disagreed.

Table 4. 27 Increased penalties for those who violate rules and regulations of TMA

Increased penalties for those who violate rules and regulations of TMA	Frequency	Percent
strongly agree	87	87.0
Agree	12	12.0
Disagree	1	1.0
Total	100	100.0

Source: Field survey, 2018

Regarding whether solid waste should be treated before discharging, 79% of the respondents in table 4.27 agreed to the issue which was further supported by another 10% of the respondents who also agreed to it. However, 10% of the respondents were undecided on the issue with another 1% of the respondents disagreeing on the issue.

Table 4. 28 Municipal solid waste should be treated before discharging

Municipal solid waste should be treated before discharging	Frequency	Percent
strongly agree	79	79.0
Agree	10	10.0
Undecided	10	10.0
Disagree	1	1.0
Total	100	100.0

Source: Field survey, 2018

In conclusion, it is worth noting that most respondents know the effects of poor waste management on the environment and their health and as such would support any move by TMA to keep their environment and water clean. From the survey also, it was concluded by respondents that a major problem affecting solid waste management in the metropolis was finance. This assertion confirms (ISWA, 2002, White et al, 1995; Gray, 1993) statement "that financial implications of improving waste management can be a burden on the budgets of municipalities". Same assertion was made by Zurbrugg (2003), "that one of the main causes of inadequate collection services is lack of financial resources to cope with the increasing amount of waste generated".

4.10 Recommended measures to improve solid waste management

Respondents were asked about measures to improve the management of solid waste in the metropolis. The survey indicated that, respondents were inclined to the implications of managing waste poorly had on their environment and health, as such they recommended that waste collection be done twice or thrice a week. Similarly, they also suggested that whiles they will practice waste management methods such as clearing of choked gutters, bury or burn waste materials, they would also prefer that Government through the TMA would provide recycling mechanisms and separates waste. Also, TMA should spray their communities often as well as arrest those who dispose waste indiscriminately.

For instance one respondent said *"if those who litter indiscriminately are arrested and prosecuted, it will serve as deterrent others from doing same. Unless we change our attitudes towards waste, it will always be our problem"(household survey, 2018).*

Another respondent also asserted that;

"Although it is the responsibility of government to manage waste, I think the town council or sanitary inspectors should resume work and go about inspecting people's houses and their environment. That notwithstanding, I will be glad if waste bins are provided at vantage places and checks are put in place to ensure any waste generated in the household are put in the waste bins" (household survey, 2018).

In conclusion, majority of the respondents said recycling of waste should be the best method of disposing of garbage since recycling has the advantage of bringing back the materials to the system again and also decreasing the cost on the disposing facilities, lengthening the life expectancy and also decreasing the impact of disposing sites on the environment as the organic waste are mostly to be accountable for producing methane and leachate.

4.11 Role of TMA in strong waste management

The survey further revealed that although the Assembly renders public services in terms of waste management to schools, markets and hospitals as well as other avenues, the Assembly has also outsourced solid waste management to private companies who collect waste in the metropolis based on approved fees from the Assembly. During an interview with the environmental health officer in the Assembly, it was noted that the private companies finance their own activities from the fees they charge. Asked if there is any waste management regulation put in place, this is what the officer said during the interview; *"Yes, we have what we call Metropolitan Environmental Sanitation Action Plan (MESAP). This captures entirely what we are supposed to do drawing inspiration from the National Environmental Sanitation Action Plan (NESAP)" (in depth interview, 2018).*

It was further disclosed in the interview that there are no medical or incinerating facilities available, however plans are underway to get machines to generate about 50-60 MWs of electricity in the

metropolis. Also, it was disclosed that the Assembly has an organic fertilizer composting plant at Nungua farms which is co-managed by TMA and Chekora ventures where feacal sludge and organic solid waste are turned into fertilizer. About 500metric tones of fertilizer are generated per annum from the composting plant.

At the Assembly, it was further disclosed that residential composting is encouraged provided residents can assure the Assembly of sticking to the rules as well as get the services of an agric extension officer to guide the process. Regarding awareness creation on waste management, the interviewee disclosed that community and town hall meetings are organized periodically to engage citizens on waste management. When asked to suggest means to manage waste in the metropolis, this is what was asserted according an officer from the Assembly "the issue where residents instead of patronizing the services of waste management companies, they give their waste to jokins and scavengers, that is those who push trucks is actually a major headache because they turn up throwing rubbish at unauthorized places, in drains or anywhere. So if the residents in can change their attitudes by adhering strictly and stop patronizing these joking and scavengers and send their waste to the waste management companies, that will do us more good because once they litter with the waste and it rains, the runoff water carries the waste which end up choking our sewer manholes leading to flood.

In conclusion, it is evident that practically, TMA is working assiduously in managing waste in the metropolis as well as encourages the participation of Private Waste Management Companies who have the funds and equipments to collect the waste generated in the metropolis.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This section summarizes the major findings of the research and concludes on the findings. The study further makes recommendations based on the findings to help address the challenges identified. The chapter finally ends with suggested areas of potential study in the future. The main objective assessed the challenges in the Tema metropolis and how waste can be managed sustainably in the metropolis. Specific objectives were;

1. Identify the main source of waste generated in the Tema Metropolis.
2. To assess waste management methods available to the Metropolitan Assembly.
3. Recommend practical interventions to ensure sustainable waste management.

Both primary (from field) and secondary data were used for the study. The primary data was collected from 101 respondents who were selected from the metropolis. A multistage sampling technique was used for the selection of the participants for the study. The survey instruments used for the data collection include questionnaire and interview guide schedule. SPSS; computer software was used in the analysis. The responses collected from the 101 respondents were cross tabulated against four income strata namely; less than 500, 500-100, 1100-1500 and 1600+ to generate discussions leading to logical conclusions. Frequency tables were drawn in some cases to help the discussions.

5.1 Summary of findings

The literature review, field study and the analysis carried out led to some valid findings which are summarized below.

✓ An average of 1.0 kilogram of waste was generated everyday by households. With the 34 bucket which weighs 2kg, it was noted that some households could produce half of it a day or a full one but was subject to one's income, location and activity engaged in by the household.

✓ The study also discovered that most of the households representing 84% stored their waste in waste bins which either placed in the house or outside the house or are emptied once in a week. However, it was found out that some of these wastes were not covered and therefore served as places for flies and other rodents.

✓ The study recorded few transfer stations (communal containers) in the study are. However, these containers were usually over filled and as such waste are indiscriminately disposed around the communal containers.

✓ The study also discovered that for all respondents, they noted that solid waste management was a challenge in the metropolis due to logistical and financial constraints faced by the Metropolitan Assembly.

✓ No household was recorded to be practicing waste separation in the study irrespective of their income and educational level.

✓ The study identified also that about 71% of the residents depended on the services of private waste collectors in the metropolis.

✓ It was identified that majority of the respondents, 78% were willing to GHs 100 per month for waste management services beyond it they were unwilling to pay irrespective of one's income status.

✓ Malaria was identified as the leading disease among the households with 53% of members of the households suffering from it within the 12 months than any other disease.

✓ Majority of the respondents suggested recycling of waste as the best method and should be practiced in disposing waste since the practice brings back the waste for another use.

✓ The study also identified that waste management in the metropolis was a shared responsibility between the Assembly and the private waste management companies. As such, privatization of waste management was encouraged in the metropolis.

✓ The Assembly was also noted to have a composting plant that turns feacal sludge and organic waste into fertilizer and as such produces 500 tons of fertilizer per annum.

5.2 Conclusions

The conclusions were drawn based on the findings from the study. The study identified that there is serious solid waste management challenge in the metropolis. Issues of financial resources in the Metropolitan Assembly were noted to have led to indiscriminate disposal of solid waste within the metropolis.

It was established that residents burn, bury or throw waste into drains and other places indiscriminately. As such, many of them suffered from malaria in the past 12 months. However, they preferred recycling as the best method of waste disposal.

Respondents equally encouraged private participation in solid waste collection since the private waste companies were noted to be effective and had the needed resources and vehicles to convey waste.

5.3 Recommendations

The following recommendations were suggested based on the findings and conclusions identified by the study. Therefore recommendations are made to help improve the management of solid waste challenges in the metropolis as well as to provide sound environmental conditions in order to improve the socio-economic wellbeing and health of residents in the metropolis.

✓ It is recommended that the TMA practiced the integrated managing solid waste approach. The approach covers waste reduction, prevention, recycling, reuse, energy recovery, treatment and disposal.

✓ It is recommended that TMA provides more waste bins and communal containers to the households are the various communities to stop the indiscriminate littering around the few communal containers. Also, the waste bins and communal containers should be emptied every day.

✓ The study recommends that appropriate land fill sites are developed by TMA and stop the old way of open dumping of waste in the metropolis.

✓ To cater for finances, the study recommends that TMA expands its revenue sources to include property and house taxes, fees for passing building plans, city cleaning tax, levies on advertisement, signposts and billboards as well as license for different trades and rents from the properties owned by the Assembly.

5.4 Recommendations for further studies

Due to resource constraints and time, the study is unable to cover all the research areas on solid waste management in a single study. Therefore, further studies is needed in areas such as private participation in managing strong waste as well as assessment of constructing a standardized land fill site capable of generating electricity in the metropolis.

References

Abuyuanl, A. M. (1999). Collaboration: A sociological perspective. Yale/UNDP research clinic report. Yale/UNDP Public Private Partnership Programme, Yale University, USA.

Abul, S. (2010). Environmental and health impact of solid waste disposal at Mangwaneni dumpsite in Manzini: Swaziland. *Journal of Sustainable development in Africa*, *12*(7), 64-78.

Addae, Stephen (1997). History of Western Medicine in Ghana 1880-1960. Durban, UK: Durban Academic Press.

Aickenhead, M. (1999). Collaboration: A review of management theory. Yale/UNDP research clinic report. Yale/UNDP Public Private Partnership Programme, Yale University, USA.

Ali, M. (1999). The informal sector: What is it worth? Waterlines, 17, 10–12.

Ahmed SA, Ali M. (2004) Partnerships for solid waste management in developing countries: linking theories to realities. Habitat Inter.

Cohen, B. (2004). Urban growth in developing countries: a review of current trends and a caution regarding existing forecasts. World Development 32 (1), 23–51.

Coffey, M., Coad, A. (2010). Collection of Municipal Solid Waste in Developing Countries. UN-HABITAT, Malta.

Chikarmane, P. (2012). Integrating waste pickers into municipal solid waste management in Pune, India. *WIEGO Policy Brief (Urban Policies)*, *8*, 23.

Das, S., & Bhattacharyya, B. K. (2013). Municipal solid waste characteristics and management in Kolkata, India. In *The 19th International Conference on Industrial Engineering and Engineering Management* (pp. 1399-1409). Springer, Berlin, Heidelberg.

Din, G. Y., & Cohen, E. (2016). Modeling municipal solid waste management in Africa: case study of Matadi, the Democratic Republic of Congo. *Solid Waste Management: Policy and Planning for a Sustainable Society*, 81.

Fletcher P, Read AD (2003). Strategic solid waste management planning for the city of Ekaterinburg (Russia), presented at Sardinia 2003.

Halla, F., Majani, B. (1999). Innovative ways for solid waste management in Dar-Es-Salaam: toward stakeholder partnerships. Habitat International 23 (3), 351–361.

Hempel CG. (1966). Philosophy of natural science. New Jersey, USA: Prentice Hall, Upper Saddle River.

Garlapati, V. K. (2016). E-waste in India and developed countries: Management, recycling, business and biotechnological initiatives. *Renewable and Sustainable Energy Reviews*, *54*, 874-881.

Ghana Statistical Service (2010). Population and Housing Census.

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste management*, *33*(1), 220-232.

Jha, A.K., Singh, G.P., Singh, G.P., Gupta, P.K. (2011). Sustainable municipal solid waste management in low income group of cities: a review. Tropical Ecology 52 (1), 123–131.

Joseph, K., Rajendiran, S., Senthilnathan, R., & Rakesh, M. (2012). Integrated approach to solid waste management in Chennai: an Indian metro city. *Journal of Material Cycles and Waste Management*, *14*(2), 75-84.

Medina, M. (2010). *Solid wastes, poverty and the environment in developing country cities: Challenges and opportunities* (No. 2010, 23). Working paper//World Institute for Development Economics Research.

Mohee, R., & Simelane, T. (Eds.). (2015). *Future directions of municipal solid waste management in Africa*. Africa Institute of South Africa.

Müller, M.S., Scheinberg, A. (2002). Gender linked livelihoods from modernising thewaste management recycling sector: a framework for analysis and decision making. Gender and waste economy. Vietnamese and international experiences. CIDA funded project.

Niiniluoto I. (1995) The emergence of scientific specialities: six models. In: Poznan studies in the philosophy of the science and the humanities, vol. 44, 1995:211–23.

Okot-Okumu, J., & Nyenje, R. (2011). Municipal solid waste management under decentralisation in Uganda. *Habitat International*, *35*(4), 537-543.

Panayotou, T. (2016). Economic growth and the environment. *The environment in anthropology*, 140-148.

Premakumara, D. G. J., Abe, M., & Maeda, T. (2011). Reducing municipal waste through promoting integrated sustainable waste management (ISWM) practices in Surabaya city, Indonesia. *WIT Transactions on Ecology and the Environment*, *144*, 457-468.

Raven, R. (2007). Co-evolution of waste and electricity regimes: Multi-regime dynamics in the Netherlands (1969–2003). Energy Policy, 35(4), 2197–2208. Retrieved March 18, 2018 from http://linkinghub.elsevier.com/retrieve/pii/S0301421506002849.

Remigios, M. V. (2010). An overview of the management practices at solid waste disposal sites in African cities and towns. *Journal of sustainable development in Africa*, *12*(7), 233-239.

Sarantakos,S. (2013). *Social Research* (4th Edition).Basingstoke, UK: Macmillan.

Scarlat, N., Motola, V., Dallemand, J. F., Monforti-Ferrario, F., & Mofor, L. (2015). Evaluation of energy potential of municipal solid waste from African urban areas. *Renewable and Sustainable Energy Reviews*, *50*, 1269-1286.

Scheinberg, A., Wilson, D.C., Rodic, L. (2010). Solid waste management in the World's Cities. UN-Habitat's Third Global Report on the State of Water and Sanitation in the World's Cities. EarthScan, Newcastle-upon-Tyne, UK.

Senkoro, H. (2012). Solid Waste Management in Africa: A WHO/AFRO Perspective. Paper 1, presented in Dar es Salaam at the CWG Workshop, March 2003.

Tacoli, C. (2012). Urbanization, Gender and Urban Poverty: Paid Work and Unpaid Carework in the City. International Institute for Environment and Development: United Nations Population Fund, London, UK.

Thyberg, K. L., & Tonjes, D. J. (2016). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, *106*, 110-123.

Tudor A, (1982). Beyond empiricism. Philosophy of Science in Sociology. Routledge and Kegan Paul, London, UK.

UNFPA (2011). State of World Population 2011: United Nations Population Fund.

UN-HABITAT (2010). Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities 2010. In: Earthscan (Series Ed.).

U.S. EPA (2012b). Solid waste management hierarchy. Wastes—non-hazardous waste—municipal solid waste. Retrieved 18 March, 2018 from http://www.epa.gov/wastes/nonhaz/municipal/ hierarchy.htm.

Wilson, D.C., Araba, A., Chinwah, K., Cheeseman, C.R. (2009). Building recycling rates through the informal sector. Journal of Waste Management 29, 629–635.

Zezza, A., & Tasciotti, L. (2010). Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. *Food policy*, *35*(4), 265-273.

Zuilen, L.F. (2006). Planning of an integrated solid waste management system in Suriname: a case study in Greater Paramaribo with focus on households. PhD Thesis. Ghent University, Belgium.

Zurbrügg, C., Drescher, S., Rytz, I., Sinha, M., Enayetullah, I. (2005). Decentralized composting in Bangladesh, a win–win situation for all stakeholders. Resources, Conservation and Recycling 43, 281–292.