UNIVERSITY FOR DEVELOPMENT STUDIES

CONTRIBUTION OF ZOOMLION PROGRAMMES TOWARD DOMESTIC WASTE MANAGEMENT IN WA TOWN

GRACE ENBONZUMAH

DISSERTATION SUBMITTED TO THE DEPARTMENT OF PLANNING AND MANAGEMENT, FACULTY OF PLANNING AND LAND MANAGEMENT, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF PHILOSOPHY DEGREE IN DEVELOPMENT MANAGEMENT

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By

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JUNE, 2016

DECLARATION

Student

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere:

GRACE ENBONZUMAH (Ms) …….. ……..

(CANDIDATE) (SIGNATURE) (DATE)

Supervisor

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by University for Development Studies.

DR: JONAS AYARIBILA AKUDUGU ……. ……

(SUPERVISOR) (SIGNATURE) (DATE)

ABSTRACT

Domestic waste management presents teething challenges confronting most rapidly growing economies and cities of low/middle income countries. This is partly due to rapid population growth, expansion in towns or cities, attitude of inhabitants to waste disposal, poor town planning and inadequate funding of waste management practices. Ghana in an attempt to find sustainable solution to domestic waste management contracted Zoomlion Ghana Limited, a giant private waste management institution which started its operations in 2006. This dissertation assesses the contribution of Zoomlion in domestic waste management in Wa town. The study employed a descriptive cross-sectional study design and data was collected between April and August, 2014. The results showed the Zoomlion company made substantial progress towards domestic waste management in Wa as evidenced from ratings (excellent, very good and good). Several programmes (waste/sanitation module, sanitation guards, etc) were introduced by the company to manage waste. Also, yard waste and food waste/chaff were major components of household waste. Services rendered by the company included solid waste collection, street/drains cleaning, cesspit emptying and communal containers services. Substantial collaboration existed between the Assembly and the Zoomlion company in that, each had a consensual role to play. The Assembly provided funds for the activities of the company contracted while the company in return provided logistics to cleaners and played supervisory role. The study revealed inherent challenges which include burning of waste containers, defecating around communal containers and wrapping human excreta in polythene and placing it in the open. Regular waste collection, the creation of awareness through public education, sanctioning people who burn waste containers as measures to ensure sustainable waste management in the Wa are recommended.

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DEDICATION

This work is dedicated to the Almighty God for his protection and guidance throughout the writing of this piece of work and also to my parents, my siblings and my family for their continuous support.

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EPA	Environmental Protection Agency
CONIWAS	Coalition of NGOs in the Waste and Sanitation Sector
CWAS	Coalition of Waste and Sanitation Agencies
CBD	Central Business District
ISWM	Integrated Solid Waste Management
Gh	Ghana
JHS	Junior High School
KMA	Kumasi Metropolitan Assembly
Ltd	Limited
MLGRD	Ministry of Local Governance and Rural Development
MSLC	Middle School Leaving Certificate
MDW	Municipal Domestic Waste
PPP	Public-Private Partnership
SPSS	Statistical Product and Service Solutions
UN	United Nations
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
US	United States
VOCs	Volatile Organic Compounds
WMA	Wa Municipal Assembly
WMD	Waste Management Department
GYEEDA	Ghana Youth Employment Entrepreneurial and Development Agency

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Waste generation, both domestic and industrial, continues to increase world-wide in tandem with growth in population and consumption. Between 1.7 to 1.9 billion metric tons of Municipal waste is generated by urban dwellers World-wide (Bindra, Benn and Darani, 2011). About 57 to 80 percent of the waste generated is disposed in landfills, including open and engineered sites. Waste management has become a major challenge in many cities in the developing world. The problems of waste management in these countries have been worsened with rapid urbanization and growing numbers of slums resulting in major problems relating to public health, environmental pollution and aesthetic nuisance (Katusiimeh, Mol, and Burger, 2012)

Historically, in many developing countries in Africa, the public sector took monopoly of providing waste management services in urban Countries and this was largely blamed for the mess in solid waste management. The public sector was commonly reported to be constrained due to lack of managerial and technical capacity, cumbersome procedures and inadequate financial resources (Obirih-Opareh and Post, 2002). These constraints have resulted in an increased interest in Public-Private partnerships (PPP) in urban waste management in many developing countries in recent years with the main objective of improving efficiency in waste collection, reducing costs and reforming the weak performance of the public sector (Jones and Pisa, 2000; Rakodi, 2003). Waste management constitutes one of the most crucial health and environmental problems facing governments of African cities. This is because even though these cities are using 20 – 50

percent of their budget in waste management, only 20 – 80 percent of waste is collected. The uncollected or illegally dumped wastes constitute a disaster for human health and the environmental degradation. Not only are their quantities increasing, but their variety is also increasing, both a consequence of increasing urbanization, incomes, and changing consumption pattern/habits fueled by globalization. This scenario places the already desperate urban councils in a difficult situation especially as they have to develop new strategies to deal with increasing volumes as well as strange varieties of waste. Poor waste management practices in particular, widespread dumping of waste in water bodies and uncontrolled dump sites aggravate the problems of generally low sanitation levels across the African continent.

According to official data and the 2005 Revision of world urbanization prospects, by 2030 half or more of the African population is expected to live in cities (UN-habitat, 2005). This trend is expected to continue in the future. The major concern is the inability of infrastructure and land use planning methods (including waste management) to cope with urban growth (the highest in the world) at 3.5 percent annually (UN-habitat, 2005). This is particularly urgent in slum areas which constitute a big part of many of the cities and towns in Africa. Waste management infrastructure is largely none existent in rural areas of Africa.

Imports of second-hand consumer goods and production or import of substandard products are all contributing to the rapid increase in waste generation. There is growing E-waste stream for which there is no waste management capacity yet. This leads to disposal of both E-waste and Municipal waste in dump sites (Davis and Herat, 2008).

In Ghana, deficiencies in waste management are visible in and around urban areas such as Accra, Tema and Kumasi where equally important competing needs and financial constraints have placed an inordinate strain on the ability of the authorities to implement a proper waste management strategy in tandem with the rapid population growth. Ghana produces 13,000 tons of waste daily, but lacked management infrastructures (Owusu-Sekyere, 2013; Songsore et al., 2009).

Consequently, most of the urban landscape is characterized by open spaces and roadside littered with refuse, drainage channels/gutters choked with waste with open reservoirs which appear to be little more than toxic waste pools, and beaches strewn with plastic garbage. The insidious social and impact of this, is greatest among the poor particularly those living in low income settlements (Un-Habitat, 2010).

The provision of such environmental services had typically been viewed as the responsibility of the central government. However, the costs involved, coupled with the increasing rate of generation due to high urban population growth rates, have made it difficult for collection to keep pace with generation thus posing serious environmental hazards. In Accra, waste haulage alone costs the assembly GH¢ 450,000.00 a month with an extra GH¢ 240,000.00 spent to maintain dump sites (Oteng-Ababio, 2010), while in Kumasi, an average of GH¢ 720,000.00 a month is spent on waste collection and disposal (Owusu-Sekyere, 2013a). The negative practice is also partly responsible for the perennial flooding and the associated severe consequences in most urban areas. The June, 2010 flooding in Accra and Tema for example claimed 14 lives and destroyed properties worth millions of cedis (Mariwah, 2012).

Managing waste is one of the challenges of the 21st century and one key responsibility of a city government. It is said that a city that cannot effectively manage its waste is rarely able to manage more complex services such as health, education or transportation (Baabereyir, 2009).

In the past, waste management particularly in Wa and Ghana as a whole was the sole responsibility of District, Municipal and Metropolitan assemblies. As a result of inefficiency in management of waste by District, Municipal and Metropolitan Assemblies, a private company known as Zoomlion Ghana Ltd was contracted to take charge of waste management in the entire country. The role played by this reputable company as waste experts over the years around the globe cannot be underscored. This company has over eight subsidiaries nationwide (Sousa, 2012; Wan and Clegg, 2010).

Among some of the services rendered by the company ranges from solid waste collection and landfill management to beautification services which include janitorial and indoor cleaning services as well as fabrication and sale of refuse containers. Currently, it has ventured into areas such as agriculture, sale and rental of construction and waste management services. The waste managers of Zoomlion Ghana Ltd have also put up the following measures in dealing with waste in the Municipality; the establishment of Zoom kids sanitation clubs in basic schools in Wa, Public education on environmental sanitation through the use of mass media; group and interpersonal forms of communication; street and drain cleaning and sweeping of pavements in the Central Business District (CDB); and the use of tricycles in the communities and areas prone to indiscriminate waste disposal practices. The company has also intensified its activities to ensure that breeding grounds of mosquitoes are totally eradicated (Wan and Clegg, 2010; Yahaya and Ebenezer, 2012).

The focus of this study is to explore the contribution of Zoomlion Ghana Ltd in domestic waste management in Wa Town. The study will particularly examined how the public-private partnership arrangement between Zoomlion and the Wa municipal assembly is contributing towards domestic waste management in Wa township

1.2 Problem Statement

The daily activities of humans in order to meet their basic needs and nutritional requirements for sustenance generate a lot of unwanted materials in Wa. The amount of waste generated from consumption has been on the increase since the past few years in the City (Monney, Tiimub, and Bagah, 2013; Wan and Clegg, 2010; Yahaya and Ebenezer, 2012). Improving environmental sanitation is known to have significant impact on health both at the household and community levels (Joshi, 2008). About 80% of Out Patients Departments (OPDs) cases in health care facilities in Wa are sanitation related diseases including malaria, cholera and dysentery (Boadi and Kuitunen, 2003).

According to the Ghana News Agency of Saturday, 20th June 2009, the Upper West Region recorded frequent cases of ill health which were mostly related to poor sanitation. Also, statistics on world malaria day reported upper west region (Wa) as topmost with 51 percent (WHO, 2010). According to the Ghana statistical service multiple indicator cluster report, open defecation is prevalent in the ten regions of Ghana with Upper West region scoring nearly 90 percent (UNICEF, 2014).

The proliferation of the use of plastic bags as containers for drinking water and food package as well as the indiscriminate disposal of these materials in the environment is a menace in Wa. Markets, public places and car parks are usually littered with refuse

sometimes with refuse bins in close proximity. In most cases, drains are also clogged or totally blocked by waste. Available evidence suggests that two out of every three households in Wa disposed their liquid waste onto the streets, in uncompleted buildings, backyard, bushes around or in the forest (Puorideme, 2014) . Open dump disposal is a common methods in Wa where refuse dumps are located far from the residence, people dispose their waste indiscriminately. Indiscriminate waste disposal has become a major sanitation problem in the region (Kavaarpuo and Wulifan, 2013; Rabiu, Alhassan, Ejere and Evans, 1996). The few dumpsites at vantage points overflow with uncollected waste and sometimes animals are found feeding on them. Children are found playing and defecating on the refuse dumps bare-footed. Water bodies get polluted giving rise to water borne diseases connected with poor sanitation such as malaria, diarrhea and intestinal worm infections. Several efforts have been made by the Wa Municipal Assembly to ensure that the town is kept clean. The Assembly formulated by-laws and has also engaged the services of a private company (Zoomlion Ghana Ltd) to improve domestic waste management. This company for example ensures that the streets are clean. They also occasionally organize cleanup campaigns where drains, public places, communities and households are cleaned (Oteng-Ababio, 2010; Yahaya and Ebenezer, 2012). They also ensure that, communal container (skips) are not poorly managed with open dumps at unauthorized sites (Puorideme, 2014). Despite these efforts, the waste management problem in Wa still persists.

Available evidence shows that, substantial knowledge exist on causes and effects of poor environmental sanitation as well as efforts by successive governments in domestic waste management through District, Municipal and Metropolitan assemblies (Baabereyir, 2009;

Fei-Baffoe, Nyankson, and Gorkeh-Miah, 2014; Oteng-Ababio, 2010; Songsore et al., 2009). However, there is limited documentary evidence on the contribution of Zoomlion Company in managing domestic waste in Wa. Two studies on Wa focused on solid waste management (Amoah and Kosoe, 2014; Monney et al., 2013) and others explored challenges of privatizing waste management (Puorideme, 2014; Yahaya and Ebenezer, 2012).

Despite government's engagement of the private sector, the problems associated with waste management still persist in Wa. The question often posed is, "*has the engagement of the private sector (Zoomlion Ghana Limited) in domestic waste management provided a better alternative to the public sector waste management we have grappled with for decades"?* This study seeks to fill the research gap in providing information on the contribution of Zoomlion Ghana Ltd in domestic waste management in the Wa as well as documenting basic information on Zoomlion Ghana Limited activities within Wa for other researchers and interested groups.

1.3 Research questions

1.3.1 General Research Question

1. What is the role of Zoomlion Company towards domestic waste management in Wa Town?

1.3.2 Specific Research Questions

1. What are the types/nature of Domestic waste Wa Township?

2. Which programmes have been initiated by Zoomlion to manage domestic waste in Wa Town?

3. What is the collaboration between the Zoomlion Company and the Wa municipal assembly in domestic waste management?
4. What are the gains/achievements made by Zoomlion Company in managing Domestic waste in Wa?
5. What challenges does Zoomlion face in managing Domestic waste in Wa?

1.4 Research objectives

1.4.1 General Research Objective

1. To identify and describe Zoomlion Gh Ltd role and contribution towards domestic waste management in Wa town.

1.4.2 Specific Research Objectives

1. To identify the types of Domestic waste Zoomlion Gh Ltd manages in Wa.
2. To outline and explain programmes introduced by Zoomlion Gh Ltd to manage Domestic waste in Wa.
3. To find out the collaboration between the Zoomlion Gh Ltd and the Wa municipal.
4. To assess the gains/achievements made by Zoomlion Gh Ltd in managing Domestic waste in Wa.
5. To examine the challenges confronting Zoomlion Gh Ltd in Domestic waste management in Wa.
6. To suggest measures to enhance effective Domestic waste management

1.5 Justification of the study

The environmentally friendly means of waste disposal is cardinal to reducing global ecological footprint and improving ecosystem services. Remedies to this situation cannot achieve desirable results without recognizing the non-linear relations that exist among and between the various elements of the bio-system. While institutions in Wa Municipality are attempting to improve the sanitation situation, the behavior of the inhabitants seems to abort the success of these efforts and without behavior change; infrastructure solution will have less success rates. So many researchers have done their parts by researching into various problems of waste disposal and proposed their solutions in Wa (Bowan, 2013; Kavaarpuo and Wulifan, 2013; Monney et al., 2013; Yahaya and Ebenezer, 2012). Yet these solutions do not complete the efforts of these researchers, it is on this basis this study seeks to take a critical look at the role of Zoomlion in managing domestic waste in Wa. This study sought to provide relevant information as an input for designing programmes or activities towards managing domestic waste in Wa.

As the municipality depends on underground water resources to supply potable water for households, a destruction of the physical environment will have serious consequences for water security. Currently water yield is already showing signs of the effects of climates change. With the wetlands in the municipality turned into refuse dumpsites, the consequences of this practice will be immense and a technological solution expensive. This study will provide comprehensive information on components of domestic waste, services provided by Zoomlion Company to household collaboration between the company and the municipal Assembly towards improving household sanitation practices. The study will also

provide information which serves as a basis for further research into issues of managing sanitation as a means of improving health and reducing urban poverty.

In addition, the identified programmes introduced by Zoomlion in domestic waste management will guide policy makers on the approach to be implemented in Ghana for effective and efficient waste management.

Finally the role of Zoomlion in managing domestic waste will outline the capacity needed by relevant institutions for Domestic waste management in Ghana.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 Introduction

Domestic wastes are unavoidable aspects of human activity. They either come from man's daily production activities or as a by- product of the materials mostly consumed by man. The rising quality of life and high rates of resource consumption patterns have had an unintended and negative impact on the environment thus generation of wastes far beyond the capacities of governments and agencies to handle. Cities are now grappling with the problems of high volumes of waste, the costs involved, the disposal technologies and methodologies, and the impact of wastes on the local and global environment is enormous (Baabereyir, 2009; Kavaarpuo and Wulifan, 2013; Oteng-Ababio, 2010).

Though the attempt for interventions to the problem of domestic waste management has been on the global agenda for decades with efforts from governments, international organizations, non-governmental institutions, and scholars across various disciplines, most countries especially developing nations are increasingly saddled with improper domestic waste management. This chapter therefore explores literature on domestic waste management. The review focuses on key concepts, types of Domestic waste, services rendered to inhabitants, equipments used, waste disposal collaborations and problems of waste management. The chapter concludes with key lessons identified from the review.

2.2 Waste

Available evidence on waste maintains that, there is no clear definition of waste. According to Katusiimeh et al,(2012); Baabereyir, (2009) and Oteng-Ababio,(2010) "the term is often left as an undefined, in spite of its critical importance" and "frequently, a list of types of waste is substituted for the underlying definition".

However, Karunasena et al, (2010) and Katusiimeh et al, (2012) provided an elaborate definition of the term waste. According to them, the concept of waste embraces "all unwanted and economically unusable byproducts or residuals at any given place and time, and any other matter that may be discarded accidentally or otherwise into the environment". They further noted that what constitutes waste must "occur in such a volume and concentration as to cause a significant alteration in the environment". Thus, apart from waste being an unwanted substance that is discarded, the amount of it and the impact it makes on the environment also become important considerations in defining waste. Davies et al, (2008) and Baabereyir, (2009) further noted that "what some people consider as waste material or substance is considered a source of value by others. To them, just as a material becomes a resource when it gains use-value, it also becomes waste when it loses its use-value.

2.3 Domestic Waste

In literature, several contributions have been offered to define Domestic waste. Domestic waste is defined as any tangible material that arises from human and animal activity and are often discarded as useless or unwanted (Boadi and Kuitunen, 2003; Ogwueleka, 2009; Yahaya and Ebenezer, 2012). Domestic waste or refuse is generated through human activities (Amoah and Kosoe, 2014; Davis and Herat, 2008; Furedy, 1984). The

management of this waste is often problematic in most of the cities (Davis and Herat, 2008; Demanya, 2007; Pokhrel and Viraraghavan, 2005). Evidence show that, cities and towns have struggled with how to collect and dispose the refuse generated by their populations (Un-Habitat, 2010; Wan and Clegg, 2010). The increasing complexity and costs of waste management are making it difficult for local authorities in many developing countries, to handle the process efficiently and effectively (Obirih-Opareh and Post, 2002; Palmer, 1995; Yahaya and Ebenezer, 2012). Related to this problem is the issue of inadequate funding and poor cost recovery for domestic waste management. Almost all urban, authorities in low/middle income countries have failed to devise effective response mechanisms to mitigate the problem of low cost recovery (Beall, 1997; Mariwah, 2012; Morrissey and Browne, 2004).

In addition, several factors negatively affect contributions to a proper delivery of the service such as the non-enforcement of physical planning and planning regulations, erratic land use policies, administrative bureaucracy, corruption, attitudes of residents towards Domestic waste management, and ineffective supervision and monitoring measures by the local authority as well as residents (Demanya, 2007; Obirih-Opareh and Post, 2002; Oteng-Ababio, 2010; Owusu-Sekyere, 2013). However, the management of domestic waste is one of the challenges facing most urban areas in the world. An aggregation of human settlements has the potential to produce a large amount of solid waste; the collection, transfer and disposal of that waste has been generally assumed by municipal governments in the developed world. The format varies, however in most urban areas garbage is collected either by a government agency or private contractor, and this constitutes a basic and expected government function in the developed world (Monney et

al., 2013; Yahaya and Ebenezer, 2012; Zurbrügg, Drescher, Rytz, Sinha, and Enayetullah, 2005). Domestic waste management continues to be a major challenge in urban areas throughout the world, particularly in the rapidly growing cities and towns of the developing world (Amoah and Kosoe, 2014; Asnani and Zurbrugg, 2007; Pokhrel and Viraraghavan, 2005; Un-Habitat, 2010). In short, domestic waste can be conveniently said to be any tangible material that arises from human or animal activity that has no direct use to human life.

2.4 Types, Sources and Classification of Domestic Waste

Domestic waste is generated from various sources. They are often classified based on various criteria including its source, material composition, physical state, as well as the level of danger it presents (Burnley, 2007; Koroneos and Nanaki, 2012; Pichtel, 2014).

In literature, the material composition of waste is also a commonly used criterion in solid waste classification. With the material composition criteria, waste is commonly classified into plastic, organic, paper and cardboard, glass, ceramics, textiles and metal waste (Burnley, 2007; Christensen, 2011). Tchobanoglous, (1993) in an analysis of household waste streams outlined the major domestic waste classes as paper, plastic film, dense plastics, textiles, miscellaneous combustibles, glass, ferrous metal, garden waste, rubbish and food waste. Koroneos, (2012) and Christensen, (2011), identified five broad categories of domestic wastes to include:

- Biodegradable waste: food and kitchen waste, green waste, paper (can also be recycled).
- Recyclable material: paper, glass, bottles, cans, metals, certain plastics, etc.

- Inert waste: construction and demolition waste, dirt, rocks, debris.
- Composite wastes: waste clothing, Tetra Paks, waste plastics such as toys.
- hazardous waste (also called "household hazardous waste") and toxic waste: medication, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, shoe polish

Prakash et al, (2010) and Pokhrel et al, (2005) also classified domestic as biodegradable or non-biodegradable. Biodegradable waste typically originates from plant or animal sources and can easily be broken down by bacterial action or by other living organisms and so has a relatively short lifespan in the environment. This type of waste is commonly found in municipal solid waste as food waste, yard waste and paper. Other biodegradable waste materials include human excreta, animal droppings, sewage and slaughterhouse waste. In contrast with biodegradable waste, non-biodegradable waste, which includes plastics, metals and ceramics, are waste substances that cannot be broken down by natural processes or living organisms (Womack and Jones, 2010).

In relation to this, Burnley, (2007) and Bauer, (1997) also identified Domestic waste to include combustible and non-combustible solid wastes from residential areas. It contains materials such as food waste (garbage), paper, corrugated cardboard, plastics, textiles, rubber, leather, wood, and yard wastes. The non-combustible (inorganic) part consists of items such as glass, crockery, tins, cans, aluminum, ferrous metals and dirt. A great portion of the residential waste are putrescible, that is wastes which decompose quickly, especially in warm weather or high temperature. These putrescible wastes come from the handling, preparation, cooking and eating of foods. Burnley, (2007) further identified bulky items,

consumer electronics, batteries, oil and tyres as special residential wastes which are collected separately. According to them, bulky items include large worn-out or broken down items such as furniture, lamps, bookcases, filing cabinets, and other similar items. The classification of waste into types, as discussed above, is very relevant for waste management planning. It provides useful information that enables municipal authorities to organize waste management operations including the frequency and means of collection, appropriate collection materials and disposal methods.

2.5 Domestic Waste Management Process

The main components of the Domestic waste management process include generation, storage, collection, transfer/transport, processing and final disposal. It is also important to include handling in this process because until the waste is placed in storage containers, the way it is handled; especially hazardous waste, is important.

2.5.1 Waste Generation

Waste generation comprise those activities in which materials are identified as no longer of any value by the owners/users and either thrown away or gathered for disposal (Momoh and Oladebeye, 2010). The United Nations Environmental Programme (2009) observed that, quantifying and qualifying the types of waste generated is the most fundamental step in solid waste management. Having the necessary information on the amount of Domestic waste generated is an important prerequisite for effective waste management, since without this information the design of mitigating measures will be hampered.

The UNEP (2009) further states that in 2006, the amount of municipal waste (MW) generated globally reached 2.02 billion tones, making for a 7 percent annual increase since 2003. It estimates that between 2007 and 2011, the generation of solid waste globally will rise by 37.3 percent, representing an 8 percent increase per year. Boadi et al, (2003) states that municipal waste represents about 14-20 percent of all waste generated. They further added that, per capita waste generation varies with a high of 5.3kg/day for Organization for Economic Co-operation and Development (OECD) countries to less than 0.8kg/day in low/middle income countries. They believe that ineffective policies, changing lifestyles, lack of awareness, among others will increase the rates over the next decade. Demanya (2007), made similar assertions about waste generation in the two largest cities of Ghana which include Accra and Kumasi.

2.5.2 Handling of Waste

Kreith and Tchobanoglous, (1994) explained waste handling to comprise activities associated with managing wastes until they are placed in the containers used for their storage, before collection or return to recycling centers. The specific activities associated with handling wastes material at the source of generation will vary depending on the types of wastes materials that are separated for reuse and the extent to which these materials are separated from the waste stream, they stated. They also noted that handling may be required to move the loaded waste from the collection centers to the final disposal sites; this however depends on the type of collection services available.

2.5.3 Storage of Waste

Storage refers to the place where the generated solid waste is stored until it is collected, as explained by Kreith and Tchobanoglous, (1994). They believe that the storage of solid waste is affected by factors such as effects of the storage on waste components, type of container, the container location and the contamination of waste components. These factors have a greater bearing on the storage of putrescible materials, which decompose rapidly and so, must be collected quickly.

2.5.4 Collection of Waste

The collection of solid wastes involves gathering of the wastes materials, transport by vehicles after collection to the location where the collection vehicle is emptied (Poulsen et al., 1995). The collection is provided under various management arrangements, ranging from municipal services to franchised private services conducted under various forms of contracts. Some collection methods they identified include communal collection points, kerbside collection and drop-offs.

2.5.5 Separation, Processing and Transformation

This functional element of the solid waste management process according to (Kreith and Tchobanoglous, 1994; Poulsen et al., 1995), involves the recovery of separated materials, the separation and processing of solid wastes components, and the transformation of the solid wastes that occur primarily in locations away from the source of generation. The methods used for recovery of wastes materials that have been separated at source include kerbside collection, drop-off and buy back centers. The separation and processing of these wastes usually occur at recovery centers, transfer stations, combustion facilities, and disposal sites. The wastes components are often separated by size using screens, manual

separation of the waste components and size reduction by shredding, separation of ferrous metals using magnets, volume reduction by compaction and combustion (Kreith and Tchobanoglous, 1994). They also established that transformation processes are used to reduce the volume and weight of wastes requiring disposal and to recover conversion products and energy. The organic fraction of municipal wastes can be transformed by a variety of chemical and biological processes. The most commonly used chemical transformation process is combustion, which is used in conjunction with the recovery of energy in the form of heat. Composting is the most commonly used biological process for solid wastes transformation. They also noted that the selection of a given set of processes would however depend on the waste management objectives to be achieved.

2.5.6 Transport of Waste

Kahn, (2014) identified the transfer and transport of Domestic wastes to comprise two principal steps.

1. The transfer of wastes from the smaller collection vehicle to larger transport equipment, and

2. The subsequent transport of the wastes, usually over long distances, to a processing or disposal site.

The transfer usually takes place at a transfer station. Although motor vehicle transport is most common, transport by rail and barges is also available. For example in San Francisco, the collection vehicles which are relatively small because of the need to manoeuvre in the narrow city streets, haul their loads to a transfer station at the southern boundary of the city. At the transfer station, the wastes are unloaded from the collection vehicles into large

tractor-trailer trucks (Khan, 2014). A similar system of transfer is found in Ghana where tricycles are used to transfer the solid wastes to storage containers, where they are subsequently transported to the disposal sites.

2.5.7 Waste Disposal

The final element in the solid waste management process is disposal. Hjemar, (1996), believed that land filling or land spreading is the final destination of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual wastes from recovery facilities, residue from combustion of solid wastes, compost or other materials. Remigios (2010) and Solomon, (2011), articulated this idea when they argued that landfill would always be needed as a final destination of residue from wastes incineration. It is important to state here that a sanitary landfill is not a 'dump' but an engineered facility used for disposing of solid wastes on land or within the earth's mantle without creating nuisances to public health or safety, such as breeding of rodents and insects, and the contamination of groundwater (Remigios, 2010; Solomon, 2011; Tchobanoglous, 1993). Having examined the functional elements of the Domestic waste management process, the next section will look at the Equipments used/ services rendered in Domestic waste management services in low/middle income countries.

2.6 Services Rendered/Equipments Used in Managing waste in LMICs

Transporting Domestic waste from households and other sites is a growing concern. Rapid urbanization in low/middle income countries leaves little room for adequate layout, planning and management. Many of the most rapidly growing parts of cities are at the periphery of existing settlement. Garbage dumps, with their associated diseases, odour and occasional fires should ideally be properly located (Lee, DEE, and Jones, 1991; Songsore

et al., 2009). Convenient garbage dump sites are becoming scarce to find as population and municipal traffic congestion increases; the transport of waste becomes longer and more time-consuming, and therefore more expensive and less efficient. Many cities employ neighborhood-level collection points, where households are responsible for transport to the transfer point and the municipal or private enterprise transports the waste from there to the ultimate disposal location (Lee et al., 1991; McGranahan and Satterthwaite, 2002; Songsore and McGranahan, 1993, 1998). According to a United Nation Environment Programme report (2009), for most cities in West Africa, up to 70% of collection / transfer vehicles may be out of use at any one time (Diaz et al., 2005).

In areas where there exist collection services which remove waste from individual households and on streets, often there are no standardized containers used to store the waste prior to convey. There may be physical dangers to waste workers in dealing with such situation. Studies propose that, the first step in "sanitary and efficient" waste management must be to ensure that all households use some form of rust/corrosion resistant containers with lids in order to facilitate collection. Lidded containers would exclude most animal pest, reduce the amount of rainfall soakings into garbage and help to reduce trash blowing about on the street (Rotich and Zhao, 2006; Sira, 2012; Thomas-Hope, 1998).

Another major concern is the development of settlements on top of landfills, many shanty-towns and in some cases the entire neighborhood is sited on top of existing landfills. For example, the smoky mountain damp in Manila, Philippines had as many as 10,000-families living in shacks or adjacent to the dump site. Aside the obvious health implications, these concentrations of people further complicate transport and unloading

procedures and present numerous safety and logistical concerns (Durand, 2013; Troschinetz and Mihelcic, 2009). Though it takes only 5-10 seconds to empty a 45-gallon container of waste into a collection truck, it takes 1-2 minutes to shovel the equivalent amount of waste. Any potential change to the waste disposal framework must take into account the urban poor, many of whom may be dependent on waste scavenging for their entire subsistence (Diaz et al., 2005).

Also, the high moisture content and organic composition of wastes in the developing world may lead to problems of increased decomposition rates in areas with high average daily temperatures and hence presenting additional challenges with insect populations and conditions conducive to disease. To mitigate these problems much more frequent collection is needed. Although daily collection has proven unrealizable or unworkable in many cities and towns, perhaps a twice weekly collection of organic materials would be sufficient to reduce decomposition (Ghose, Dikshit, and Sharma, 2006).

It is important to note that municipal domestic waste management (MDWM) involves a combination of activities and services that may include all or most of the following; collection of waste, temporal storage, transportation and storage of the waste as well as waste recycling and by extension, reclamation or reuse, treatment of the waste and disposal. There are a lot of factors that determine how domestic waste should be treated. They include technology, economic, manpower, land space and environment (Chang, Chen, and Wang, 1997; S. Cointreau, 2006; Daskalopoulos, Badr, and Probert, 1998).

The command and control approach to Domestic waste management by waste managing authorities is designed in such a way that, the motivation for agents to comply comes from

fear of fines and penalties. For this disincentive to work, however, absolute vigilance and enforcement capacity must be adequate. Most low/middle income countries lack such capacity and generally, tend to have the problems with their command and control approaches which include; inadequate and detailed law, lack of inspection staff, lack of transport, inadequate empowerment of inspectors to offer fined tickets to offenders, political intervention to quash fined tickets, disinterest by the courts for these minor offences and lack of courts for them, inadequate police coverage to enable arrest and follow-up through the court system, and insignificant and therefore non-deterring fines and penalties (Asnani and Zurbrugg, 2007; Baabereyir, 2009; Jones and Pisa, 2000).

Some common methods of Domestic waste management in low/middle income countries include; Source reduction, sanitary land filling, composting, recycling and incineration.

2.6.1 Source Reduction of Waste

Waste reduction is the reduction of the volume, weight and the toxic level of waste before incinerating, or land filling. There are various methods of reducing waste at source, including waste minimization and re-use. Waste minimization according to Kopicki et al, (1993) is focused at reducing the generation of waste through education and improved production processes rather than targeting technology to improve management. Minimizing the amount of waste produced has the potential of reducing costs or increasing profits by maximizing the use of resources and by reducing the amount of waste to be disposed. Reuse has to do with sorting out materials such as bottles, plastic bags, cardboard and cans for domestic purposes. Reuse plays a very important resource conserving role. It also has a linkage with onsite separation and processing, where materials that are still of economic value are separated. Other materials which can be recycled are also separated for

recycling. Austria, the Netherland, and Denmark, have evolved necessary management processes to efficiently resolve the waste disposal problem by essentially coaxing their citizens to separate their domestic solid waste into glass, paper, plastic categories; thereby enabling easy collection and consequently reuse (Asomani-Boateng and Haight, 1999; Otchere, Sarpong, and Okyere, 2014; Puopiel and Owusu-Ansah, 2014).

2.6.2 Sanitary Landfill

Final disposal of waste at sanitary landfills is given the lowest priority in an integrated waste management approach. A sanitary landfill is a facility designed specifically for the final disposal of waste that minimizes the risks to human health and the environment associated with solid wastes (UNEP, 2003). Sanitary landfills commonly include one, two or three different liners at the bottom and side of the disposal area, in order to prevent leachates from polluting nearby surface waters or aquifers. Liners also prevent the underground movement of methane. Waste arriving at landfills is compacted and then covered with a layer of earth, usually every day. This prevents animals from having access to the organic matter to fill sanitary landfills may also include other pollution-control measures such as collection and treatment of leachate, and venting or flaring of methane. It is possible to produce electricity by burning the methane that landfills generate (Remigios, 2010; Zerbock, 2003).

According to Botkin and Keller (1997), landfills should be designed to concentrate and contain refuse without creating a nuisance or hazard to public health or safety. This means that the waste should be handled with the greatest care. Also hazardous solid waste materials should be land filled separately from non-hazardous materials. Disposing all municipal wastes collected at landfills is not desirable from a social, economic and

environmental point of view, sanitary landfills require significant investments and they often present political obstacles for their construction, due to local opposition. Residents who live near a proposed landfill may oppose its construction.

Sanitary landfills are necessary for final disposal of the waste that could not be prevented, reused, recycled or composted. Ideally, sanitary landfills should be used primarily for non-reusable, non-recyclable and non-compostable residues. Sanitary landfills constitute a dramatic improvement over disposal of wastes in open dumps. Sanitary landfills greatly reduce pollution and risks to human health and the environment compared to open dumping (Bauer and Herrmann, 1997; Solomon, 2011).

In an examination of landfills throughout the low/middle income countries in 1997-1998,(Johannessen and Boyer, 1999), found varying amounts of planning and engineering in MDWM dumping; among the various regions visited, African nations (with the exception of South Africa) had the fewest engineered landfills, with most nation practicing open dumping for waste disposal; waste managers in Asian and Latin American nations were more likely to be aware of environmental effects of improper landfill design and were much more likely to design and implement some control measures, however limited in scope. Sanitary landfills, on the other hand, are sites where waste is allowed to decompose into biologically and chemically inert materials in a setting isolated from the environment. Cointreau, (1982) outlined four features that must be present in order for a landfill to be considered sanitary. They include;

- ✓ Full or partial hydro geological isolation through the use of lines to prevent leachate infiltration into the soil and groundwater; collection and treatment infrastructure should be used where leachate is expected to be generated.

- ✓ Formal engineering preparations with an examination of geological and hydrological features and related environmental impact analysis, waste tipping plan and final site restoration plan.

- ✓ Permanent control, with trained and equipped staff to supervise construction and use.

- ✓ Planned waste employment and covering with waste and soil placed in compacted cover to reduce water infiltration, odors and pests.

Other practical and social considerations must be addressed when planning landfills, especially in the context of developing nations and their problems. One of the most important is the siting of landfills in proximity to urban areas. Nationally, there are few people who would be excited by having landfills in their backyard; however, it is important to realize that landfills must be located within reasonable distance to population concentrations along a good road system. If they are located too far from collection points and transfer stations, waste transport could become very expensive due to the distance the waste is transported. More so, if the site is located far from the urban area, without regard to the ability of the government or institutions responsible for waste management to transport waste with its limited finances, scattered unregulated indiscriminate dumping will become financially attractive once again (Cointreau, 1982; D. Khan and Samadder, 2014; Remigios, 2010; Solomon, 2011; Zerbock, 2003).

Furthermore, landfills are one form of Domestic waste management that nobody wants but everybody needs (Dagadu and Nunoo, 2011; Kreith and Tchobanoglous, 1994). According to them, there are simply no combinations of waste management techniques that do not require landfilling to make them work. Of the basic management options of Domestic waste, landfills are the only management technique that is both necessary and sufficient. According to Kreith (1994) some wastes are simply not recyclable, many recyclable wastes eventually reach a point where their intrinsic value is completely dissipated and they no longer can be recovered, and recycling itself produces residuals. He further highlighted that the technology and operation of modern landfill can assure the protection of human health and the environment.

In contrast to what the various authors have said about sanitary landfill as an option for waste management, they have failed to recognize that land fill in itself has some disadvantages as it is costly to construct, maintain, can pollute ground water through leaching and location is a problem in terms of availability of land particularly in the cities. Other critical factors such as gas recovery, composting, waste to energy recovery, storm water control, distance to any settlement and water body were not clearly spelt out by the authors. Therefore, there could be an alternative which is recycling (Puopiel and Owusu-Ansah, 2014; Wan and Clegg, 2010).

2.6.3 Composting

According to Thompson, (2012) composting is the process of turning organic household waste into fertilizer through aerobic fermentation thereby allowing it to decay and become a usable product. This fertilizer can be used in lawns, parks, and gardens. Composting is a minimally used form of waste disposal in Accra and does not contribute to the danger of

food pollution. Of the 1,250 tons of garbage collected per day, about 10-15% is composted (Drechsel, Gyiele, Kunze, and Cofie, 2001) cited by Thompson, 2012). Also Botkin and Keller, (1997); Fang et al, (1999) say, composting is a process or a rapid and partial decomposition of moist, solid or organic waste, by aerobic organisms.

There are many advantages to composting. First and foremost, it would reduce, in some cases significantly, the amount of waste requiring ultimate disposal, and therefore extending the life of landfills. When done correctly, the end result becomes a useful product, capable of being used at the household or farm level to augment soil nutrient levels and increase organic matter in the soil, increasing soil stability (Thompson, 2012; UNEP, 2009).

Environmentally, the process by which composting decomposes organic waste is preferable to landfill processes; in a landfill, bacteria break down organics anaerobically in the absence of oxygen, resulting in the aforementioned releases of methane gas. When properly composted, however, the organic matter is decomposed using an aerobic process, which produces no methane by-product (Pandyaswargo and Premakumara, 2014; Pathak, Singh, and Kumar, 2011; Taiwo, 2011; Zerbock, 2003).

There are three scales at which compositing has been implemental at the residential level, the decentralized community level, and the centralized large-scale (municipality-wide) level. The larger the undertaking, the more capital investment is required. Most developing countries which have found success with composting have found it works best when implemented at the household level, with some projects doing well at the community level as well. At the municipal level, certainly overall cost and functionality are the primary

reason for the success of a given process; the financial commitment required, as well as the effort required to maintain equipment sufficiently to keep a large scale operation running, has resulted in widespread failures; including India (9 of 11 plants closed between 1974 and 1996) Brazil (Only 18 of 54 facilities operating in 1990, and elsewhere (Botkin and Keller, 1997; Dadi, Sulaiman, and Leta, 2013; Thompson, 2012).

Dadi et al, (2013) also documented neighborhood-level composting in some areas. It has been successful in several cases. In Jakarta in 1990, a community composting project was quite successful, owing to government help (providing rent-free land to establish the site), extensive worker and community education, and establishing a distributor for the final product long before construction began. In 1997, however the project lost its main distribution and now the facility is only able to run at half capacity. In Brazil, some communities are able to operate medium-size community operations where municipal projects have failed (Gotaas, 1956; Zurbrügg et al., 2005).

Household-level composting has the greatest potential for success in many areas, especially those sited where small scale agriculture is found in great abundance close to urban areas, where limited gardens are found within the city itself. The key is to find a useful destination for the final product, either by selling to neighborhood farmers / gardeners or on the household's own plots (Botkin and Keller, 1997; Dadi et al., 2013; Haug, 1993; Thompson, 2012).

2.6.4 Incineration

The Centre for Environment and Development (2003: 9) cited by Puopiel, (2010) defined incineration as a controlled combustion process for burning combustible waste to gases

and reducing it to a residue of non-combustible ingredients. According to the Centre, during incineration, moisture in the solid waste gets vaporized and the combustible portion gets oxidized and vaporized. Carbon dioxide, water vapour, ash and non-combustible residue are the end products of incineration. Incineration reduces solid wastes 90% by volume and 75% by weight (Wang, Chiang, Lin, Tsai, and Sun, 1999). Incineration is a veritable way of energy recovery, where the heat generated from the burning of waste is used for example heating swimming pools. Incineration however needs to be supported by land filling since there will always be residue after the process (Wang et al., 1999).

Arguing in line with this, other evidence has it that, Incineration should not be considered a disposal option, since following incineration there is still some quantity of ash to be disposed of (probably in a landfill), as well as the dispersal of some ash and constituent chemicals into the atmosphere. It should instead be considered more in terms of its waste-reduction potential, which can be 80-90% in terms of waste volume. (Hjelmar, 1996; Vogg, Metzger and Stieglitz, 1987). Additionally, specific technical expertise and related general repair and maintenance technology are often absent in developing nation scenarios. High costs and environmental problems have led to incinerates being shut down in many cities including Buenos Aires, Mexico City, Sao Paolo and New Delhi.

Incineration seems at present a promising option for few countries; however small island nations are perhaps a category where such technology may be practical. With their smaller land mass, island nations often have less land available to them for land filling, and even in the event land is available, environmental considerations may not reveal these sites to be viable options. Being surrounded by open water increases the attractiveness of ocean dumping. Most developed nations have abandoned this practice out of environmental

concerns; however environmental regulations may not outlaw this practice in some poorer nations. Reduction by incineration, along with sanitary disposal of the residue, would therefore be a useful alternative to traditional disposal methods, and have proven useful in nations such as Bermuda and the British Virgins Islands (Sabbas et al., 2003).

According to Brunner, (1993) negative environmental consequences of incineration mostly revolve around air born emissions. Certainly, incinerators should not be located where prevailing wind patterns would carry emissions over densely settled areas. Incineration volatilizes many compounds potentially harmful to human health. They include; metals (especially lead and mercury), organics (dioxins), acid gases (sulfur dioxide and hydrogen chloride), nitrogen oxides as well as carbon monoxide and dust (C. R. (Incinerator C. I. Brunner, 1993).

2.6.5 Recycling

Puopiel (2010); Kreith (1994) and Poulsen et al, (1995) believe that recycling is the most profitable and double of all waste management options. The benefits of recycling does not lie solely in diversion of waste away from disposal but, even more importantly, in the reduction of the amount of virgin resources that need to be harvested and processed for the manufacture of new products. Recycling though looks promising and a creative way of reducing the proportion of waste that makes its way to the final disposal sites, it remains an option which has not been explored to a higher degree in Ghana. Since only a few materials are salvaged (which sometimes occur at the disposal sites) by scavengers, leaving the great volumes into the waste stream (Kopicki, Berg, and Legg, 1993; Poulsen et al., 1995b).

According to Martin et al, (2006) more recycling, reuse and composting in the future might be done at source, in the home. Some countries have national policies to encourage this: elsewhere NGOs are active, for example the use of national solid waste management association and the British Land Reclamation Group (REGRO). Waste recovery and waste recycling or reuse are terms that can lead to misunderstanding: one country might recover 80 percent of its waste paper but recycle or reuse non; another may recover only 10 percent but recycle or reuse most of it. This is because once waste is recovered, there is the problem of sorting, transporting and accumulating different components (Barrow, 2014; Martin, Williams, and Clark, 2006).

On the local or regional level, waste reduction can be accomplished through the increased use of source separation and subsequent materials recovery and recycling. Separating waste materials at the household level occurs to some extent almost universally, and prevent the most valuable and reusable materials from being discarded. Following human retention of valuable materials, waste-pickers currently remove most valuable materials, either the garbage enters the waste stream or on rout, especially in the lower and middle income areas of many municipalities. In these instances, there is little need for additional encouragement of recycling. Even in the more affluent areas of developing cities, often there are found itinerant “buyers” of waste materials such as cardboard and glass. These buyers will help to direct many materials out of the waste stream, and illustrate a key point (Wilson, Velis, and Cheeseman, 2006).

If recycling materials is a viable undertaking, small enterprises have been and will continue to spring up whenever there is an opportunity; in fact the theft of source- separated recyclable materials has been documented in many pilot schemes in both developed and

developing nations. Zerbock, (2003) has it that by allowing small enterprises to address the problems, valuable funds are saved, jobs are created, and landfill space is saved. Some improvement in these traditional systems is clearly desirable, however. Foremost are worker health concerns. Waste pickers are highly susceptible to disease and it has been proposed to provide low-cost productive working gears, such as gloves, boots, and clothing, to prevent contact injuries and reduce pathogens. Experience in Calcutta, India however, has shown that most gear is simply sold by the workers for cash, and they continued to work as before. In areas where recycling and waste diversion is not as spontaneous, municipally sponsored separation and collection may be needed. To be effective, policies need to be implemented on both the national and local levels. For examples, consumer education, or the incorporation of Municipal waste (MW) issues in school curriculum, would be highly desirable. Recycling will also reduce the volume of waste to be handled, hence, the pressure on disposal systems (Barrow, 2014; Yedla and Park, 2009)

2.7 Private Sector Collaboration in Domestic Waste Management in LMICs

In low/ middle income countries, the private sector is increasingly seen as a key participant in the full range of urban waste management activities, including collection, transportation treatment, processing, separate collection, recycling, composting, and disposal of waste (Ogu, 2000).

According to Sandra Cointreau−Levine (1994), there are three important collaborative roles for the private sector in Domestic waste management. First, where existing public service delivery is either too costly or inadequate, the private sector participation offers a means of enhancing efficiency and lowering costs through the introduction of commercial

principles and greater attention to customer satisfaction. Second, in situations where local public funds for investment are in continually short supply, the private sector may be able to mobilize needed investment funds. Third, the private sector is well situated to draw on local and international experience in the Domestic waste management field and introduce proven and cost effective technologies along with management expertise. Field studies conducted by the World Bank and others tend to substantiate these claims that, the private delivery of domestic waste services can be successful in terms of greater efficiency, coverage and quality of service. Keys to successful private sector involvement in municipal waste management include creating contestable markets, establishing an appropriate regulatory framework and operations standards for contractors, and strengthening local government capacity to negotiate contracts and monitor performance. In the simplest terms, the focus must be on competition, transparency, and accountability (Bartone, Leite, Triche, and Schertenleib, 1991). Since the 1980s there has been a trend towards decentralization and privatization of the waste management operations in many cities in Africa and India by engaging in Public-Private participation (PPP) Oteng-Ababio, (2010). This private-sector participation trend is in line with the resurgence of market-oriented prescriptions globally and has been implemented to fit with Structural Adjustment Programmes and the related Economic Recovery Programmes adopted by many governments in low/middle income countries. More recently (during the 1990s and presently) civic/ community engagement and stakeholder participation have been added as themes to the debate on waste management. (Kaseva and Mbuligwe, 2005; Oteng-Ababio, 2010). According to Hofny-Collins, (2006), evidence is mounting that a decentralized integrated approach, integrating the efforts of the private sector, scavengers

and local communities, holds promise of making a considerable contribution towards urban solid waste management. Current thinking in waste management incorporates principles to include; Privatization, Decentralization, Community involvement, Participation of different stakeholders, Appropriate cost-effective technology options, (many of which invariably are small-scale), Involvement of people already familiar with waste handling, i.e. build on existing systems and Plurality of approaches.

2.8 Private Sector Collaboration in Domestic Waste Management in Ghana

The high population and its associated increase in urbanization and economic activities in Ghana especially Accra, has made the impact of the society's waste very noticeable. The urban areas of Accra produce about 760,000 tons of municipal waste (MW) per year at approximately 200 metric tons per day EPA, (2002). The Accra Metropolitan Assembly spends about two billion cedis per month (about $227, 000) on waste collection and about 12 billion cedis per year on urban solid waste management. This amount does not however, cater for about 30 per cent of domestic waste in the metropolis (Fei-Baffoe et al., 2014; Fobil, Armah, Hogarh, and Carboo, 2008). Johannessen and Boyer (1999) observed that the design and optimization of domestic waste management technologies and practices that aim at maximizing the yield of valuable products from waste, as well as minimizing the environmental effects have had little or no consideration in the African continent. They also observed that at the national and municipal levels, Ghana has not taken steps to construct, operate, or maintain sanitary landfills. It is under the World Banks urban environmental sanitation project that Ghana developed plans to build its first sanitary landfills in Accra, Kumasi and Takoradi all in Ghana. The inadequate information on quantification and characterization of waste; health, social, economic and environmental

impact of municipal waste management is a common occurrence in Ghana especially in the Wa town. The problem is mostly compounded by insufficient funding. The waste management system so far in Ghana has not properly integrated other solutions as collection treatment, and supply for re-use, reprocessing and final disposal. The system has provided enough room to adapt to future pressures (increase in waste quantities and composition). It is also pertinent in Ghana where waste management services are largely inefficient and ineffective. It is estimated that about 83% of the population dump their refuse in either authorized or unauthorized sites in their neighborhood, and due to weak capacity to handle domestic waste, unsanitary conditions are created. Although these weaknesses have been attributed to lack of logistics and financial management, people's attitude towards waste management should not be ignored. Several factors account for the massive buildup of urban garbage and waste (Boadi and Kuitunen, 2003; Sandra Cointreau−Levine, 1994).

According to Damanya, (2007) and Owusu-Sekyere, (2013), filth had engulfed the central Kumasi in the Ashanti Region. It further stated that, they openly sold foodstuffs and their wares in the middle of the road and on the pavements in the midst of the filth which they themselves generated. With this situation, one always wondered why there was so much indiscipline at the city center of the Kumasi metropolis, especially at the precincts of the central market, and whose responsibility it was to ensure sanity at the place as the Kumasi Metropolitan Assembly (KMA), looked on helpless.

The coalition of NGOs in the water and sanitation sector (CONIWAS) organized a sanitation forum on September 18, 2008 in Wa in the Upper West region. Lance Bayuor, the regional environmental officer clearly stated that environmental sanitation had become

a crisis not only in the upper west region but Ghana as a whole. Poor physical planning, inadequate financing, bad personal attitudes towards sanitation were some of the factors leading to poor sanitation. He went forward to add that environmental health and domestic waste management were the biggest problems of most Assemblies especially the densely populated district capitals. Waste management involves costly activities which require the provision of sanitary infrastructure, tools, equipments and capacity development. All these cannot be provided by the District Assemblies alone to ensure improved sustained sanitation services. There is therefore no wonder that our towns, communities and villages are engulfed with waste. According to the UN Human Development Report, Only 18% of Ghanaians have access to safe toilet facilities as at 2006. Improved sanitation facilities and practices can also reduce acute respiratory infections by 50%. Sanitation is therefore a vital component of the health of the people and an important factor in economic development. Lance Bayuor finally observed that the Environmental Health Directorate has been working in collaboration with Zoomlion Company, Coalition of Waste and Sanitation Agencies (CWAS), PRONET, Ghana Health service, Plan Ghana, Town and country planning Department, Chiefs and traders to ensure clean environment to prevent avoidable diseases.

2.9 Zoomlion Programmes aimed at Managing Domestic Waste in Ghana

Zoomlion was founded in 1992 as Changsha Hi-tech Development Agency, a Chinese manufacturer of construction machinery and sanitation equipment. It became Zoomlion construction mechanical industry Cointreau (2006). Globally, Zoomlion as a waste expert over the years cannot be estimated. This company has rendered services ranging from domestic waste collection and landfill management, landscaping to beautification services.

In pursuance of excellence in proper waste management and sanitation, the Zoomlion Company is currently collaborating with international waste management companies in South Africa and Germany for technical know-how and capacity building. Also, China is partnered for modern equipment as well as Denmark for research into biogas (Weiland, 2009).

The Zoomlion Company also operates in other African countries such as Togo, Angola and Guinea while negotiations are far advanced for the company to start operations in Nigeria, Sierra Leone. In its passion to pursue excellence in the industry, Zoomlion Ghana Limited has exchanged ideas with international waste management companies like TEDCOR (PTY) Limited of South Africa. This is a south-south arrangement for technical cooperation and capacity building and training exposure for delivering quality and affordable solutions based on technical innovations. Staffs of Zoomlion have also had the opportunity of exchanging ideas with personnel from experience waste management companies like Waste management Phambiland, and South Africa (Dagadu and Nunoo, 2011).

In 2006, The Ghana government contracted the services of Zoomlion Company to augment the efforts of metropolitan, municipal and district assemblies across the country to ensure quality and proper collection and disposal of waste and general environmental cleanliness. The need to invite a private company was prompted by the fact that municipal Assemblies have not been able to manage the waste generated efficiently over the years due to obvious reasons (Otchere et al., 2014).

Zoomlion Company is a giant in the domestic waste management as well as environmental sanitation business in Ghana and Africa as a whole. Starting in 2006 as Zoomlion Company with a few members of staff, Zoomlion has now grown over the past four years to about 2,800 core staff and 65,000 workers under various forms of public-private partnership. The company has hired and continues to hire the requisite expertise and competent personnel both home and abroad at all levels, and the management boasts of some of the most experienced professionals in waste management. In addition, Zoomlion staffs are highly motivated and well-trained to meet the growing local and international challenges of its industry. The company has been able to practice cleanliness in this country to an appreciable level. It has created various squads to address environmental challenges from various angles; the eco-brigade, mosquito control, a forestation, sanitation guides, the bola and tricycle teams. One distinguishing feature about Zoomlion is the employment of over 65,000 citizens of the labour force of Ghana that is bringing economic sanity into the country (Obirih-Opareh and Post, 2002). The vision statement of the company is to champion the cause of clean and environmentally healthy communities in Ghana and throughout Africa.

2.10 Zoomlion Collaboration in Domestic Waste Management in the Wa.

Privatization of Services is emerging as an option open to all Municipal Assemblies. The Privatization concepts (concession, contracting, franchise, open competition) and their management require that training be offered to Municipal Administrators, civil and sanitary engineers, as well as private sector actors. Health inspectors and environmental health technicians will all require re-training to be able to meet new roles. Zoomlion Company participation in waste management services delivery should be looked at as a

means of enhancing cost-effectiveness and mobilizing the best resources in the waste management sector. Zoomlion, a private company engaged in the management of solid waste throughout Ghana and even beyond, has been involved in the management of solid waste in the Wa Municipality. Some of the company's aims in managing the waste are;

- ✓ The mobilization of more equipment for improved service delivery which otherwise is a problem to the Municipality.
- ✓ Improve service quality and reduce cost which will finally increase the revenue for the municipality.
- ✓ To ensure a completely cleared environment for the people of the Wa Municipality.
- ✓ The above statements have a direct link with the public health service statement of the United States Disease control and prevention division (Prevention, 2001), which identified 22 human diseases that can be associated with poor domestic wastes management. The diseases include typhoid fever, cholera, dysentery, various diarrhoeas, anthrax, tuberculosis, trachoma, plague, muuire, leptospirosis, rabies rickettsia pox, malaria, yellow fever, dengue, encephalitis, and trichinosis among others (Keusch et al., 2006).
- ✓ Like any other private company, the operation of this company started in the later part of 2007 in Wa. Zoomlion has over eight subsidiaries and 7000 projects nationwide. It had contract with the Wa Municipal Assembly which was to ensure a complete cleanliness of the municipality streets and also to lift some refuse containers at their points of collection. Available evidence showed that, the

municipality has not been zoned but it has 50 collection points with shared responsibility between Zoomlion and the Municipal Assembly. 38 out of the 50 containers were being managed by Zoomlion whilst the Wa Municipal Assembly takes control of the remaining 22. Interestingly, because of the griming managerial problems that bedeviled the Wa Municipality in terms of domestic waste management, Zoomlion has extended its contract by lifting and dumping all the containers at the collection sites in the Wa municipality. The system of collection, which is being adopted by the company, includes container lifting, tricycle collection and sweeping of the principal streets of the Municipality in the early hours of each day.

Studies have shown that Wa Municipality is the fastest growing urban center in the Upper West Region, with a growth rate of 2.8 %.The Municipality has a population of 107,214 (Ghana Statistical Service, 2012). The result of this is the generation of various kinds of waste. This is evidenced from the heap of materials found around various car parks, market centers and residential areas.

The Ministry of Local Government and Rural Development (1999) notes that all waste, deposited in the public domain shall be the property of the Metropolitan /Municipal / District Assembly and the Assembly may also direct generators of waste to dispose of or surrender such waste to the District Assembly at places approved by the District Assembly. This is to ensure a clean environment and also to prevent hazards associated with improper disposal of waste. In this case, after collecting the waste, the dumping site is located at Siiriyiri about 5km from Wa. Also, available information shows that, the constituents of the waste are mostly sand, ashes, plastics, outdated newspapers and garbage from dining

tables among others. With the higher percentage being sand and ashes which reflect the high poverty level of the indigenes that still use charcoal and fuel wood as their sources of cooking. According to the 2010 Population and Housing Census reports, wood is the main source of cooking fuel in the region (79.8%), with charcoal being (16.5%).

2.11 Gains in Public-Private Participation in Domestic Waste Management

Effective Domestic waste management is necessary to ensure better human health and safety. The Environment must be safe and accommodating to the public by preventing the spread of diseases. Also a good waste management system must be economically sustainable (Ogu, 2000). Available information indicates that PPP can help mobilize resources, reduce risk, reduces per unit cost of service delivery, improve efficiency and effectiveness, contribute to economies of scale and influence service delivery in the medium to long term (Fobil et al., 2008).

In a Ugandan study of PPP in waste management in Kampala City Center, the data showed that, the private sector is appreciated compared to their public sector counterpart (Katusiimeh et al, 2012). The study explained that, most senior officers initially declined in to embrace the PPP idea arguing that, private firms lacked the necessary human skill, technical and financial resources to provide better services compared to the public sector. While this could be true, results from the interview revealed that, public officials sabotaged in the company activities through irregular and delayed payments to the company for services rendered compelled it to quit the contract.

In a related study in Ghana the PPP in Domestic waste management in Accra revealed an overall improvement of 25% on waste collection rate by the private firms that were

engaged. The public sector by show of commitment earmarked the operation of a public dump-site which is exclusive preserved for public use and offers a potential for the PPP activities even in the near future (Oteng-Ababio, 2010). The study further underscores that, efficient and sustainable domestic waste management requires proper treatment and handling of the final disposal site. With this background, it calls for strengthening of the collaboration between the firms and the councils which will coordinate and establish uniform infrastructures for domestic waste management in Cities. The results from a survey in Tanzania posits that, as a result of privatizing domestic waste collection in the City of Dar es Salam, waste collection improved from 10% in 1994 to an average of 40% of the daily generated domestic waste in 2001 (Kaseva and Mbuligwe, 2005).

Similar successes have also been reported in Benin, Nigeria and in Calcutta, India where the private sector is in charge of more than 40% of the domestic waste generated (Ogu, 2000; Kaseva and Mbuligwe, 2005). According to them, when the private sector Private engages in waste management, they have higher operating efficiency because, firstly they are free from bureaucratic hurdles and the upkeep of their equipment is excellent. Good condition of vehicles and equipment ensures not only trouble-free operation but also results in higher output and profitability. The private sector according to literature is endowed with good qualities such as political independence, economic rationality, efficiency, dynamism and innovation and other qualities which make it measure up favorably to public sector (Katusiimeh et al, 2012; Mariwah, 2012).

2.12 Challenges Confronting Authorities in Domestic Waste Management

The management of Domestic waste has proven to be a herculean task for many towns and cities in developing countries. This is evidenced by the large number of uncontrolled

dumps, gutters choked with garbage to various degrees and the irregular collection of waste among many others. In most of these low/middle income countries, the privatization of waste management services is often seen as the only viable option, and potentially offers higher quality of service at competitive prices, allowing the government sector to focus on the roles of monitoring and enforcement of services (Zhang, Tan, and Gersberg, 2010).

Despite the importance of adequate Domestic waste management to the urban environment, the performance of many city authorities in this respect leaves much to be desired. According to Zhang et al, (2010), irregular services rendered to producers of refuse by municipal councils compel them to find alternative ways in disposing of refuse. They observed that the main methods adopted by the waste producers are burning, burying, or indiscriminate dumping. This is very common in Ghana where waste management services are largely inefficient and ineffective. It is estimated that about 83% of the population dump their refuse in either authorized or unauthorized sites in their neighborhood, and due to weak capacity to handle solid waste, unsanitary conditions are created (Karunasena, Amaratunga, and Haigh, 2010; Songsore and McGranahan, 1993).

Although these weaknesses have been attributed to lack of logistics and financial management, people's attitudes towards waste management should not be ignored (Boadi and Kuitunen, (2003). Boadi maintained, indiscriminate disposal contributes to the huge buildup of urban garbage and waste. Boadi further noted that, this resulted from inadequate and deficient infrastructure, for environmental administration, lopsided planning pastures and disregard for basic aesthetics, industrial and commercial growth, and other human factors. According to Ogu, (2000), urban wastes in Nigeria are regarded as "non-resources" having at best a nuisance value and therefore not surprising that an equally

negative posture has been adopted in managing wastes from urban concentrations in the country.

Ogwueleka, (2009), stated that the management of household refuse is tied to perceptions and socio-cultural practices which result in modes of appropriation of space which are greatly differenced according to whether the space is private or public. This is relevant to the study, because the area has diverse socio-cultural practices, as the population is heterogeneous. To Momoh and Oladebeye, (2010), the main cause of the problem of Nigerian city's poor environmental condition can be ascribed to improper management of domestic wastes and the lack of seriousness in the enforcement of solid waste disposal code. This is very pertinent in Ghana where the enforcement of the waste disposal code is not effective at the local levels. Post, (1999), in an article entitled, "*The Problems and Potentials of Privatizing Solid Waste Management in Kumasi, Ghana"* identified the main problem facing Ghana as the lack of suitable sites for disposal of solid waste, of which we attribute to the failure of social and economic development to keep pace with the natural population increase and rural-urban migration. He further observed that, residential domestic waste forms the bulk of all sources of solid waste produced in urban areas. These household wastes are known to have high densities with high moisture content and the organic component of solid wastes, which properly accounts for about 70% to 90%, while tins, cans and paper are probably responsible for about 5% to 10% of the total waste produced. He stressed on the argument that, because the capacity to handle all of the household waste generated is still weak, about 83% of the population dump refuse in either authorized or unauthorized sites in their neighborhood which creates unsanitary conditions. They also argued that insufficient communal facilities can lead to open defecation along

beaches, drains, and open spaces and the tendency for faecal materials to become intermixed with household refuse.

This view expressed by Post (1999), is relevant to the study because areas like Wapaani, Zongo, Dondoli, Nayiri, Tamaranuni, Suuriyiri, Fongo and Kabanye are densely populated. They are also not served with adequate sanitary facilities. These inadequacies lead to indiscriminate open defecation and disposal of refuse into drains, gutters, and waterways. He proposed the involvement of local groups in domestic waste management side by side the operations of governmental agencies.

2.13 Conceptual Framework

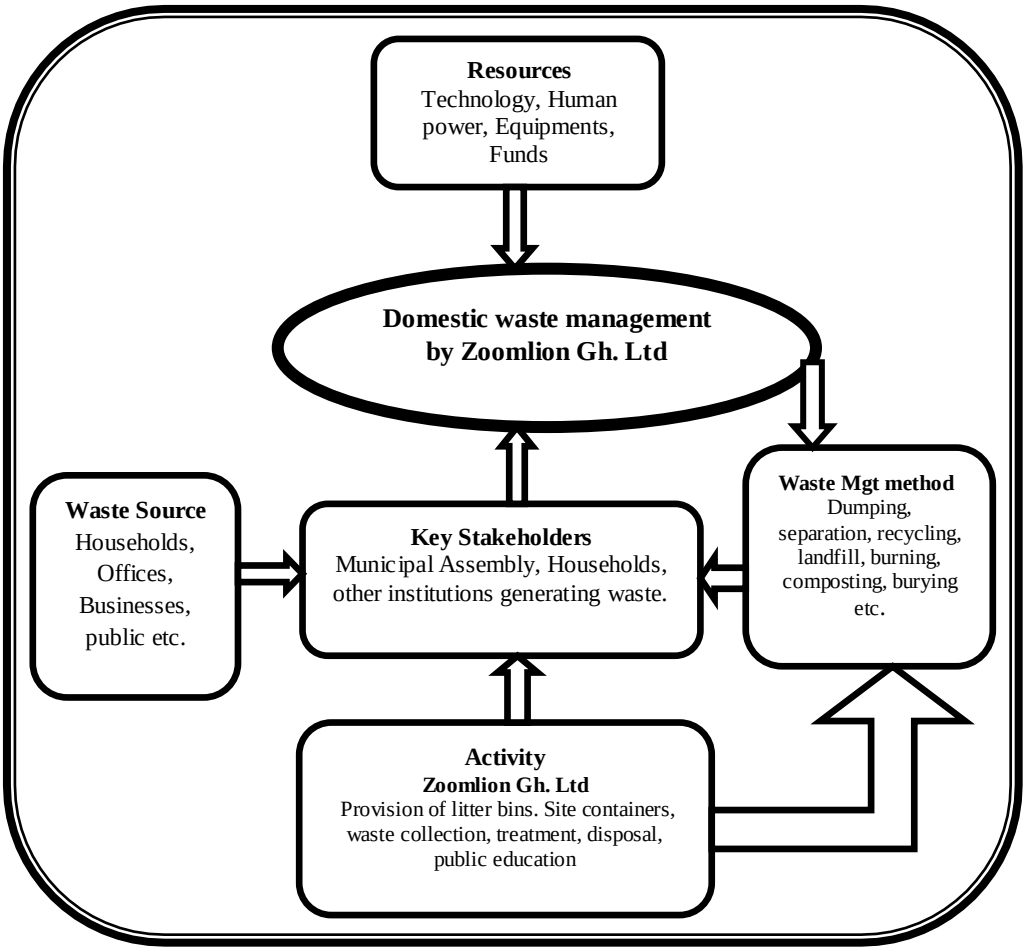
From the review, it has been identified that Domestic waste management is not an isolated, municipal problem that has to be managed by the local government. There is a need for varied measures, which will take into account integrating domestic waste management into a broader framework of environmental management.

The conceptual issues that will be tackled include the availability of domestic waste management facilities, the collection, disposal of domestic waste, the capacity of the institutions responsible for domestic waste management and the sources or funds for domestic waste management, public education and sensitization on effective domestic waste management. In relation to resources availability, quantities will be needed to ascertain adequacy, since they all influence domestic waste management.

The waste management methods that will guide this study include; dumping, composting, recycling, incineration, and sanitary landfill, as pertains in integrated waste management which is often considered the most appropriate way of managing domestic waste.

This framework which guided this study is suitable for sustainable waste management in an appropriate form for studying not only the effects of the various sectors but also the role of agencies in managing waste and the implications for sustainable environment.

Figure 1: Conceptual Framework for the Study



Source: Author's Construct, 2015

Source: Author's construct, 2014

2.14 Issues arising from studies reviewed

From the studies reviewed, domestic waste collection and disposal are very essential in domestic waste management. In many low/middle income countries landfills are commonly used for final waste disposal. There are two main methods of solid waste collection system, namely door-to-door and communal. Provision of waste collection facilities, frequency of waste collection, and equipment for managing domestic waste is very important for effective and efficient waste management.

Provision of waste containers, waste equipment, resources availability, community participation and education on need for cleanliness are equally vital for domestic waste management. Others are capacity for managing solid waste (resources), methods used (source separation, recycling, and landfill) and the role stakeholders (NGOs, Waste Management Institutions and households) play in managing solid waste. It is important to recognize that, the major portion of waste comes from domestic sources. It is equally important to note that; efficient and effective waste disposal depends largely on availability of waste containers and dustbins and attitudes of the people. The waste that is disposed from households has to be collected and transported for final disposal. The collection and transportation and management of landfills depend heavily on resources. Based on this framework, sustainable waste management therefore can be achieved with the active involvement of all relevant stakeholders in the collection and disposal of domestic waste in the Wa. Adequate government attention and proper allocation of waste management resources is very paramount.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

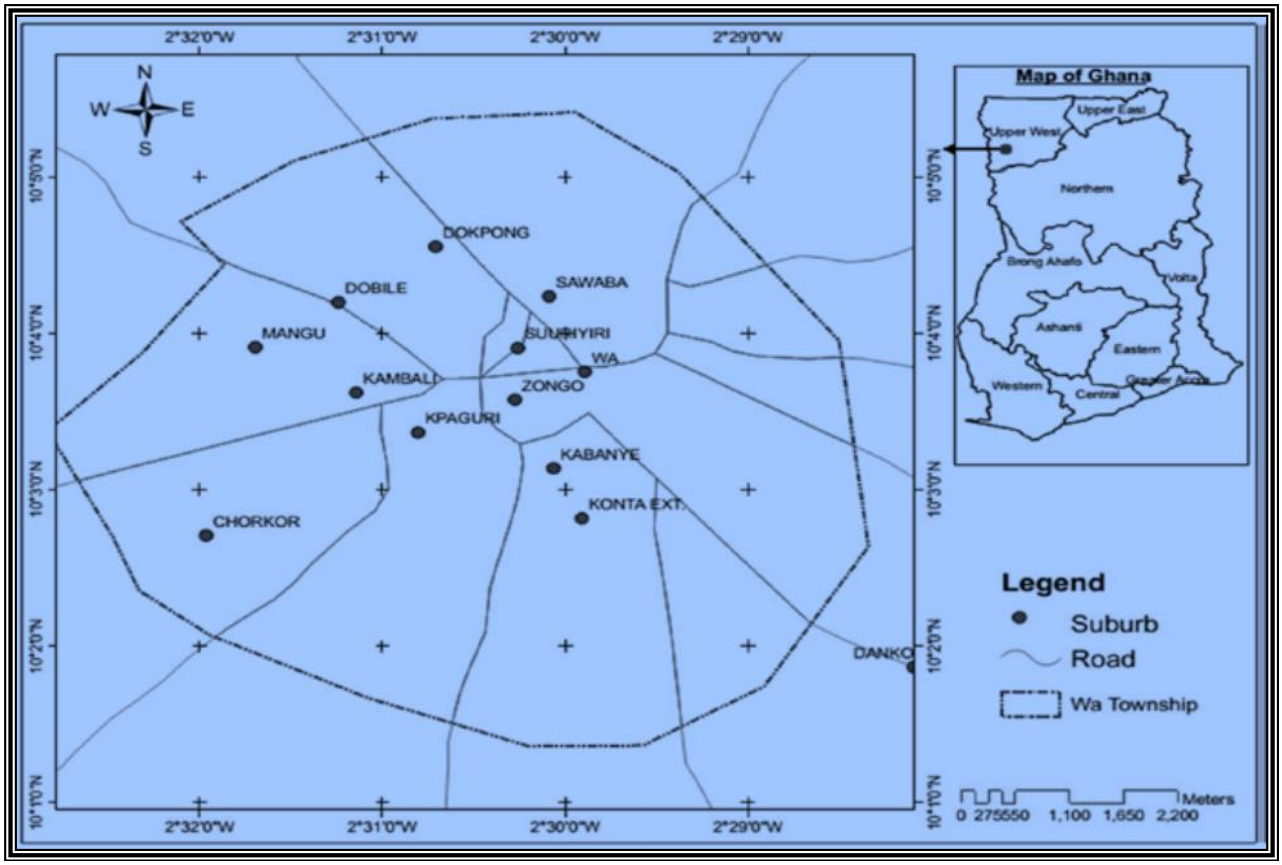
The studies reviewed revealed key issues that are relevant to the design and collection of data for the study. These issues are: the availability of domestic waste management facilities, the collection, disposal of waste, and the capacity of the institutions responsible for solid waste management and the sources of funds for domestic waste management. These issues formed basis for the research questions and the objectives of this study and informed the methodology used to collect the necessary data for insights to domestic waste situation in the Wa township (Creswell, 2009). This chapter examined the geo-physical characteristics of the study area (location and size) human characteristics (Population size, growth rate, density) Education, Health, and Economic activities as well as details of methods and techniques used to gather the information for the study.

3.2 Location and Population

The study area is the Wa town within the Wa Municipality. Wa is the regional capital of the Upper West Region of Ghana. It gained Municipal status in 2004 as part of the government's decentralization policy of bringing governance closer to the ordinary people. The Wa Municipality is bordered to the north by the Nadowli District, to the east by the Wa East District, to the west by Wa West District and to the South by Sawla-Tuna-Kalba Districts in Northern region. The Wa town lies within latitude 1º40' and 2º45'N and longitude 9º32' to 10º20'W thus covering an area of approximately 1,180 square kilometers which is about 32% of the region and 2.56% of nation`s land mass respectively. The population of Wa Municipality is 107,214 (female 54,218 / Male 52,996). Wa town

alone has 11,425 households and a population size of 66,441with an average growth rate of 2.8% per annum and 4.0% in the urban centers (Ghana Statistical Service, 2012, 2013).

Figure 2: Wa Town Study Area



Source: Wa Municipal Assembly, (2010)

3.3 Education

There is improvement in the education sector over the past years. There are primary and junior high schools within the Wa town. We have 6 second cycle schools a teacher training institution, Health Assistants training school, a Polytechnic and a University campus (GES, 2014). Education is very relevant in domestic waste management. This is because the curriculum includes aspects of environmental management which is taught from the basic level through to higher education. In the curriculum, good domestic waste management

practices are covered and this enables pupils from the onset to appreciate basic concept of cleanliness. The students also generate waste for the institution and the municipality to manage.

3.6 Research Design

A descriptive cross-sectional explanatory design was used. This cross-sectional design involves the description of data collected from a population, or a representative subset, at one specific point in time (April-August, 2014) and explaining the outcome to reflect the situation at that particular point in time (Creswell, 2009; Creswell and Tashakkori, 2007). This cross-sectional study is a situation in which the condition and potentially related factors are measured at a specific point in time for a defined population. Cross-sectional studies are thought of as a "snapshot" of the occurrence and characteristics of a condition in a population sample at a particular point in time. This study employed secondary data (documented information on Zoomlion Company, Wa Municipal Assembly, other relevant bodies/Information sources including the internet, newspapers, previous research report, articles, books) and Primary data (Interviews, questionnaires, and general field photos etc). The explanatory component has to do with using the information from the interviews as backup in explaining the quantitative results obtained from the respondents in more detail (Creswell, 2009).

The cross-sectional study design was adopted because it guided in delving more into issue of domestic waste management through the open ended questions and structured interviews. Also the selection of different sources of information and data collection methods was to enable cross checking (“Principle of triangulation”) to ensure that you don’t rely on a single source of information, or one set of tools to draw conclusions. The

use of different methods strengthens the validity of the findings from the qualitative research methods (Creswell and Tashakkori, 2007).

3.7 Study Population

Wa town (City) which is the study area was chosen due to its diversity in environmental problems and accessibility to information regarding the research questions to be answered in the study. Another relevant reason was the area being likened to a "model city" for the entire region regarding domestic waste management challenges. Wa has a population of about 66, 441 (GSS, 2010). The study sample was made up of a heterogeneous population in terms of occupation and age. The respondents were selected from different locations within the town.

The targeted population included;

- ✓ Men and women aged 15-50 years who were either resident family or household heads.
- ✓ Workers of Zoomlion Gh. Ltd
- ✓ Municipal Assembly officer in charge of waste management

3.8 Sampling and Sample Size Estimation

With 11,425 households in Wa, the sample size was calculated using the mathematical formula as follows;

Formula: $n = \frac{N}{1+N\,(\alpha)^2}$ where

***n*= Sample size, *N*= Sampe frame/taget population (total number of households in Wa), $\hat{e}^2$= represented the margin of error which is *0.08* with confidence level of *92%*. By substituting 11,425 and 0.08 into the formula, **n=154** approximately.

Therefore, the sample size 160 was selected.

Wa Municipal is demarcated into 31 clusters of communities of which 19 are in Wa town. These 19 communities were grouped into 3 categories comprising; Self-contained/individual ownership housing sector (high income strata), tenement sector (middle income strata) and indigenous sector (low income strata) based on the Ghana statistical service household characteristics classification (GSS, 2012). Two (2) residential areas each were then selected from these 3 categories using the simple random sampling. Of these 6 communities, 20 respondents each were selected from the communities giving a total of 120 household respondents. The sampled communities were Degu (JAHAN-Tampalipani area) and Kunta-SSNIT Areas; Kpaguri and Dobile areas; Dondoli and Sokpayiri residential areas to represent the income categories respectively **(Table 1)**. Thirty (30) respondents (ie 10 each from the 3 schools) were selected from three schools out of the 10 basic schools with Zoomkids programme in Wa namely; Saint Aidans (Anglican) JHS-Wa, T.I Ahmadiya JHS-Wa and Jujeidayiri JHS-Wa. Finally Ten (10) respondents were also selected from Zoomlion Ghana Limited workers within Wa town giving a total sample size of 160 (120+30+10=160) respondents.

3.9 Sampling Techniques

This is the method used to select a sample of a group of individuals to reflects the characteristics of the population which is large or so widely scattered as it is impossible to interact with all the individuals in the given population (Creswell and Tashakkori, 2007). This study used cluster random sampling and purposive sampling methods.

3.9.1 Cluster Sampling

This is a sampling technique used when "natural" but relatively homogeneous groupings are evident in a population (Creswell and Tashakkori, 2007). This technique identifies the population under groups known as clusters. The clusters are formed based on members who share common characteristics or attributes. A random sample from each cluster is selected to represent a proportion of the group. The subsets of the clusters are then pooled to form the random sample. The required information is collected from the sample within each selected cluster. This may be done for every element in these groups or a subsample of elements may be selected within each of these groups/clusters. A common motivation for cluster sampling is to reduce the total number of interviews and costs given limited resouces (Creswell, 2009). In this study, the first cluster involved the identification of the 19 communities (electoral areas) in Wa from the total of 31 communities in the whole of Wa Municipal. The second stage was identifying these communities according to cluster of Self-contained housing sector (high income), tenement sector (middle income) and indigenous sector (low income) based on the household characteristics (Creswell and Tashakkori, 2007; Ghana Statistical Service, 2012; Wa Municipal Assembly, 2011). The third was a sample of six (6) communities from which twenty (20) households were included in the interview.

Table 1: Simple Cluster Sampling of Residential Areas in Wa

CLUSTERS	RESIDENTIAL AREA	SAMPLED AREA
Self-contained housing sector ***(high income)***	*Degu, Kunta-SSNIT, Dokpong-SARI-Airport,*	*Degu* *Kunta- (SSNIT)*
*Tenement sector (**middle income**)*	*Kpaguri Dobile, Daku/Bamahu, Mangu, Kabanye Sombo, Kambali, Kumbiehi-Sawaba*	*Kpaguri* *Dobile*
*Indigenous sector (**low income**)*	*Dondoli, Sokpayiri, Tagirayiri, Nayiri Fifamuni, Fogu, Zongo Community Center,*	*Dondoli* *Sokpayiri*

Source: Field Survey, 2014

3.9.2 Purposive Sampling

Purposive sampling technique, also called judgment sampling, is the deliberate choice of an informant due to the qualities the informant possesses. It is a non-random technique that does not need underlying theories or a set number of informants. Simply put, the researcher basing on what needs to be known sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Creswell, 2009). Purposive sampling is especially exemplified through the key informant technique (Tongco, 2007).

According to (Guarte and Barrios, 2006), Purposive sampling is used where the researcher targets a particular segment of the population. In this study, the numbers of schools with the Zoom kids programme were five (5) hence the researcher purposively selected 3 schools and 10 respondents from each making a total of thirty (30) Zoomkids respondents.

The research also targeted ten (10) Zoomlion workers (cleaners), the area manager as well as the municipal officer in charge of waste management.

3.10 Sources of Data Collection and Methods

This is the process of gathering and measuring information on variables of interest, in an established systematic manner that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. The data collection component of research is common to all fields of study including social sciences and humanities. While methods vary by discipline, the emphasis on ensuring accurate and honest collection remains the same. The goal for all data collection is to capture quality evidence that then translates into rich data analysis and allows the building of a convincing and credible answer to questions that have been posed in the study (Creswell, 2009; Gillham, 2008; Hinkin, 1998; Willis, 2004). This study gathered information from both primary and secondary sources.

3.10.1 Primary Data

This consists of collection of original primary data from field by the researcher. It is often undertaken after the researcher has gained some insight into the issue by reviewing secondary research or by analyzing previously collected primary data. It can be accomplished through various methods, including questionnaires, interviews and direct observations. This study employed questionnaire, key informant interviews and direct observation.

3.10.2 Questionnaires

A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents. A questionnaire is a

set of questions arranged in a sequential order and can be self-administered. The questionnaire was invented by Galton (1869). Questionnaires have advantages over some other types of surveys in that they have options, do not require as much effort from the questioner as verbal surveys, and often have standardized answers that make it simple to compile data. Thus, for some demographic groups conducting a survey by questionnaire may not be concrete (Creswell, 2009; Gillham, 2008). In this study, questionnaires were designed for the respondents (household, Zoomkids and cleaners). The use of questionnaire aimed to ensure uniformity in the standardized wording. Both closed and open ended question were included. Open ended questions allowed respondents to include comments (Creswell, 2009). To ensure that questionnaire did not get lost, copies of questionnaires were administered and retrieved personally by the researcher.

3.10.3 Key Informants Interview

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a range of people (including community leaders, professionals, or residents) who have first-hand knowledge about the community/the issue concern (Kumar, 1989; Willis, 2004). Key informant interview with Zoomlion Ghana Ltd area manager was conducted to ascertain his views on the role of Zoomlion in domestic waste management in Wa. The interview involved the use of a structured open ended interview guide which was used by the researcher to conduct a face-to-face interview with the company's manager on activities of the company, logistics, achievements collaboration with the Municipal Assembly and challenges facing the company in domestic waste management in Wa.

3.10.4 Direct Observation

Observations enable the researcher to describe existing situations using the five senses, providing a "written photograph" of the situation under study. Barker, (1980) describes direct observation as the primary method used by anthropologists doing fieldwork. Fieldwork involves "active looking, improving memory, informal interviewing, writing detailed field notes and taking photos (Creswell, 2009). Participant observation is the process enabling researchers to learn about the activities of the people under study in the natural setting through observing and participating in those activities. It provides the context for development of sampling guidelines and interview guides.

Aside the questionnaires and interviews, the researcher also conducted field observation as part of the data collection procedure. This involved the observation of waste situations and other conditions that could affect domestic waste management in the study areas such as the layout of settlements and road access within residence. Waste disposal sites were also observed to gather data on such things as standard of maintenance and environmental quality in the surrounding or nearby communities. In the course of the field observation, photographs were taken of waste scenes such as street litter, chocked gutters/ drains, waste storage containers, the transportation and final disposal of waste. The researcher participated in waste collection tours with waste laborers as they went about their work in some parts of Wa. The exercise enabled me to gain first-hand knowledge of the waste situation in the municipality including the waste disposal habits of the residents, the level of waste disposal services available to residents, the collection, transportation and disposal of waste and the management of final waste disposal sites in Wa.

3.10.5 Secondary Data

Secondary data represent information that has already been produced / collected by others. A secondary data is used by a person usually not present at the event and relying on it as source documents for information. Examples of secondary data include; information from Internet, journals, Books/ Magazines, Newspapers ,Official statistics and government statistics (Gillham, 2008). In this study, a review of relevant articles on domestic waste management was carried out to build the research questions and the problem. Documented evidence from Newspapers, the municipal Assembly and Journals also aided the tools construction.

3.11 Questionnaire Administration and Pre-testing

The questionnaire for the household survey was developed to cover sections of the study objectives which sought to assess issues concerning household waste generation and disposal practices, availability and type of waste disposal services, payments for waste disposal services, householder's rating of the waste management situations in their communities and how the situation could be improved. The questionnaire was, therefore, seen as an appropriate tool which allowed for the collection of standardized information across participating households with regard to the variables of interest. The instrument was divided into appropriate sections to allow for the systematic collection of data from households in different socio-economic areas in the study areas (high, middle and low-income communities).The survey questionnaire was semi-structured, containing both open-ended and closed-ended questions. The closed-ended questions required the respondent to make choices from alternative responses while the open-ended questions provided space for them to give their own answers to questions. An advantage of the semi-

structured questionnaire was that while the closed questions made the questionnaire easy to complete, the open-ended questions provided the opportunity for respondents to give more detail information about the issues being investigated.

The pre-testing of the instrument was conducted in Kabanye community within the study area but outside the communities selected for the study. Priority was given to a community that shared similar characteristics with the study area to enhance matching. The purpose of pre-testing was to discover possible weakness, inadequacies, ambiguities and problems in the instrument. Twenty (20) respondents were involved in the pilot study and questionnaires were personally administered and retrieved by the researcher. Two (2) research assistants were recruited and trained to assist in data collection. To determine the validity of the tools, the questionnaire was given to the officer in the waste management unit of the municipality. His assertion of the questionnaires appropriateness guided the review of the tools. According to Creswell (2009), "researchers have no single stance or consensus on addressing traditional topics such as validity and reliability". In view of this, a strategy the researcher used to ensure validity of the instrument was the performance of the pilot test. Pre-testing is able to help in establishing the reliability, validity and practicability of the questionnaire because it helps to check the clarity of the questions, give feedback on validity of test items and also makes sure that the data required will answer the research questions. The researcher as part of the pilot-testing, asked the respondents to comment and recommend suggestions to improve the instrument. Some very useful and valuable suggestions emerged from the pre-testing such as ambiguity and clarity of questions. These views were collated and studied closely which helped the

researcher to remove ambiguous statements. Inconsistent statements were completely expunged either because of similarity or non-relevance.

3.12 Data Analysis

On completing the data collection process the researcher undertook an interpretation exercise of the research findings so as to derive meaning from the results. This study employed both qualitative and quantitative means which were analyzed and presented differently. Quantitative or numerical data extracted from questionnaire and interview responses were processed using the Statistical Package for Social Sciences (SPSS) and data presentation was done using tables, graphs and figures. Microsoft Excel was also used in the production of other graphs and charts. The use of SPSS was relevant in data processing and arriving at univariate summaries in figures. The SPSS saved time and reduced the researcher's efforts in constructing charts/figures based on the available data collected.

Descriptive statistics played an important role in generating percentages and statistics from respondents. Interviews, photographs and document review generated qualitative or narrative data that described and explained the different activities that are being undertaken on solid waste management in Wa. It is therefore relevant to understand that brief summaries, published data, initiated for domestic waste collection and waste management rating, activities undertaken at community level, legislative aspects and sustainable domestic waste management practices and options documents and reports were vital in this study as content summary was used to tease out details to support in explaining the quantitative results in detail. In view of this, findings from the research study which include socio-demographic information, programmes as well as the effectiveness of

community participation in domestic waste management in Wa are presented through the use of tables, graphs and pie charts. The key informant interview information gathered from the Zoomlion Company Area Manager and the Municipal Officer were summarized into themes using content analysis (programmes, equipment/ services rendered, achievements, collaboration with Assembly and challenges facing the Company in managing the waste) and presented alongside the quantitative results.

3.13 Ethical Consideration

Ethical consent involves the procedure by which an individual may choose whether or not to participate in a study. The researcher's task is to ensure that participants have a complete understanding of the purpose and methods to be used in the study, the risks involved, and the demands placed upon them as a participant (Gregory, 2003). The participant must also understand that he or she has the right to withdraw from the study at any time. The two forms of consent are direct and substitute. Direct consent is the most preferred because agreement is obtained directly from the person to be involved in the study. Substitute consent, or third-party consent, is given by someone other than the person to be involved in the study. Substitute consent may be obtained when it is determined that the person does not have the capacity to make the decision or is dependent on others for his or her welfare, such as children under the age of 18 or people with cognitive or emotional disabilities (Ellis, 2007). In relation to this study, I sought consent from individual participants and other stakeholder to include access and acceptance, as well as confidentiality and anonymity. According to Folkman, (2000) "whenever possible, the investigator should inform all participants of the objectives of the study and all aspects of the research or intervention that might reasonably be expected to influence willingness to participate". The

investigator is further required to "explain all other aspects of the research or intervention about which the participants require" In this study, the purpose of the study was explained to participants and making them aware that participation was optional and they could choose to answer or not answer any questions in the course of the interview.

The second ethical issue that was given prominence is, access and acceptance. This involves obtaining permission to carry out research in a community, institution or organization. Access and acceptance involve both allowing an investigator into a given physical environment and also permitting him/ her to conduct the investigation in a particular way. In the conduct of this study, access to all premises such Zoomlion Ghana Limited, communities and homes were duly negotiated with the people concerned. Letters were written in advance to the community leader, Assembly members, Zoomlion Area manager in Wa and the Municipal Assembly explaining the purpose of the study and seeking consent to carry out the research. In administering the questionnaire, the same permission/consent was sought from individuals. Respondents were also assured of confidentiality and anonymity in the information they give.

3.14 Limitations of the Study

The collection of data for the research was affected by two major adverse factors which limited the amount and quality of information gathered for this investigation. One such limitation was the limited sample size of 160 participants in the household survey with 92% CI. I initially planned to use a much larger sample of about 386 households with 95% CI. Unfortunately, a number of factors constrained my intentions and efforts. The most important factor that limited my fieldwork was financial constraints. I did not get financial

assistance from anyone, I therefore had to rely on my own limited resources to meet the cost of the entire fieldwork exercise including accommodation, printing and photocopying of research instruments and other documents, payments at various offices and remuneration for my field assistants.

Another limitation of my research methodology is related to the techniques employed in the analysis of the data which is univariate descriptive and does not provide sophisticated / advance statistical analysis (Bivariate or regression models) of the quantitative data collected. This is, however, due to the nature of the research design which is largely descriptive. The calculation of the sample size did not also take into consideration the clustering nature of the study population.

Lastly, the current chieftaincy dispute in Wa town affected the scope of the study. One of the sections (Limanyiri/Nayiri) which could form part of the study areas was excluded due to the uncertainty regarding peace in this community. This area has nucleated buildings, inadequate drains and waste containers.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter covers the results and discussion of Domestic waste management in Wa. The results are presented in sections. Thus, socio-demographic characteristics of respondents, type of domestic waste the company manages, waste disposal options, background information on Zoomlion company programmes/ services rendered/equipments used in domestic waste management, Public-Private partnership (PPP) and its usefulness in collaboration between Zoomlion company and Wa Municipal Assembly, gains/achievements made by the company, Challenges confronting the company in service delivery and concluding with measures to enhance effective and efficient domestic waste management in Wa. All the 160 questionnaires sent out to the 3 targeted groups were retrieved and this gave a response rate of 100%. The respondents were grouped into households (120 respondents), respondents from the schools with Zoom kids clubs in Wa (30) and Zoomlion company waste management workers (10). A designed key informant interview guide which was also used to elicit information from the Zoomlion company area manager and the Municipal officer in charge of sanitation in Wa are presented alongside the quantitative analysis.

4.2 Socio-demographic characteristics of respondents

The socio-demographic characteristics considered include age, sex and educational levels of the respondents selected for the survey. Age and sex composition are presented together in tables for the various respondents in the subsequent sub-sections while their educational levels are represented with charts.

4.2.1 Age and sex distribution of household respondents

Out of a total of 120 household respondents, a detailed summary in **Table 2** shows that, majority of these respondents were between age group 45-54 (40%) whiles the lowest number of household respondents were those below age 25 and above 55 (6% each). It is important to note that, those between age groups 25-34, 35-44 and 45-54 who were among the active age group were mostly responsible for domestic activities as they played active role in management of the household and for that matter, it is not surprising they form a substantial proportion (90%) of the household respondents.

Table 2: Age and sex distribution of household respondents

AGE	SEX		TOTAL	
	Male (%)	Female (%)	Frequency	Percentage (%)
15-24	1	5	6	5
25-34	6	18	24	20
35-44	10	26	36	30
45-54	11	37	48	40
55+	2	4	6	5
TOTAL	**30 (25)**	**90 (75)**	**120**	**100**

Source: Field Survey, 2014

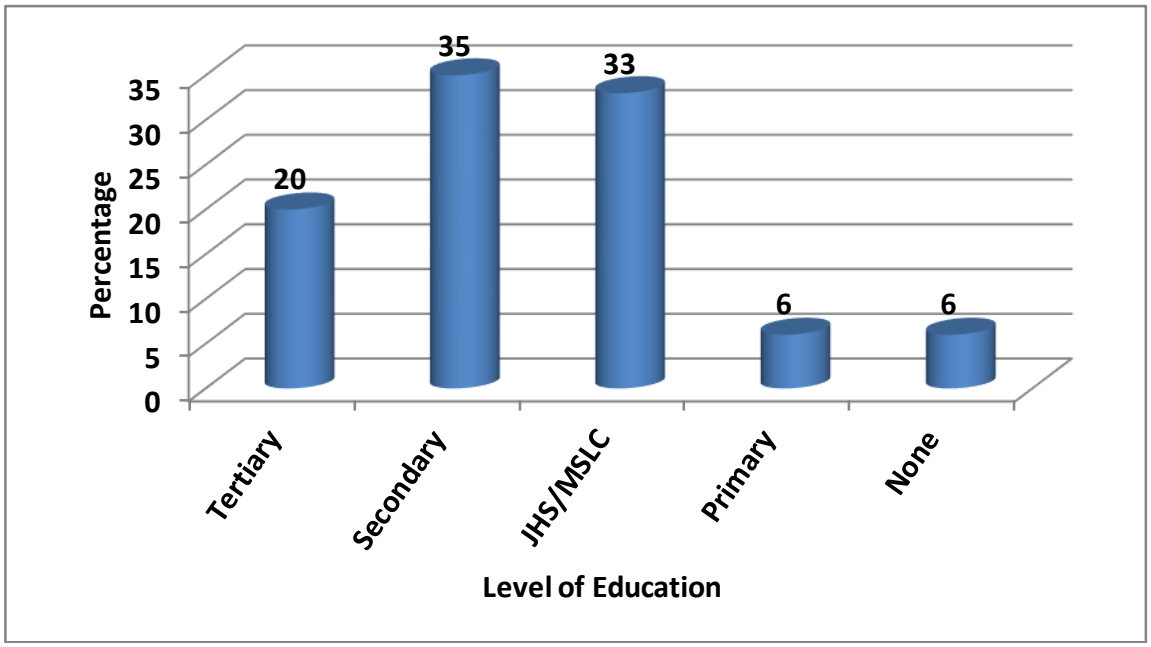
It should be noted that, age plays a significant role in household responsibilities in low income countries. Age group 44-54 (40%) emerged the majority who mostly play active role in the household especially in determining / directing waste disposal places into communal containers. The sex compositions of the respondents are presented alongside the information on age. Information from **figure 2** shows that, females form the majority

(75%) compare to their male counterparts (25%). In most low/middle income settings and particularly in Wa (Ghana), domestic cleaning including waste disposal are perceived to be the responsibility of women. On the other hand in high income residential settings, this responsibility may not be assigned to any particular sex and for that matter a collective responsibility of both sexes. For this reason, it is not surprising to find majority of household respondents were females. The males are usually expected to leave early in the morning for their place of work while the women carry out domestic chores or follow suit to her places of activity. In this case, it means many respondents you reach at the household during the day are mostly females.

4.2.2 Educational Level of Household Respondents

Most of the household respodents (**figure 3**) had Secondary Education (35%) and Junior High School/ Middle School leavers (JHS/MSLC) (33%). From the results, more than three-quarters of the household respondents had basic education and beyond (85%). Those with tertiary education accounted for 20%. With this level of educational background, Zoomlion Ghana Limited can capitalize on it to intensify their educational campaign on waste management which can influence behavioural change. Also, from the data collected, most of those with Secondary education and beyond belonged to the high and middle income residential category while those with no education were from the low/indigenous residential dwellers category.

Figure 3: Educational Level of Household Respondents



Source: Field Survey, 2014

From the results, it is important to mention that, almost all respondents except 6% (No education) had basic education meaning they had basic knowledge on environmental cleanliness often taught in basic schools and for that matter will be better handlers of domestic waste compared to their counterparts with no formal education. Consistent with this findings is a study from, Nepal where women's group used formal education to convince residents to see the need for proper handling of waste (Pokhrel and Viraraghavan, 2005).

4.2.3 Age and sex distribution of Zoomkids Clubs Respondents

Of the 30 schools with Zoomkids clubs interviewed, half were within age group 14-15 (50%) as in **table 3**. The least respondents were age group 10-11 and 18+ (10% each). It is clear that, those between age groups of 12-13 and 14-15 (80%) were among the active basic school going group and should be targeted when discussing issues of domestic waste management.

Table 3: Age and sex distribution of Zoomkids clubs respondents

AGE	SEX		TOTAL	
	Male (%)	Female (%)	Frequency	Percentage (%)
10-11	2	1	3	10
12-13	3	6	9	30
14-15	12	3	15	50
16-17	2	1	3	10
18+	-	-	-	-
TOTAL	**19 (63)**	**11 (37)**	**30**	**100**

Source: Field Survey, 2014

According to Duhigg (2012), an expert in habit formation emphasized that, strong and good habits formed early in life influences behavior change which often translates into an ensuing reward. Duhigg for instance indicated that the sight of your jogging shoes by the side of your bed when you wake up in the morning is the trigger for you to jog (the behavior), leading to a feel-good boost within your body system after the jog (the reward). Of course, the relevant reward can vary from person to person. Forming good waste disposal habits through waste bins at early ages in life can lead to good habit formation in

waste disposal at the household level in later years during adulthood which could translate into good environmental health practices and good health. From **table 3**, the male children were majority compared to their female colleagues (63% versus 37%). This shows that, boy's enrolment in schools could still be higher than girls hence continuous promotion of girl child education across schools is very relevant. Several factors account for low female children enrolment in schools. Available evidence attribute this phenomenon to factors ranging from early drop out of school to assist parents in household chores, teenage pregnancy, taking care of younger siblings to apathy from parents in educating female children (Colclough, Rose, and Tembon, 2000).

4.2.4 Age and sex distribution of Zoomlion company cleaners

Ten (10) workers from Zoomlion Company in Wa were selected and interviewed. In relation to the household respondents, half of the company's respondents were between 35-44 (50%) age group with the least proportions of respondents found within 15-24 and 45-54 (10% each) age category (**table 4**). The information shows that, majority of people working as cleaners under the company were within age groups 25-34 and 35-44. There was no worker in age group 55+ among the respondents which could probably be the vigorous physical energy requirement for manual cleaning work unlike sedentary work (sitting, reading, watching television, playing computer games etc) which do not use the same equal levels of energy exertion. Beyond age 55 most people in low / middle income settings are in the later years of their life expectancy, close to formal employment retirement and not physically capable to undertake vigorous task for various reasons. **Table 4** equally presents information on sex distribution of the Zoomlion Ghana Limited workers (Cleaners) within the age categories. Thus we had 3 males representing 30% as

against the 7 females who constituted 70% of the respondents. It is important to say that, this results is concordant with the assertion that, in many low income these settings, cleaning and gathering of domestic wastes is regarded as an activity exclusively for females and most men are unwilling to engage in Manual Street sweeping and gathering of waste. A plausible reason for the few men could be the direct financial remuneration attached.

Table 4: Age and sex distribution of Zoomlion company cleaners

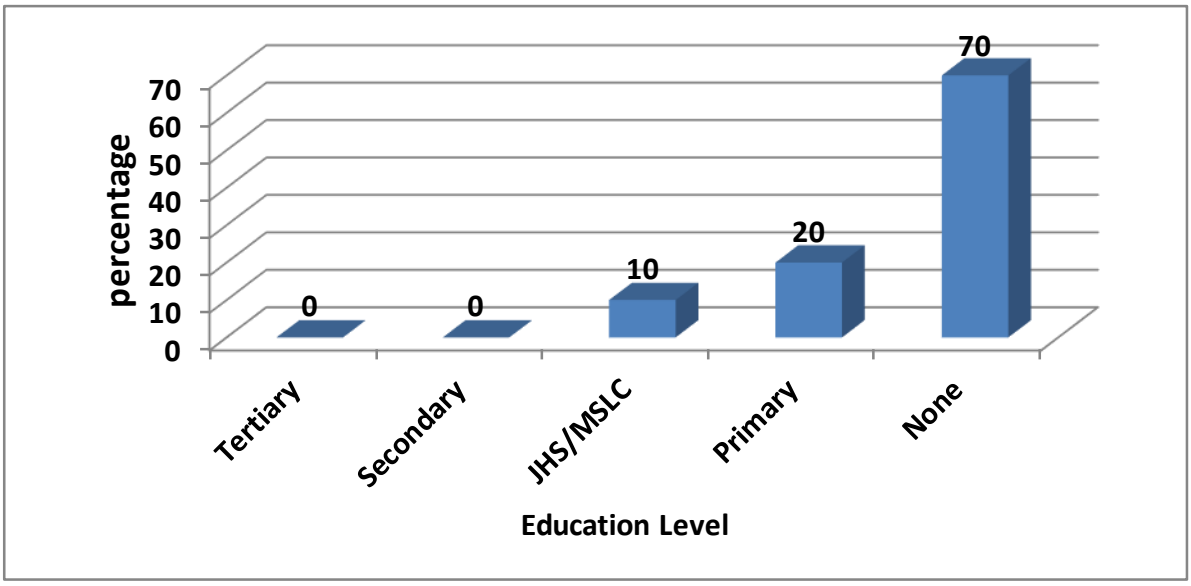
AGE	SEX		TOTAL	
	Male (%)	Female (%)	Frequency	Percentage (%)
15-24	-	1	1	10
25-34	1	2	3	30
35-44	2	3	5	50
45-54	1	1	1	10
55+	-	-	-	-
TOTAL	**3 (30)**	**7 (70)**	**10**	**100**

Source: Field Survey, 2014

4.2.5 Educational Level of Zoomlion Company Workers (Cleaners)

The data from the Zoomlion company workers shows that, most of the drains, streets and pavement cleaners had no formal education (70%). JHS/MSLC and primary education accounted for 10% and 20% respectively (**figure 4**).

Figure 4: Educational Level of Zoomlion Company Workers



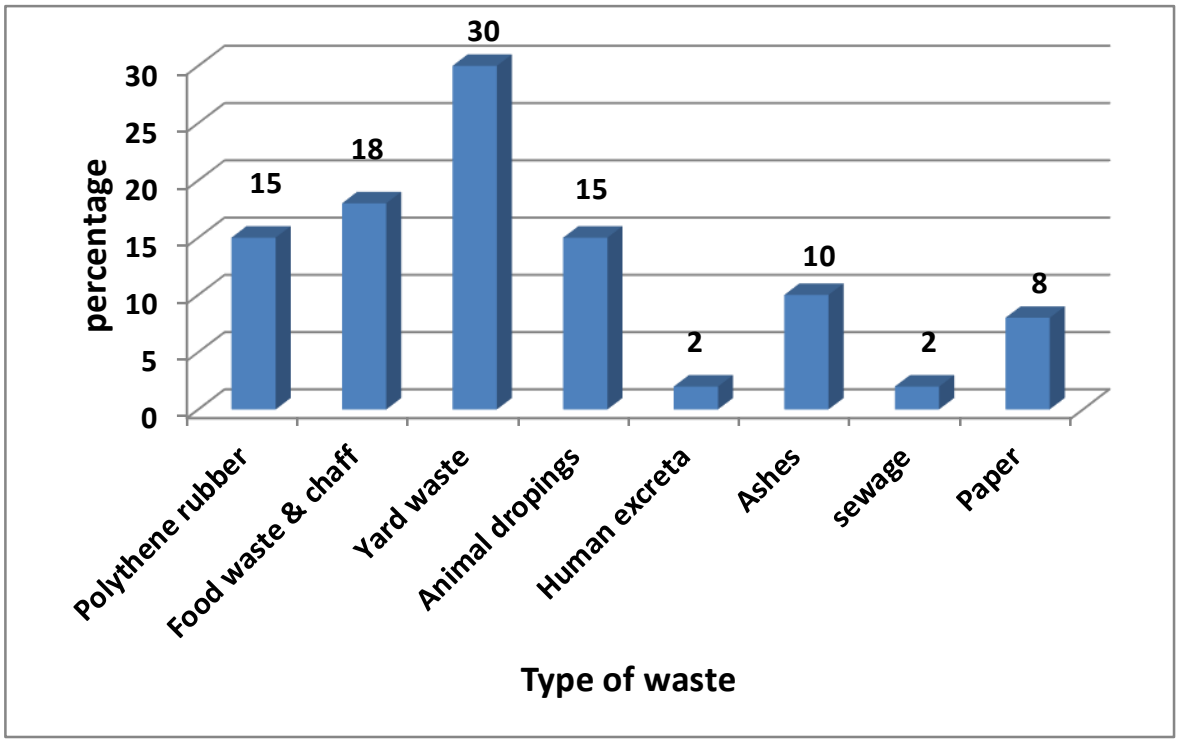
Source: Field Survey, 2014

Non of these workers had secondary and tertiary education (0%). Most inhabitants with secondary and tertiary level education often prefer engaging in clerical (white color) jobs other than engaging in street / drains cleaning jobs.

4.3 Nature/types of Domestic Waste Generated in Wa Town

This aspect of the of the objective sought to assess respondents knowledge on types of domestic waste they generated (**figure 5**). From the data summary, yard waste (leaves, twigs) was indentified among the highest component of domestic waste (30%). The second highest was food waste and chaff (18%) with polythene rubber and animal dropping ranking third by the respondents (15% each). Ashes and paper placed fourth and fifth highest (10% and 8%) respectively while human excreta and sewage (kitchen /bath waste water) being the least with 2% each.

Figure 5: Nature of Domestic Waste Generated in Wa Town



Source: Field Survey, 2014

These types of waste conform with Prakash et al, (2010) and Pokhrel et al, (2005) who Classified Domestic waste as biodegradable or non-biodegradable waste including food waste, yard waste and paper. Other biodegradable waste materials include human excreta, animal droppings, sewage and slaughterhouse waste and the non-biodegradable as plastics, metals, glass, ceramics etc. Managing human excreta and sewage, is often complex and easy to collect when it is confined to a septic tank (enclosed area). This process is facilitated through the use of a vacuum suction truck.

4.3.1 Zoomkids identification of type of Domestic Waste

A summary of information on type of domestic waste responses from the Zoomkids shows that, 40% identified polythene rubber as a major component of domestic waste, 30% metioned yard waste and 10% each indicating paper and ashes. The least were food waste

and animals dropping accounting for 5% each. Free range system of keeping animals is dominant in Wa and this could account for animal droppings forming a component of domestic waste in Wa.

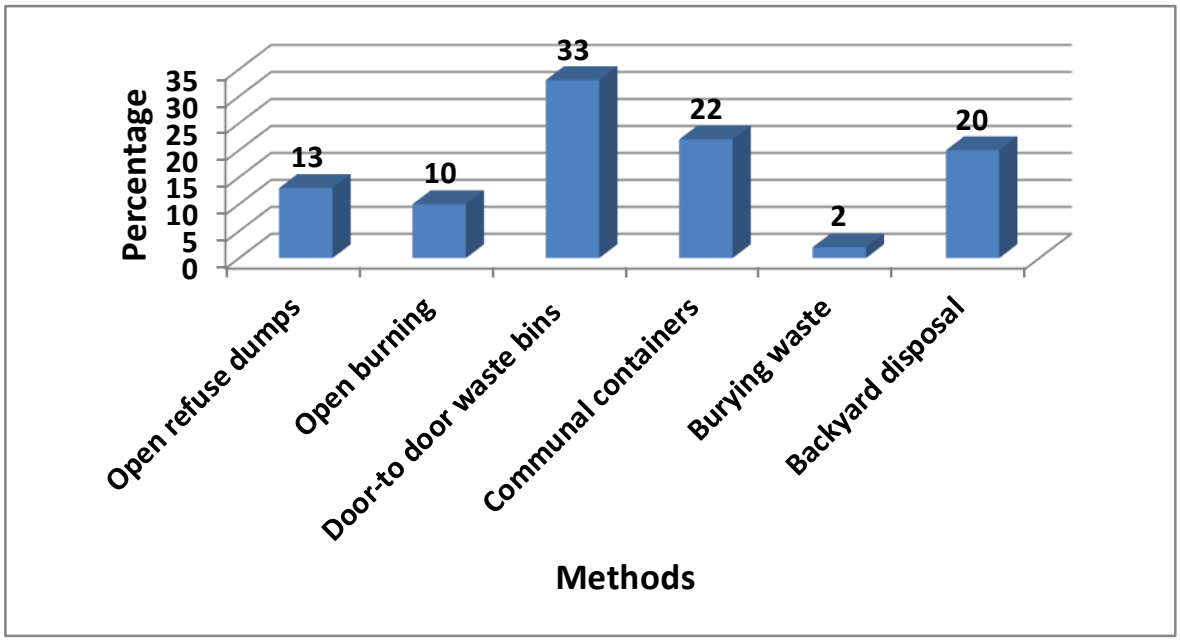
4.3.2 Identification of type of domestic waste by cleaners

The company cleaners were asked to indicate the type / components of domestic waste. Almost two-thirds of the respondents (59%) mentioned polythene rubber, 25% indicated paper while 13% identified animal droppings. The least being human excreta accounted for 3% from respondents. The interview from the the Zoomlion Company area manager and the municipal sanitation officer did reveal any difference in type of waste compared to those identified by the three categories of respondents mentioned above. In order of quantities of the domestic waste components, they mentioned polythene rubber, yard waste, food waste/chaff, animal droppings, ashes and paper.

4.3.3 Waste Disposal Options Available to Households in Wa

This aspect sought to find out how households dispose waste. **Figure 6** shows that, more than a third of the respondents (33%) used the door-to door waste bins service provided by Zoomlion Company for domestic waste disposal (**figure 7**). The second option respondents identified was the use of communal skip containers for waste disposal (22%).

Figure 6: Households Waste Disposal Options in Wa



Source: Field Survey, 2014

The communal skip container disposal (**figure 8**) option is where metal containers are positioned at specified locations within the town for inhabitants to deposit waste which is later transported to the dump site by skip trucks designed to lift them. Residents from the middle and high income category often rely on the door to door services. Examples of such communities include Degu and Kunta-SNNIT residential areas (high income housing) as well as Kpaguri and Dobile (middle income). Kreith and Tchobanoglous (1994), attested that, storage of domestic waste is affected by the type of waste, type of container, container location and contamination. For these reasons, waste must be collected and disposed within the shortest possible time.

Figure 7: Door-to-door Waste Bins and the Waste Bins Lift Truck

Source: Field Survey, 2014

Open refuse dump and burning accounted for13% and 10% respectively. The open refuse dumps ("Bola') are located within the community where domestic waste is disposed by residents. The open refuse dump and the communal container method were mostly used in low income residential areas in Wa (Dondoli and Sokpayiri). These two communities are densely populated settlements with limited access to road networks. Open spaces that are not occupied virtually turn into free grounds for open refuse dumps. Surprisingly, a sizeable proportion still practice backyard disposal (20%). The least option recorded 2% where inhabitants indicated they bury their waste. Waste burying is not a common activity in urban settlements since it is increasingly difficult to locate space to dig and bury waste which is often human excreta.

Residents who use the communal container service pay no fee for waste disposal and collection. Fees are deducted from the District Assemble Common Fund (DACF). This

could be a plausible reason for which most people residing within the low and middle income communities patronize the communal skip container services.

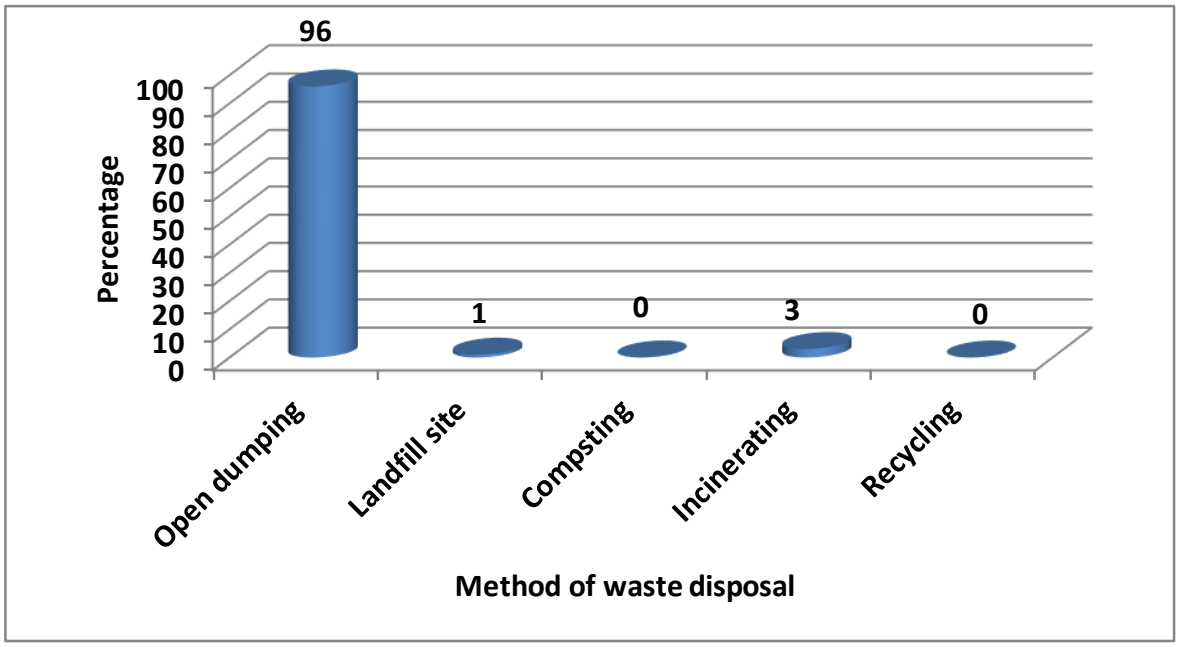
Figure 8: The communal skip container system

Source: Field Survey 2014

4.3.4 Assessment of waste disposal options available to the Zoomlion Gh Ltd in Wa.

The study also sought to find out from household respondents how the household waste collected were disposed by the Zoomlion company. From the summary of responses shown in **figure 9**, nearly all the respondents (96%) indicated Open dump as means that the company employs in disposing domestic waste in Wa. Composting and recyling recorded (0%) respectively. Landfill and incineration were mentioned by only 1% and 3% of the respondents respectively.

Figure 9: Waste disposal options available to Zoomlion Company in Wa



Source: Field Survey, 2014

Figure 10 shows an Open dump site owned by the Municipal assembly and located at Siiriyiri on the Wa-Dorimo road (5 km from Wa town) where Zoomlion Gh Ltd disposes off domestic waste as part of the collaborative arrangement. This open dump method of waste disposal is least underscored by literature. According to Puopiel and Owusu-Ansah, (2014), Accra Metropolitan Assembly deposited waste at Mallam, a suburb in Accra but this open site was abandoned in 2001 when the dump site exceeded its capacity and following serious objection from the residents. The implication is that, when this formal system of open dump disposal can no longer cope with the over increasing volume of waste generated in Wa, the general public will by themselves employ various crude forms of waste disposal such as indiscriminate disposal into valleys, depressions, drain channels and open burning (Monney et al., 2013). Another study from Accra equally confirmed that, existing dump sites dotted around the suburbs is a violation of the existing environmental

and sanitary laws, yet residents tolerate the situation because of lack of landfills and activities at the only proposed landfills in Kpone and Kwabenya stalled since the early 1990s (Oteng-Ababio, 2010).

Figure 10: Open Dumping Site Near Siriyiri used by Zoomlion Company in Wa

Source: Field Survey, 2014

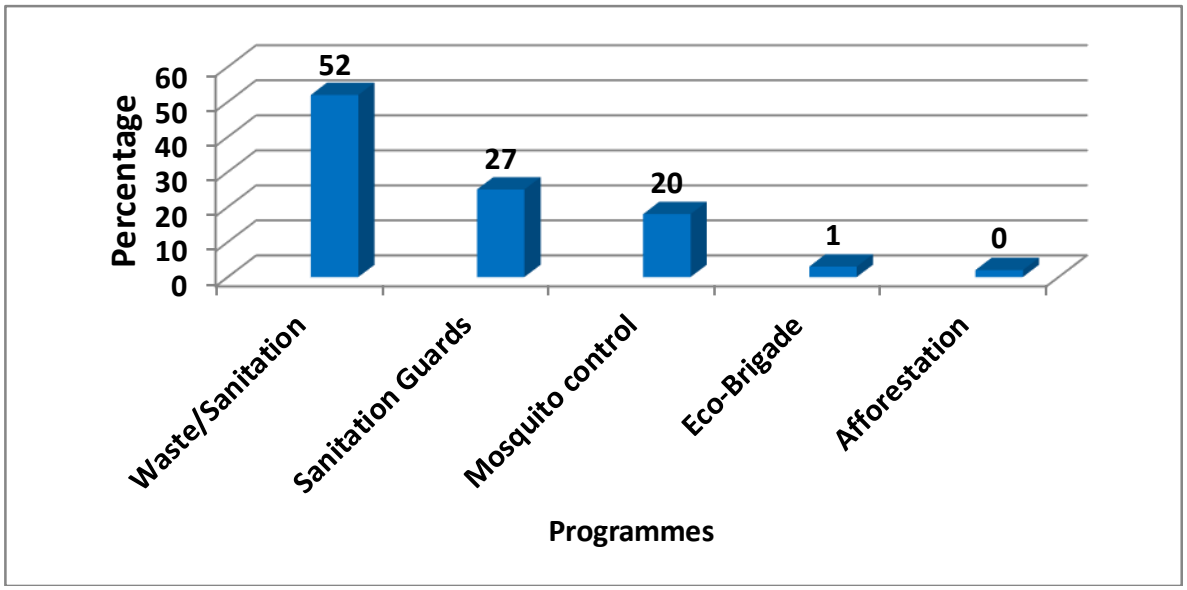
According to the United Nations Environmental Protection Agency (UNEPA, 2009) many cities have no controlled system for waste disposal. Waste is burnt in pits, dumped in random locations, or disposed of in uncontrolled dumps without any further management. Zhang et al, (2010) in their study maintained that, open dump actions harm public health and contaminates the environment. Controlled waste disposal can help improve and protect the health of local populations and preserve valuable environmental resources, such as groundwater and drinking water. In literature, there are other options for domestic waste

disposal that Zoomlion can explore in the Wa municipality. For instance, the company can operate a properly designed, constructed, and managed landfill; burn the waste in a controlled facility (incineration) that converts waste to energy or better still composting the domestic waste into manure for agricultural purposes (UNEPA, 2009; Zerbock, 2003). One of the main occupations of the indigenes within Wa is agriculture. Therefore, composting waste will go a long way to improve agricultural production in the municipality; Organic manure will readily be available to farmers to fertilize their farms and not over depend on chemical fertilizers which increase soil acidity, rendering the soil/land infertile in the medium to long term.

4.4 Programmes introduced by Zoomlion Gh. Ltd in Wa

To achieve this objective, household respondents were asked to identify Zoomlion programmes among a list of their programmes introduced to assist in domestic waste management using a questionnaire. The summarized data displayed in **figure 11** shows that, half of the respondents (52%) identified waste/sanitation as a programme introduced by Zoomlion company to manage domestic waste in Wa. Closely following waste/sanitation programme was the Sanitation guards programme representing 27%. Vector (Mosquito) control accounted for 20% with no respondent identifying Afforestation programme (0%).

Figure 11: Programmes Introduced by Zoomlion Gh Ltd in Wa



Source: Field Survey, 2014

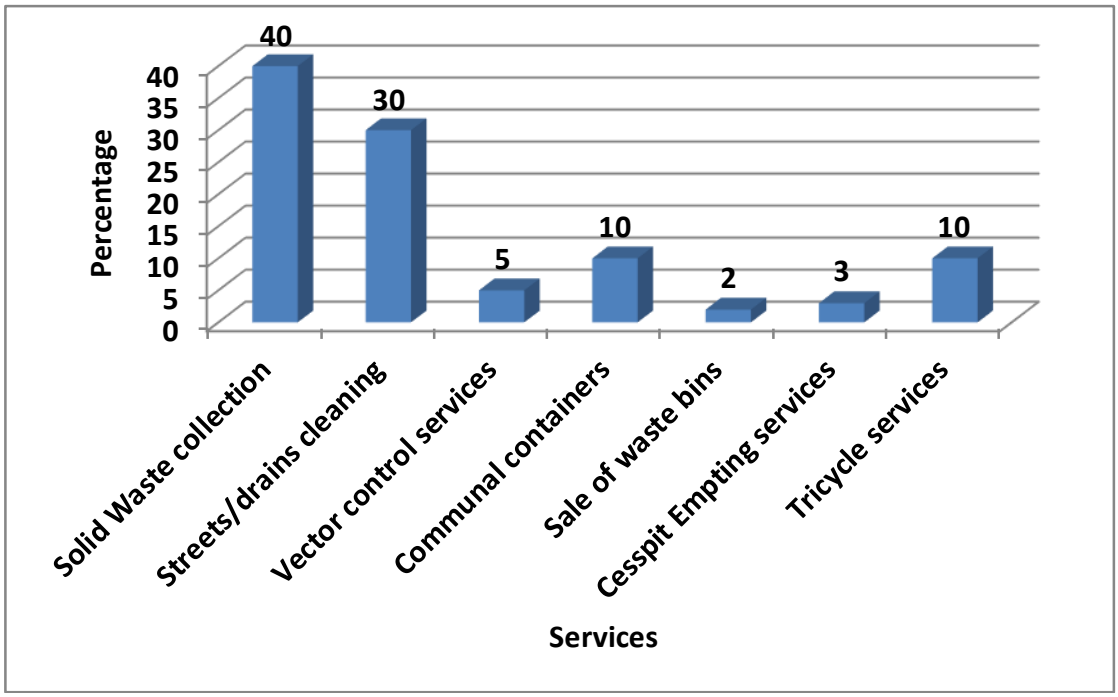
Afforestation which is one of the programmes is not directly linked to waste management but focuses on enhancing environmental quality through tree planting. The Eco-brigade which is a Coastal development programme is common along the Coastal towns and involves cleaning beaches and coastal afforestation. It is carried out in collaboration with the Ministry of Environment, Science and Technology. The eco-brigade programme is not common among inland towns and that could account for it being among the least identified programmes among the respondents. According to Poulsen et al., (1995), Waste/sanitation management involves conventional gathering of the wastes materials, transport by vehicles after collection to the location where the collection vehicle is emptied. This process often ignores other aspects such as domestic waste generation, and the alternative practices of recycling and reuse. Thus, in many low/middle income countries, the essential components of this programme are collection, storage and disposal. It is important to state that most

poor waste disposal practices are threat to human health. The common disposal sites for wastes collected are mostly open pit dumps with no leachate control, no application of cover material to limit odor, exposure to houseflies and refuse being blown about which become health hazard (Tchobanoglous et al, 1994).

4.4.1 Type of services rendered by Zoomlion Company

The range of services offered include solid waste collection services, street and drains cleaning, cesspit emptier services, tricycle waste collection service, communal container service, vector control, janitorial, landfill managements, fabrication and sale of waste management equipments. A summary of the information provided in **figure 12** showed that, nearly half of the respondents (40%) identified solid waste collection as a domestic waste management service in Wa. Closely following waste collection was street cleaning representing (30%), Communal containers and tricycle services came third with 10% each. Vector control attained 5%, while cesspit service and sale of waste management equipments recorded 3% and 2% respectively. The door-to-door waste collection service is a component of the solid waste collection mentioned earlier where households pay for waste to be directly collected in waste bins from their residence. Households pay GH¢ 10.00 per month to the Zoomlion company for the waste truck to pick these waste bins placed in front of their houses at specified periods. The waste bins initially were distributed free and households only pay for the collection of waste monthly. The door-to door service was introduced in Wa in 2009. Other services the study identified which were identified by other studies to address environmental challenges confronting the country included afforestation, eco-brigade, mosquito control, sanitation guides, bola and tricycle teams (Obirih-Opareh and Post, 2002).

Figure 12 Services provided by Zoomlion identified by household respondents



Source: Field Survey, 2014

The street/drains cleaning service comprises employees contracted and paid monthly remunerations to keep public places (drains, streets, pavements, lorry stations, parks etc) clean. The tricycles are often used to transport the gathered waste at specific location close by for the kerbside collection by the trucks to the final dump site. The municipal has 40 skip container points and Zoomlion company was assigned 14 containers per the contracted aggreement, but due the griming managerial problems that bedeviled Wa municipal in terms of domestic waste management, Zoomlion has extended its contract arrangement by lifting and dumping all the containers at the collection sites within the Wa municipality (Wa Municipal, 2011).

4.4.1.1 Solid waste collection service

The waste collection service is a specially designed service for low income communities with densly populated communities which is prone to indiscriminate waste disposal practices. By this arrangement, the pre-collection is assisted by placing containers and picking them at specified intervals for final disposal. The door-to-door waste collection service is an aspect of this component. In relation to waste collection service, household respondents were asked to identify the frequency with which the waste collection service was carried out. The results showed that, 75% of the respondents indicated once a week whiles 25% mentioned twice per week.

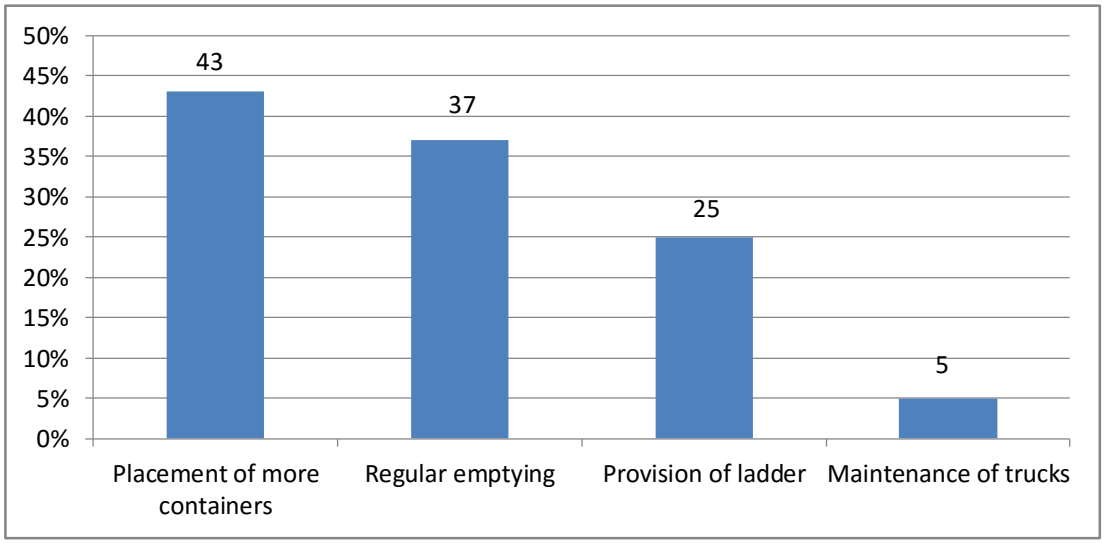
Figure 13: A Spilled Communal Container

Source: Field Survey, 2014

The frequency with which waste is collected and deposited at dump is an important process in waste manegement which avoids stench odour, spillage and waste decomposition in containers (**figure 13**). Infrequent waste collection could be a plausible reason why containers around selected places within Wa were engulfed with filt and yet residents looked on unconcern. Consistent with these findings, a study from Songsore (1992) explained that, with the establishement of waste management departments in

assemblies, infrequent waste collection results in filty cities with residents holding the view that it is the sole responsibility of the assemblies to manage domestic waste. Respondents further provided suggestions (**figure 14**) that could improve efficiency of communal refuse container services. 43% of the respondents were of the view that more refuse containers should be provided, 37% indicated regular emptying of containers, 15% identified provision of ladders for children who cannot reach the container to use it whiles 5% suggested regular maintenance of refuse trucks .

Figure 14: Suggestions towards improving the skip container service



Source: Field Survey 2014

4.4.1.2 Street and Drains Cleaning

Under street cleaning/sanitation programme, the Company entered into a contractual collaboration with the government of Ghana to manage domestic waste and sanitation under the National Youth Employment Authority (NYEP) now called Ghana Youth Employment and Enterprenuerial Development Agency (GYEEDA). Under this collaborative arrangement, the government recruits the workers and pays their allowances

quarterly while Zoomlion company provided them with working equipments (for cleaning streets, public places and drains) and daily supervisory role. Their activities involved the sweeping of major streets within the town center and carting the waste to temporal waste sites for onward transportation to the final disposal sites.

Figure 15: Waste/Sanitation Workers

Source: Field Survey, 2014

The results showed that, about 567 people were employed under the waste and sanitation module of Zoomlion. Zoomlion manages personnel recuited by the Ghana Youth Employment and Entrepreneurial development Agency (GYEEDA) to sweep the various principal streets in Wa. **Figure 15** presents a cross section of cleaners at work. Respodents were also asked to identify the periods within which the cleaning activities were carried out. 46% of the respondents mentioned the daily sweeping was done between the hours of 5:00-7:00 a.m, 34% indicated, 5:30-8:00 and 20% between the hours of 6:00-9:00a.m.

from these responses, it evident to mention that cleaners work between 5:00am and 9:00am daily.

4.4.1.3 Cesspit Emptier Service

The Cesspit service has to do with emptying households septic tanks (with water closets) as well as public laterines for disposal. The Cesspit service by Zoomlion is common with residents in the high class sector and households with septic tanks. From the interview conducted this service attracted a fee of 100 Ghana cedis per trip.

4.4.1.4 Tricycle Waste Collection Service

These are tricycles designed to collect refuse within short inaccessible locations within the communities where waste trucks can not maneuver to pre-collection sites for final transporting to the disposal sites. Zoomlion GH Ltd has forty-seven tricycles which are used by the cleaners. The tricycles assist in waste disposal especially when the vehicles are broken down. The male cleaners are the worker who are asigned to use these cycles.

4.4.1.5 Sanitation Guards

The sanitation guards programme aims at developing and maintaining a clean and safe environment in all human settlements. This is carried out through collaboration with the Ministry of Local Government and Rural Dervelopment. Under this PPP arrangement, sanitation guards assist the Environmental sanitation officer of the various Assemblies (Wa Municipal Assembly inclusive) to effectively carry out their routine (sanitary) duties. These guards assist in supervision/inspecting premises (homes,lorry parks, markets and schools). They also undertake hygiene education and promotion in communities and schools.

4.4.1.6 Zoomkid Clubs

In trying to inculcate good sanitary practices in our young ones, zoomlion Ghana Limited introduced Zoomkids clubs in selected basic schools in all the ten (10) regions of Ghana. There are 10 schools in Wa where this programme has been introduced. The company supplies them tools such as wheelbarrows, boots, rakes, shovels to keep their school suroundings clean. From the study, most of the schools with the Zoomkids club manage their wastes by burning except few of schools like Aiden's basic school who cart their waste to a communal skip container close to the school.

4.5 Equipments available to Zoomlion Company for waste management

Zoomlion Company is one of the unique waste management companies in Wa. They offer a range of services. The company employs a range of equipments (waste bins, communal containers, cesspit emptiers, skip trucks, Bulldozers etc) for domestic waste management. They also have technical know-how and manpower.

4.5.1 Waste collection equipments

From the interview conducted, the following equipments are used by Zoomlion Gh Ltd and Municipal Assemble to manage domestic waste: skips, compacters, tractors, tricycles, wheelbarrows, rakes, foot and fork pickers, wallington boots, shovels, dustbins among others. From the interview it was also realized that, broken down equipments are maintained at their mechanic workshop at Bamahu, however vehicles with major faults are sent to Kumasi for maintenance. The number of vehicles and other equipments available are indicated in **table 5** below.

Table 5: Equipments used for Waste Collection

DESCRIPTION	ZOOMLION GH LTD	WA MUNICIPAL ASSEMBLY	NUMBER IDLE	TOTAL NUMBER
Compact tracks	2	1	1	2
Roll on/ off	2	1	1	2
Tricycles	51	0	4	47
Communal containers	38	22	0	50
Wheel barrows	52	0	0	52
Wallington boots	70	30	0	100
Bull Dozer	1	0	0	1
Dustbins	754	56	35	775

Source: WMA and Zoomlion Gh Ltd 2014

Zoomlion Gh Ltd also supply equipments to households, Zoomkid schools, public cleaners/sanitation guards to help manage waste. Zoomlion through it's Sanitation improvement package occasionally supply free dustbins and communal containers to households and communities. They also provide, wheelbarrows, boots, rakes and pick Axes to Zoomkids clubs as well as their sanitation guards to ensure effective and efficient waste management.

4.6 The private sector collaboration in Domestic waste management

Domestic waste management in Ghana which is a component of environmental sanitation has been problematic for successive governments and local authorities till date. In response to Domestic waste management, the government of Ghana in 2006 partnered with Zoomlion Company to manage the waste and sanitation module. In this arrangement, the company was tasked with providing the requisite equipments and working gears to undertake sweeping and cleaning major streets of the towns and public places including de-silting drains. The company equally provides supervisory role. The collaborative component with the government is that, the company receives payment for services through the Wa municipal assembly from which they pay cleaners allowances. The company programmes include; waste/sanitation module, nationwide mosquito control programme, sanitation guards, national forest plantation development programme and the coastal development (Eco-brigade). This section in the objectives sought to find out from respondents, the programmes introduced by Zoomlion Company in Wa to manage domestic waste.

4.6.1 Collaboration between Zoomlion and the Municipal Assembly in Wa

The activities of Zoomlion company towards Domestic waste in Wa has gradually overshadowed the role of the Wa Municipal Assembly due to its dwindling capacity to manage waste. This is consistent with findings in literature by Ochere et al, (2014) who indicated that, In 2006 the Ghana government contracted the services of Zoomlion company to augment the efforts of metropolitan, municipal and district assemblies across the country to ensure quality and proper collection and disposal of waste and general environmental cleanliness. The need to collaborate with a private company was

necessitated by the fact that municipal Assemblies had not been able to efficiently manage the waste generated over the years due to obvious reasons. Arguing in the same line, Sandra Cointreau-Levine, (1994) emphasized that, private sector is well positioned and can do better in domestic waste management compared to the public sector since the public service delivery is either too costly or inadequate, private sector participation offers a means of enhancing efficiency and lowering costs through the introduction of commercial principles and greater attention to customer satisfaction.

In line with the PPP collaboration, Zoomlion Company entered into contractual agreements with the Wa Municipal Assembly to provide a wide range of services to inhabitants to enhance waste management within Wa town. An analysis of the interview responses from the Zoomlion company area manager and the Wa municipal sanitation officer revealed the following:

4.6.1.1 Wa Municipal Assembly collaborative responsibilities:

1. The municipal Assembly recruits cleaners through the NYEP/GYEEDA programme who are engaged in the solid waste/sanitation management unit as well as the other related services including those working under the street/drains cleaning and de-silting.
2. Provision of quarterly allowance for payment of the cleaners through the Zoomlion Company as well as paying the company for managing the services.
3. Provision of sites for placing communal skip containers for waste disposal as well as open land site for final disposal of the refuse.

4.6.1.2 Zoomlion Company collaborative responsibilities

1. The Company takes charge of equipping the recruited cleaners with cleaning equipments and working gears (wheel barrows, shovels, booths, hand gloves etc) to undertake the sweeping of ceremonial grounds, major streets, town parks as well as de-silting drains.
2. Lifting the skip containers with the skip truck and also emptying the domestic door-to-door waste bins service at regular intervals.
3. Managing disposal containers including the final waste disposal site.
4. Training the workers and playing supervisory role to ensure effective and efficient waste management within Wa.

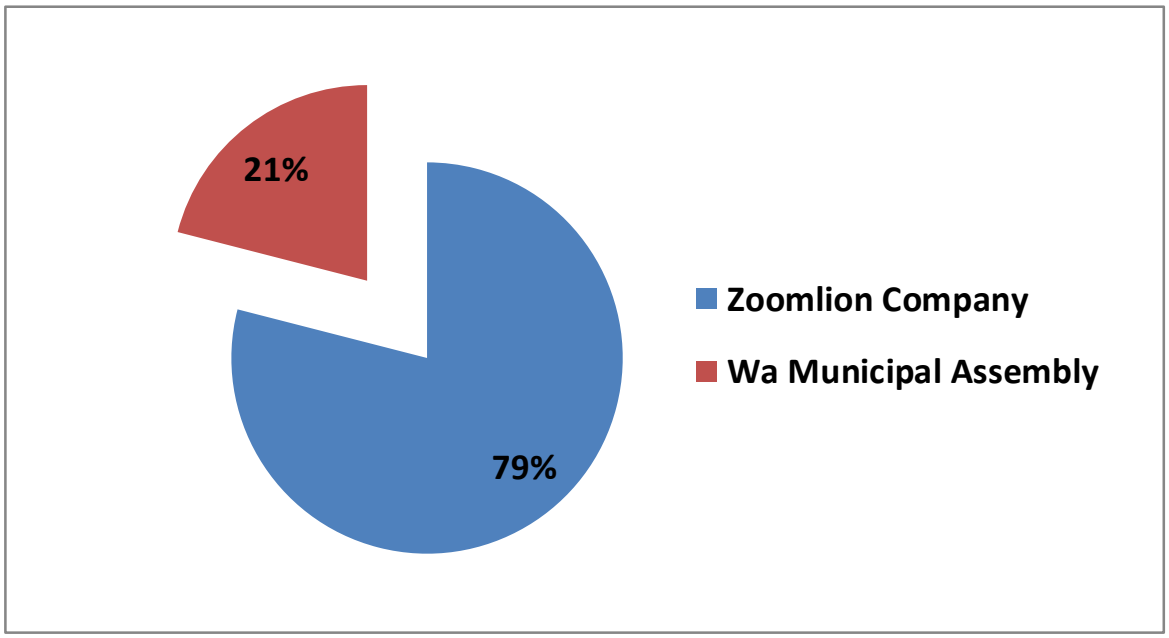
Like most Local authorities in Ghana, financial challenges affect the smooth operation of the Zoomlion Company in Wa when remittances delay beyond the quarterly arrangement Yahaya, (2012).

4.6.2 Domestic Waste Management Institutions in Wa Town

Household respondents were asked to identify Domestic waste management institions in Wa. **Figure 16** shows that nearly four-fifth (79%) of the household respondents identified Zoomlion Gh Ltd while those who mentioned Wa municipal Assembly was (21%). This simply mean that, some residents hold the view that, waste management in Wa is the responsibility of the Municipal Assembly. One can equally say from the available summary that, substantial proportion of residents are not aware the Municipal Assembly has contracted Zoomlion company to take responsibility over waste management in Wa. By extention, residents view the current domestic waste management arrangement as shared responsibility between the Wa Municipal Assembly and the Zoomlion

company.The implication of this view from respondents is that, once people perceive institutions as being responsible for waste collection and disposal, households and the general public would pay less attention and commitment in managing their own waste (Yahaya and Ebenezer, 2012). From the review of the Municipal records, the zoomlion company took over the lifting of waste of all the 41 skip containers located within the communities (Wa Municipal Assembly, 2011)

Figure 16: Domestic Waste Management Institutions in Wa



Source: Field Survey, 2014

4.7 Achievements of Zoomlion Company in Waste Management in Wa

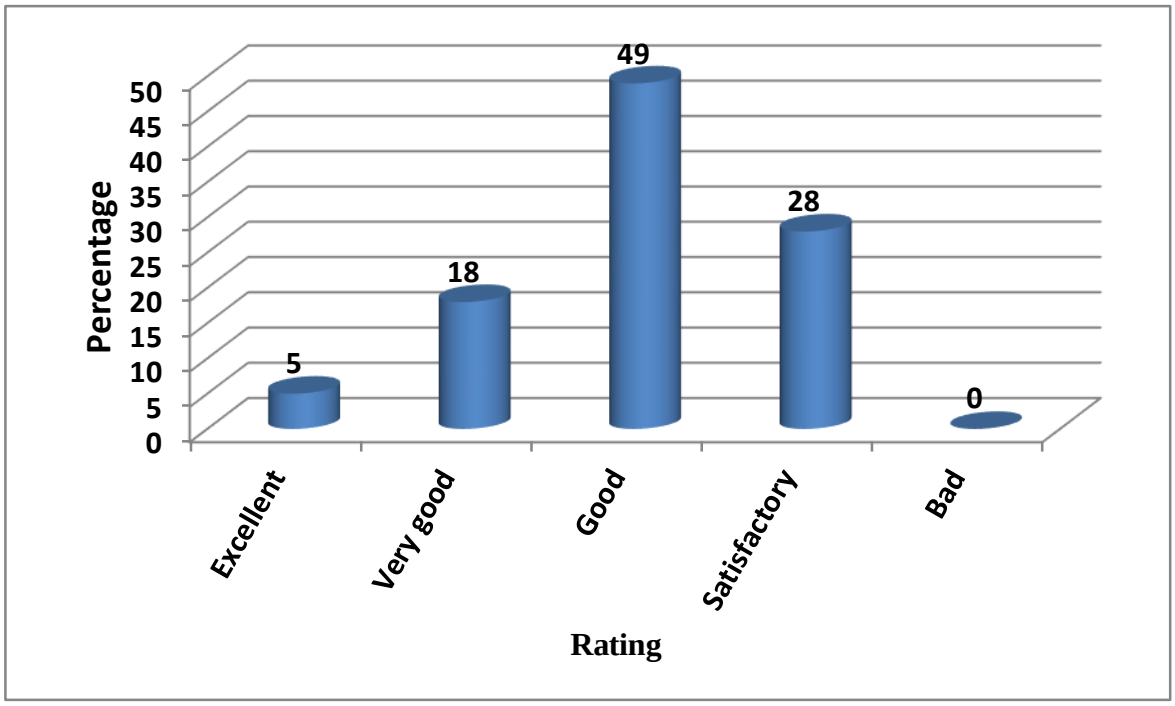
This objective of the study was achieved by seeking the views of the Zoomlion company manager and the Municipal sanitation officer through the interview as well as assessing the responses of household respondents on the success rating of the company. The two Officers maintained that, there has been substantial commitment from both the municipal assembly and the company in managing domestic waste. The Area manager mentioned that

such commitment is evidenced by the fleet of equipments and trucks that were at the company's disposal as well as the enthusiasm exhibited by the workers in managing domestic waste. The Municipal sanitation officer on his part maintained that, the success and survival of the Zoomlion Company was hinged on the consistent transfer of funds from the Local government ministry through the Wa municipal assembly for payments of commitments. He further added that, the Assembly had virtually relinquished waste management activities to the company and for these reasons it was significant to state that there was substantial progress in cleanliness evidenced at the time.

4.7.1 Zoomlion Contribution in Domestic Waste Management in Wa

Household respondents were asked to rate the contribution of Zoomlion company towards domestic waste management in Wa. The analysis represented in **figure 17** shows nearly half (49%) of the respondents indicated the contribution of the company was good followed by satisfactory (28%). A smaller proportion (5%) said their contribution was excellent while 18% indicated the company provided very good services. In view of the good service delivery, the company which started in 2006 has grown over the years with 2,800 staff and 65,000 workers under various programmes in Ghana Obirih-Opareh and Post (2002).

Figure 17: Assessment of Zoomlion Company's Contribution in Domestic Waste

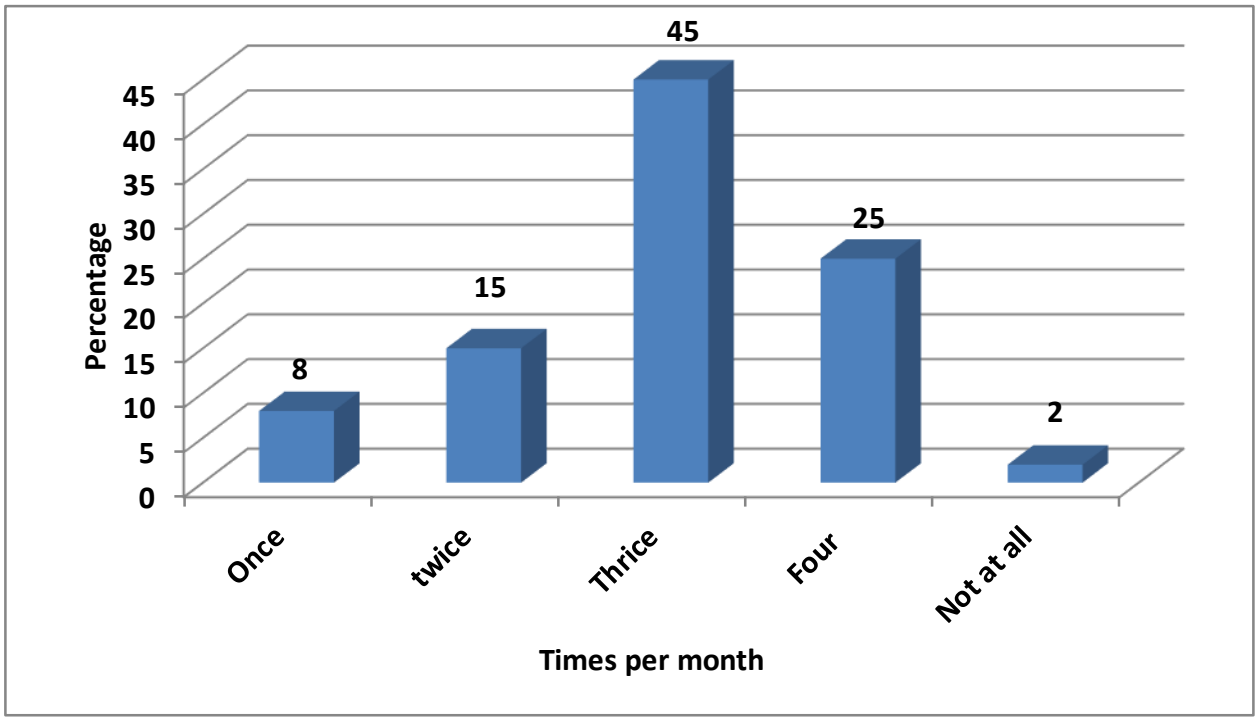


Source: Field Survey, 2014

4.7.2 Assessment of frequency of Domestic waste collection in Wa

This question was meant to find out from the household respondents how often the waste was collected and sent to the final dump site by the Zoomlion Company in case of the door-to-door waste bins service and the communal container service within a month. In relation to the number of times the company empties household bins/containers, 45% indicated that the waste was collected thrice in a month, while 23% of the respondents mentioned four times meaning once every week (**figure 17**). 15% identified that wastes were collected twice in a month. The least was 2% who said they don`t pick at all. In situations where waste containers are not emptied for a long time, waste container deteriorate (**figure 19**) or shrubs grow in them.

Figure 18: Frequency of Domestic Waste Collection in Wa



Source: Field Survey, 2014

Figure 19: Containers not emptied in Wa

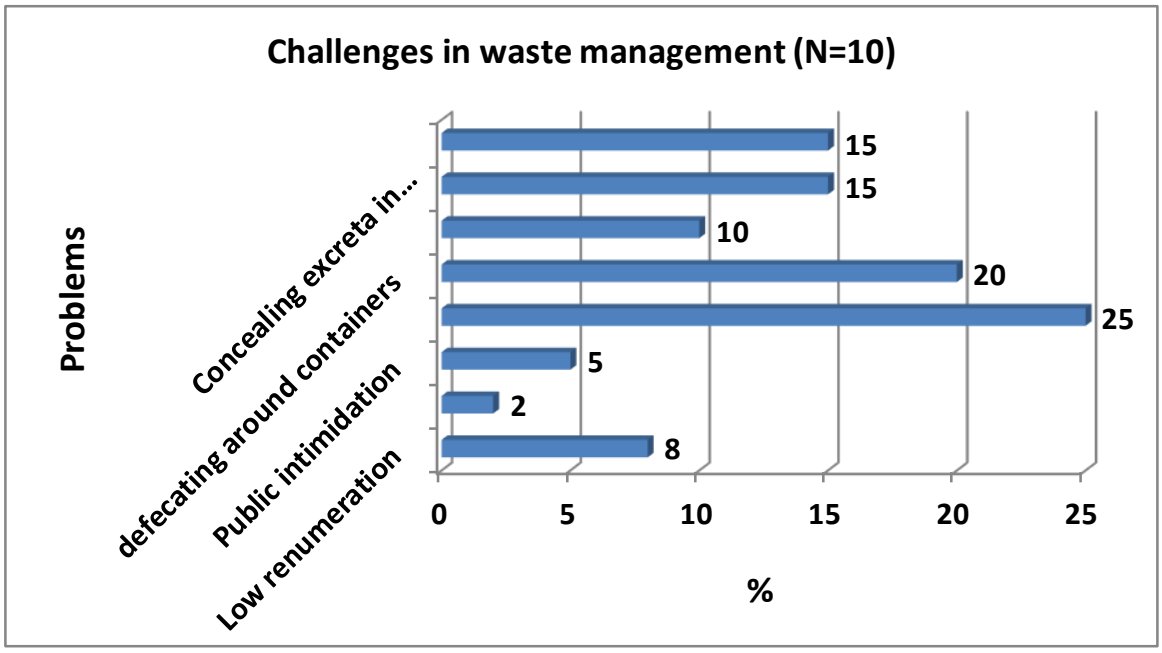
Source: Field Survey, 2014

Poulsen et al. (1995) contended that, timely waste collection from contracted points and emptying is important in waste management process. Also, the high moisture content and organic composition of wastes in low / middle income countries may lead to problems of increased decomposition rates in areas with high average daily temperatures and hence presenting additional challenges with insect populations and conditions conducive to disease as mentioned in the literature. To mitigate these problems much more frequent collection is needed. According to Ghost et al, (2006), although daily collection of waste has proven unrealizable or unworkable in many cities, perhaps a twice weekly collection of organic materials would be sufficient to reduce decomposition.

4.8 Challenges facing Zoomlion Company in domestic waste management in Wa

This objective targeted the Zoomlion company cleaners in waste management. This was a multiple response question that received a total of 60 valid responses (**figure 20**).

Figure 20: Challenges confronting domestic waste management in Wa



Source: Field Survey, 2014

The respondents' mentioned that many residents after getting to the container with their waste sometimes dump the refuse on the floor or beneath the container whilst the container itself was yet to be full. Defecating around the containers was equally a common practice as it also attracted a 20% score in the analysis. Surprisingly, the cleaners mentioned a crude form of disposing human excreta where perpetrators wrapped fecal matter in rubber bags (polythene) (15%) and place them in the open to be collected by cleaners. Poor remuneration, insufficient and weak tricycles, vehicles (**figure 21**) and public intimidation (ridiculing cleaners) were among some of the challenges enumerated as hampering their efforts in domestic waste management in Wa town. The workers also mentioned burning of the communal containers as the major problem (25%). In relation to the burning, most workers indicated that some unscrupulous people put ashes with fire into the containers thereby triggering the burning.

Figure 21: Spoilt lid Tricycle and a Burnt Refuse Container

Source: Field Survey, 2014

4.8.1 Zoomlion Company's specific challenges

Zoomlion is a waste management company that partners with the Wa municipal assembly to manage waste. In relation to their smooth operation, the company has challenges in logistics which include inadequate roll on/ off trucks, skip loaders and compacters. Currently, the two roll on/off trucks and the compactor are inadequate for effective waste management given the volume of waste in Wa. The interview results showed that, the company had distributed close to thousand (1000) free litter bins to households but most bins got destroyed within a short time. Some households which patronize the door-to-door service put ashes with fire into the litter bins which eventually burns them. Also, some clients either refused to pay for the monthly litter bin collection or deliberately default in payment which hampers the smooth management of the company.

4.8.1.1 Delay in the release of funds by the central government

The study also revealed that the Zoomlion Company is challenged with finance because of the delay in the release of funds by the central government. The company major source of revenue is government's subvention on sanitation to the Assemblies. The releases of such funds are not timely and for this reason the company is not well resourced to procure logistics to manage the wastes.

4.8.1.2 Bad media reportage

The study also identified negative media reportage about the activities of the company. is The manager lamented amazing situations where the media emphasized minor issues as against the glaring positives. This behavior from the media frustrates and dampens workers moral.

CHAPTER FIVE

5.0 SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

In the survey, 160 respondents were interviewed on Zoomlion Company`s contribution to domestic waste management in the Wa town. Using stratified random sampling technique, 120 household's respondents were selected. Thirty (30) Zoomkids comprising 10 respondents each from three (3) schools with Zoomkids clubs in Wa town were also selected. Thirdly, ten (10) Zoomlion workers (streets/drains cleaners) were selected giving the total of 160 respondents in the survey. The Wa municipal assembly sanitation officer and the Zoomlion company area manager were also selected and interviewed. This chapter provides a reflection on key issues worth noting and proposed strategies for addressing them.

From the previous chapter's discussions, the key issues confronting domestic waste management in Wa town are; indiscriminate refuse disposal including human excreta concealed in polythene bags, inadequate skip containers, and inadequate financial resources. Below are the key findings.

5.2 Summary of key findings

From the results discussed in chapter four, the following are key findings from the study. They are discussed to reflect the headings as follows;

5.2.1 Programmes initiated by Zoomlion Company to manage domestic waste in Wa

The study revealed that, most household respondents identified waste/sanitation module (52%), sanitation guards (27%), mosquito (vector) control (20%) as programmes introduced to manage domestic waste in Wa. Eco-brigade attracted the least from both households and Zoomkids respondents 1% each.

5.2.2 Households waste Disposal

The study revealed that, the main methods of household waste disposal were the use of door-to-door waste bins service, communal skip, open refuse dumps and backyard disposal. From the study, 20% of the respondents still engage in backyard waste disposal, while 13% and 10% engage in open refuse disposal and open burning is done to reduce the waste to ashes. This means nearly half of the respondents (43%) dispose waste indiscriminately which is an unhealthy practice and should be discouraged.

5.2.3 Waste collection

Irregular waste collection and negative attitudes towards domestic waste disposal account for the domestic waste management problem in Wa town. This was confirmed from the study where respondents indicated wastes were not collected frequently twice the week collection standards proposed in the literature by Ghost et al, (2006). The survey revealed that, 45% indicated the waste was collected thrice in a month meaning once every 10 days. Other responses were; 8% indicating a single collection in a month and 15% (twice collection a month). This infrequent waste collection leads to decomposition of waste and deterioration of waste container Poulsen et al (1995)

5.2.4 Equipments used/services rendered to inhabitants in Wa

He study detected that, the company used a variety of equipments to support domestic waste management efforts in Wa. Some of these equipments include: skip containers/ trucks, cesspit trucks, tricycle, domestic waste bins and communal containers. The whole wa municipal had 50 skip containers which were placed at specific spots identified in consultation with the Wa municipal Assembly. Inhabitants within these communities are encouraged to place refuse in them for further carting but due to the limited number, the position of some of these containers were far from inhabitants thereby resulting in others resorting to open indiscriminate dumping. Among the services they render to inhabitants were; solid waste collection service (40%) street/drains cleaning (30%), communal container and tricycle services (10%). Others are fabrication and sale of waste management equipments (2%) while vector control and cesspit emptier services attracted 5% each respectively. There were also limited dust bins in some public places. Estimates show that 13 more skip containers were required in six identified communities. Equipments for transporting waste (tricycles) were also inadequate.

5.2.5 Collaboration between Wa municipal assembly and Zoomlion Gh. Ltd

Information gathered from the study shows that there is substantial arrangement between the Zoomlion Company and the Wa municipal assembly in managing domestic waste in Wa. Evidence showed that, the Assembly recruits cleaners through the NYEP/GYEEDA programme to work with the Company as cleaners. The Assembly also pays workers quarterly allowances through the company while the company also provides equipments / working gears to enable workers undertake the cleaning activities. Zoomlion Gh Ltd again plays the supervisory role and receives management services fees from the Assembly.

5.2.6 Challenge in domestic waste management in Wa

Respondents indicated some unscrupulous residents wrap human excreta with paper or polythene rubber bags and place them in the street for the cleaners to pick when sweeping. Residents also put ashes which sometimes contained fire and this could be the possible cause of containers getting burnt. The study equally identified inadequate and weak equipments (tricycles), and complains of delays in receiving remunerations.

5.2.7 Final waste disposal site

There was no landfill site for final wastes disposal. The Zoomlion Company relied on open dump by convenience. By this principle, collected waste is disposed in depressions they find appropriate, sometimes very close to residential areas. This has the tendency of causing fires since waste generates methane gas, which is highly flammable. This is a direct affront to the basic planning principle of health and safety, as it puts properties and persons closer to the sites in danger. The settlements (Siriyiri and Busa area) closer to where these disposal sites were located had no comprehensive settlement plans to guide their development. It is questionable which factors the Environmental Health Department considered before allocating dump sites at Siriyiri and the Busa. Though a third site which is also a depressions used for waste disposal is out of town (Wa-Kumasi road), about 10 kilometers away but it is seldom used. The principle of dump by convenience comes into play here. Users of disposal sites often aim at minimizing transport cost through distance to sites. If such is the case, it is a major reason why this disposal site is unattractive. The implication of all this is that the town has no clear policy on what should constitute the most appropriate way of containing its waste**.**

5.3 Recommendations

Though the Zoomlion Company has contributed substantially to domestic waste management in Wa, there are challenges confronting the company and for that matter, the following recommendations are made:

1. Communal labour should be encouraged at all levels of the society especially households cleaning their immediate surroundings drains and public places.

2. Skips (communal containers) and household waste bins should be conveyed on regular bases, especially when they are full and at appropriate intervals to prevent waste decomposition in bins.

3. There should be public education on the need to make sure ashes do not contain fire before dropping with waste into bins and communal containers (skips).

4. The sanitation guards who are responsible for door- to- door education on waste disposal should intensify education on the dangers involved in having a filthy environment.
5. Municipal sanitation officers/task force should be deployed to inspect the sanitary conditions at the household level so as to sanction defaulters with fees for poor sanitation.
6. People involved in the domestic waste management should be well remunerated as a way of motivating them and encouraging other to join.
7. The polluter pays principle (PPP) where Companies producing products that generate waste (polythene) are made to bear the cost of polluting the environment should be introduced as a way of supporting domestic waste management.

8. The Municipal Assembly should form an environmental task force in each Electoral area (community) to monitor the activities of waste disposal including proper dumping of the refuse into the skips. Defaulters should be made to pay fines (fees) and a percentage of this should be given to the task force.
9. The replacement of burnt communal containers / waste bins should be shifted to the individuals it served. Any community that burns a skip (container) should be made to contribute and pay for its replacement.
10. Respondents with household waste bins pay GHC 10.00 per month as fee for the bins to be emptied regularly if they are provided with free bins. This service is common among the high and medium income housing sectors. The Zoomlion Company should find a way of including residents in the low income housing sector to widen the door-to-door refuse service collection.
11. Zoomlion Company should construct an engineered landfill and avoid the current practices of relocating waste dumps to any unoccupied land space within Wa.

5.4 Conclusions

After going through the various stages of this study, it is important to examine if the objectives of the study were addressed vis-a vis the information included in the conceptual framework for the study.

The first objective sought to identify the types of domestic wastes Zoomlion Company manages in Wa. This is consistent with the sources of waste in the conceptual framework. The results showed that, yard wastes, food waste/chaff and polythene rubber were identified among the other categories of household waste generated by residents. The provision of services is related to the company`s activities. The study identified various

equipments used to support service delivery. They include wastes bins, communal containers, tricycles, cesspit and skip trucks. The range of services were solid waste collection, streets and drains cleaning, sale of waste management equipments, cesspit emptier service, communal containers and tricycle services.

The study sought to identify programmes introduced by Zoomlion Company to manage domestic waste in Wa town. The data revealed that, waste/sanitation module, Sanitation guard module and mosquito control unit were common programmes the company employed in domestic waste management given its central position in the conceptual framework discussed in chapter two.

The fourth objective aimed to assess the collaboration between the Wa municipal assembly and the Zoomlion company in domestic waste management. The study reveals that, the two key stakeholders had a shared responsibility. The Wa municipal assembly recruit cleaners and provide the financial capacity for payment of services while the Zoomlion company provides logistics to the workers and plays supervisory roles.

In assessing the gains made or achievements of the Zoomlion company in managing domestic waste in Wa, household respondent's gave their views through ratings. The overall rating was very good. The company had a variety of equipments to support domestic waste management as well as the commitment from the Assembly in keeping to the payment schedules for services rendered.

Burning of communal skips, indiscriminate disposal of waste into drains as well as fecal matter (human excreta) in polythene rubbers identified by cleaners confirm challenges in domestic waste management in Wa.

The study posits that any sustainable domestic waste management system requires efficient wastes management methods, proper service delivery and sustainable waste treatment/disposal sites. This calls for stakeholders' coordination and collaboration to develop waste disposal infrastructure (incinerator, landfills and recycle plants). Given this attention, governments will not only lower the cost of managing waste but also make efficient use of limited resources. It is not uncommon to see wastes management policies/implementation gradually shifting from public to private sector collaboration in many cities in developing countries of which Wa is no exception.

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APPENDICES

UNIVERSTY FOR DEVELOPMENT STUDIES

MPHIL DEVELOPMENT MANAGEMENT

TOPIC: Contribution of Zoomlion Programmes towards Domestic Waste Management in Wa Town.

HOUSEHOLD QUESTIONNAIRE

APPENDIX I

The questionnaire seeks to elicit information on the contribution of Zoomlion programmes toward domestic waste management in Wa Town. It is an academic exercise. The answers provided therefore shall be treated confidentially.

SECTION A: IDENTIFICATION OF RESPONDENT

1. Respondent's ID ----------
2. Demographic and Socio Economic Features. (Please tick in space)
3. Age

   15-20 [ ] 21-25 [ ]

   26-30 [ ] 31-35 [ ]

   36-40 [ ] 41-45 [ ]

   45-50 [ ] 50+ [ ]

4. Sex Male [ ] Female [ ]
5. Type of occupation

   i. Private [ ]

ii. Government [ ]

iii. None [ ]

6. Level of education

i. Primary [ ]

ii. JHS/Middle form 4 [ ]

iii. SHS/O'Level [ ]

iv. Tertiary [ ]

v. None [ ]

7. Marital Status

i. Married [ ]

ii. Single [ ]

iii. Others

8. Religious affiliation

i. Christian [ ]

ii. Muslim [ ]

iii. Other----------

9. Household Characteristics

i. Owner occupant

ii. Tenant

iii. Rent free occupant

SECTION B: PROGRAMMES INTRODUCED BY ZOOMLION TO MANAGE DOMESTIC WASTE

9. Which of these waste management units is the leading waste management unit in wa?
    i. Zoomlion Gh Ltd
    ii. Wa municipal Assembly
10. What are the programmes initiated by Zoomlion to manage domestic waste in wa?
    i. Waste and sanitation module
    ii. Mosquito control programme
    iii. Sanitation guards
    iv. Afforestation
    v. Eco-brigade
    vi. Others----------
11. Which of these programmes has helped you to manage waste at home?
    i. ----------
12. Which equipments does the company use to manage domestic waste
    i. ----------
    ii. ----------
    iii. ----------
13. What services does the company render to the inhabitants in relation to domestic waste management?
    i. Solid waste collection services
    ii. Street and drains cleaning

iii. Fabrication and sale of waste management equipments

iv. Cesspit emptier

v. Tricycle waste collection

vi. Communal container

vii. Vector control

viii. Others----------

14. Suggest three ways you think Zoomlion programmes has contributed to managing domestic waste in Wa.

i. ----------

ii. ----------

iii. ----------

SECTION C: HOW INHABITANTANTS DISPOSE WASTE

(Disposal of Household Waste)

15. Where do you dump your waste?

i. Dump site [ ]

ii. Backyard [ ]

iii. Burning [ ]

iv. Communal Skip/ container [ ]

v. Road side [ ]

vi. Waste bin [ ]

vii. Others ----------

16. How much is paid to empty a household waste bin monthly?

i. Ghana Cedis [ ] pesewas [ ]

17.What is your source of information on domestic waste management?

i. Mass media

ii. Wa municipal assembly

iii. Zoomlion company

20. How many times does Zoomlion Company transport your waste in a month?

i. Once

ii. Twice

iii. Thrice

iv. Four times

v. Five times

vi. None

21. What are the benefits of keeping our surrounding clean?

i. ----------

ii. ----------

iii. ----------

SECTION D: SUCCESSES ACHIEVED THROUGH THESE PROGRAMMES

Tick in order of successes achieved by Zoomlion through its waste management programmes

ACTIVITY			
	Very Good	Good	Moderate
1. Daily Cleaning of streets and drains			
2. Provide Communal containers to communities within Wa to dump their waste			
3.Assist schools in Wa municipality with equipment to manage waste			
4.Educate the general public on proper ways of managing and handling waste			
5.Provide sanitation equipments to the municipal assembly to manage domestic waste			
6. Transport waste to landfill site at Wa Sombo			

SECTION E: CHALLENGES ENCOUNTERED IN THE COMPANY IN THE PROCESS OF INTRODUCING THESE PROGRAMMES.

16. What are the challenges facing Zoomlion company in managing domestic waste?

i. ----------

ii. ----------

iii. ----------

17. What measures have you put in place to overcome these problems?

i. ----------

ii. ----------

iii. ----------

QUESTIONNAIRE FOR ZOOMKIDS

APPENDIX II

1. Respondent ID----------
2. School----------
3. Age

   10-12 [ ] 13-14 [ ]

   15-16 [ ] 17-18 [ ]

   19+ [ ]

4. Sex Male [ ] Female [ ]

5. What are the ways you dispose of waste at school?

   i) Burning

   ii) Dumping in pits

   iii) The use of Zoomlion facilities

   iv) The use of tricycle

6. What source do you get information on waste management?

   i. School

   ii. Parents/ Relations

   iii. Media

   iv. Wa municipal Assembly

   v. Zoom lion Gh Ltd

7. What are the programmes initiated by Zoomlion to manage domestic waste in wa?

   vii. Waste and sanitation module

   viii. Mosquito control programme

   ix. Sanitation guards

   x. Afforestation

   xi. Eco-brigade

8. Have you ever received any form of assistance from Zoomlion?

   i. YES [ ] NO [ ]

9. What form of assistance was given to your school?

   i. Tools/Equipments

   ii. Cloths

   iii. Cash

12. Specify the type of tools/equipment----------

13. What services does the company render to the inhabitants in relation to domestic waste management?

   ix. Solid waste collection services
   x. Street and drains cleaning
   xi. Fabrication and sale of waste management equipments
   xii. Cesspit emptier
   xiii. Tricycle waste collection
   xiv. Communal container
   xv. Vector control
   xvi. Others

QUESTIONNAIRE FOR ZOOMLION WORKERS

(STREETS, DRAINS AND PAVEMENT CLEANERS)

APPENDIX III

1. Respondent ID ----------
2. Residence----------
3. Age

   15-20 [ ] 21-25 [ ]

   26-30 [ ] 31-35 [ ]

   36-40 [ ] 41-45 [ ]

   45-50 [ ] 50+ [ ]

4. Level of Education
   i. Primary
   ii. JHS/Middle form 4
   iii. Others
   iv. None
5. Marital status
   i. Married [ ]
   ii. Single [ ]
6. How many times do you clean in a week?
   i. ----------

ii. ----------

7. What time do you start work and at what time do you close?

i. ----------

ii. ----------

8. How do you dispose of the waste collected?

   i) Burning

   ii) Dumping in pits

   iii) The use of Zoomlion facilities

   iv) The use of tricycle

10. Do you think this programme has helped you to solve waste management problems in Wa?

11. Which programmes are introduced by Zoomlion help to manage domestic waste

    i. Waste and sanitation module

    ii. Mosquito control programme

    iii. Sanitation guards

    iv. Afforestation

    v. Eco-brigade

    vi. Others----------

14. What services does the company render to the inhabitants in relation to domestic waste management?

    i. Solid waste collection services

    ii. Street and drains cleaning

    iii. Fabrication and sale of waste management equipments

iv. Cesspit emptier

v. Tricycle waste collection

vi. Communal container

vii. Vector control

viii. Others

15. What problems do you encounter in the discharge of your duties (cleaning)?

iii. ----------

iv. ----------

v. ----------

16. What measures are taken by Zoomlion to solve domestic waste management problems in Wa?

i. ----------

ii. ----------

KEY INFORMANT INTERVIEW GUIDE

(ZOOMLION COMPANY AREA MANAGER and WA MUNICIPAL SANITATION OFFICER)

APPENDIX IV

1. Respondent ID ----------
2. Which programmes did the Zoomlion company introduce to manage domestic waste in Wa?
3. Which type of Domestic waste does the company manage?
4. Mention the equipments the company use in managing domestic waste
5. What is the arrangement/collaboration between the Zoomlion company and Wa assembly?
6. Mention the successes/achievements of the Company in domestic waste management.
7. What challenges doe the company face in managing domestic waste in Wa?
8. What suggestions will you recommend to enhance effective domestic waste management in Wa.