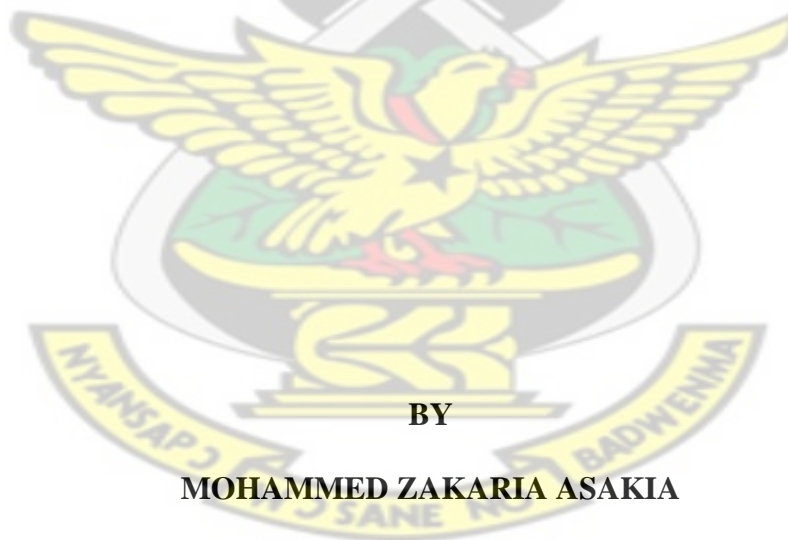


**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI**

**DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY
COLLEGE OF SCIENCE**

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**TYPES OF SOLID WASTE GENERATED, THEIR STORAGE AND DISPOSAL
IN POBAGA, BOLGATANGA MUNICIPALITY IN THE UPPER EAST
REGION, GHANA**



**BY
MOHAMMED ZAKARIA ASAKIA**

JANUARY, 2014

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IN POBAGA, BOLGATANGA MUNICIPALITY IN THE UPPER EAST
REGION, GHANA**

BY

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**A Thesis Submitted to the Department of Theoretical and Applied Biology
Kwame Nkrumah University of Science and Technology, Kumasi
In Partial Fulfillment of the Requirements for the
Master of Science Degree
in
Environmental Science**

JANUARY, 2014

DECLARATION

I hereby declare that this submission is my own work towards the MSc and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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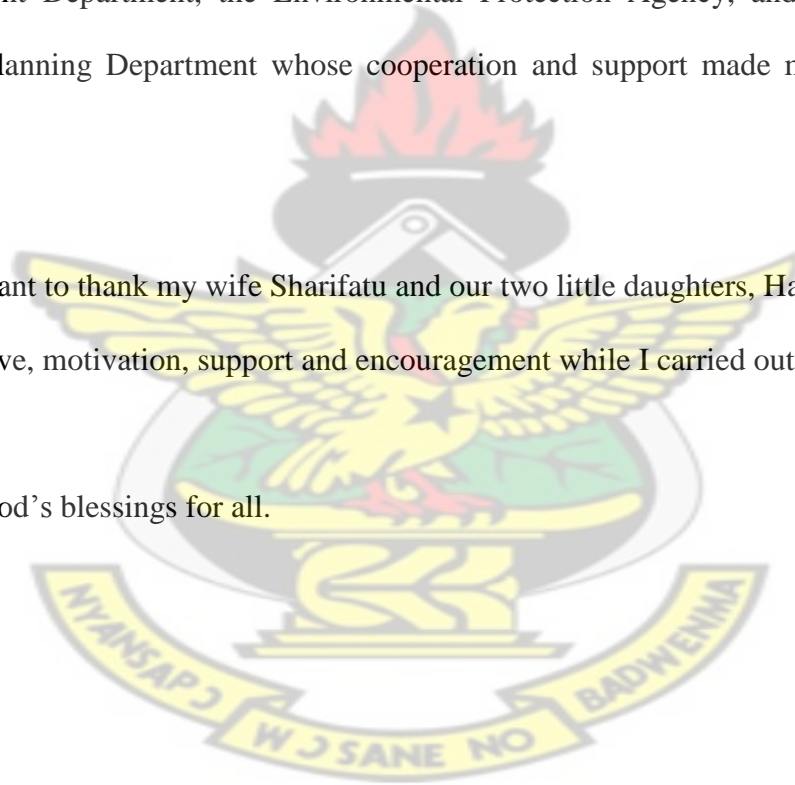
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ABSTRACT

Uncontrolled urbanization in Ghana has resulted in poor environmental conditions in urban settlements in the country. Solid waste disposal, in particular, has become a daunting task for the municipal authorities who seem to lack the capacity to tackle the mounting waste situation. The study investigated the nature of solid waste problem in Pobaga, a suburb of Bolgatanga in the Upper East Region, Ghana. It described the waste situation in the study area and identified the causes of the problem from the perspective of key stakeholders in the waste sector. The delivery of solid waste collection services across different socio-economic groups of the urban population. A mixed method approach including questionnaires, interviews, field observation, documentary analysis from stakeholders in the waste sector was adopted. The key issues identified by the study were: that Pobaga is experiencing worsening solid waste situations but the municipal authorities lack the capacity to cope with the situation; that while several causes of the urban waste crisis can be identified, data gathered showed that the major waste item generated in Pobaga is organic waste and the least waste item generated is metals. The increase in organic waste could be attributed to the fact that Bolgatanga's economy is agro-based. As population increases, it is projected that there would be an increased in solid waste output in the near future. This means that the average per capita waste of 0.5 kg generated in urban areas will be exceeded and therefore the need for a more pragmatic ways of dealing with the solid waste collection and disposal. Based on these findings, it is suggested that the solution to the worsening environmental conditions in Pobaga and in Ghana lies in recycling by converting the waste (biodegradable) into a useful resources, the appropriate technology and resources have to be employed.

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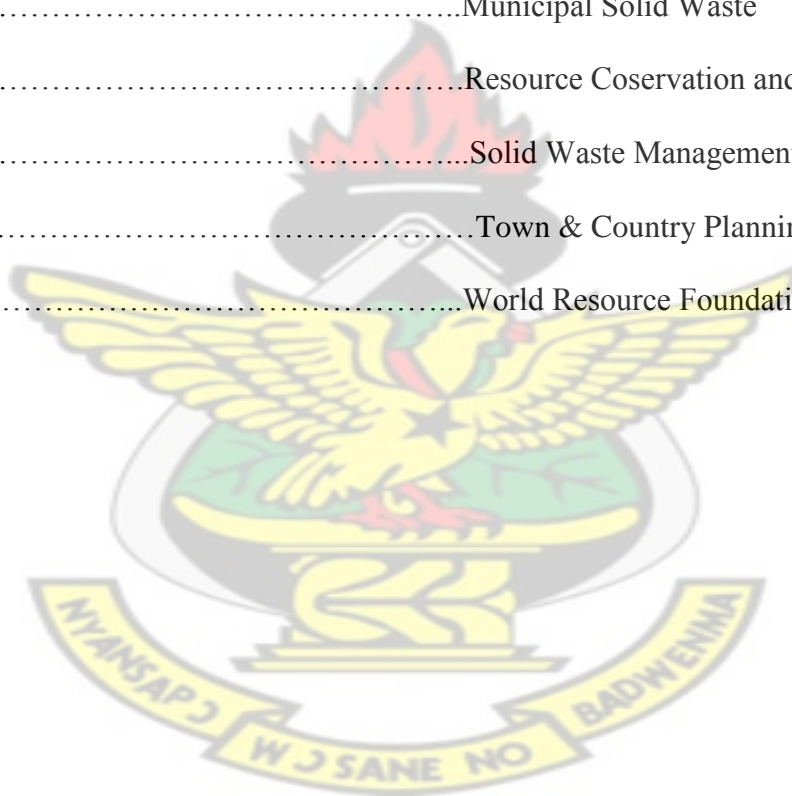
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LIST OF ABBREVIATIONS

BMA.....	Bolgatanga Municipal Assembly
DfUR.....	Department of Urban Roads
EPA.....	Environmental Protection Council
GSS.....	Ghana Statistical Service
IWM.....	Integrated Waste Management
MDG.....	Millanum Development Goals
MSW.....	Municipal Solid Waste
RCRA.....	Resource Coservation and Recovery Act
SWM.....	Solid Waste Management
T&CPD.....	Town & Country Planning Department
WRF.....	World Resource Foundation



CHAPTER ONE

INTRODUCTION

1.0. Introduction

Urbanisation is a complex phenomenon that provides opportunities and benefits for countries; but also associated with the process are problems of social, economic and environmental nature. Among the many problems that confront cities in Ghana, solid waste collection and disposal is a particularly worrying issue that seems to overwhelm the authorities. In fact, the problem appears intractable and can be likened to a ‘monster’ staring the authorities in the face while they look on helplessly (Kironde, 1999).

Most city governments are confronted by mounting problems regarding the collection and disposal of solid waste. In high-income countries, the problems usually centre on the difficulties and high cost of disposing of the large volume of waste generated by households and businesses. In lower-income countries, the main problems are related to collection, with between one-third and one-half of all solid waste generated in Third World cities remaining uncollected (Pacione, 2005).

Today, municipal solid waste collection and disposal are particularly problematic in developing country cities, but many western cities had also grappled with this problem in the past (and some probably still do).

Nowadays, some western countries generally rely on land filling to overcome the problem of waste collection (Girling, 2005; Pacione, 2005). The landfill seems to have a special attraction for municipal waste managers because it offers a cheap and convenient option for waste disposal compared with other strategies such as reuse, recycling and

energy recovery (Chazan, 2002). In fact, with the exception of few countries like Austria, the Netherlands and Denmark who recycle substantial proportions of their waste, most countries in Europe and North America still dump the bulk of their municipal solid waste in landfills (Girling, 2005). Thus, the current requirement for countries to move up the waste hierarchy remains a real challenge for even the rich and technologically advanced countries (OECD, 2000).

While cities in the developed countries have generally overcome the problem of waste accumulation and now grapple with finding appropriate methods of treatment and disposal, developing country cities are still grappling with the basic problem of waste accumulation as well as its disposal. Pacione (2005) observed that the main problems facing developing country cities with regard to waste management are related to the collection of waste from the city environments, with between one-third and one-half of all the waste generated in the cities remaining uncollected.

Recent studies in Africa have shown that the problem of waste management has become intractable and threatens to undermine the efforts of most city authorities (Pacione, 2005), Kirondi (1999). Kirondi (1999) observed that the city environment in most developing countries is characterised by heaps of garbage, overflowing waste containers, choked drains, clogged streams and stinking gutters. Unable to provide adequate waste disposal and other environmental services within their entire jurisdictions, municipal authorities in most developing countries tend to concentrate their waste collection efforts in official and wealthy areas while the poorer areas receive little or no service for waste removal even though waste collection operations are usually funded with public resources (Lohse, 2003). Besides, waste disposal facilities, which are usually poorly maintained,

are frequently sited in the neighbourhoods of the poor and other vulnerable population groups (Camacho, 1998; Bullard, 2005) which implies the shifting of environmental burdens on the poor.

The generally poor waste situations in developing country cities and the perpetuation of social and environmental injustice against the poor remain critical challenges and deviate from the objectives of the Millennium Development Goals (MDGs), Agenda 21 and other moves to address the problems to improve the living conditions of the poor. In line with the situation in poor country cities generally, Ghanaian cities are grappling with mounting solid waste and other environmental problems with socio-spatial inequalities in the distribution of the waste burden. These issues invite research attention.

1.2. Statement of the research problem

The problem under investigation in this study is the worsening solid waste collection and disposal situation found in urban settlements in Ghana. The concentration of population and business activities in Ghanaian cities is being accompanied by a rapid increase in the volume of solid waste generated from production and consumption activities. Against this situation of mounting waste production, municipal authorities in the country seem unable to organize adequate collection and safe disposal of waste within their jurisdictions. As a result, urban settlements in the country are saddled with a worsening solid waste situation which proves to be intractable and threatens public health and the environment. A cursory observation within the cities shows visible aspects of the solid waste problem including accumulation of garbage, heavy street litter, waste-clogged drains and water bodies and stinking gutters.

In spite of the concerns frequently raised by concerned groups, civil societies,

institutions and individuals among the populace, the solid waste situation in the cities continues to worsen, thereby posing serious threats to public health and the environment. Besides, the environmental burdens associated with the worsening solid waste situation appears to fall more heavily on the poor even though waste removal are public funded.

1.3. Main Objective

The main objective of the study was to assess the efficiency of solid waste collection and disposal in Pobaga, Bolgatanga Municipality of the Upper East Region

1.4. Specific Objectives

The specific objectives were:

- i. To identify the sources and composition of solid waste generated in Pobaga.
- ii. To determine the amount of solid waste generated in the municipality per household.
- iii. To identify household waste storage and disposal arrangements.

1.5. Justification for the study

The worsening solid waste collection and disposal situation in Ghanaian cities has attracted attention among the populace. High profile government officials including Ministers of State, parliamentarians and even the presidency have expressed concern about the deplorable solid waste situation in cities in the country. Ghana's Minister of Tourism, Jake Obetsebi Lamprey lamented that "the visible mountains of refuse in Accra give visitors the impression that Ghana is a filthy country" (Daily Graphic, July 13th. 2007). In view of the above, this study can be justified on the grounds that it will further the understanding of the solid waste problem affecting Ghanaian cities and provide a

useful starting point for addressing an otherwise intractable problem. The study will also contribute to both the theory and practice of urban solid waste management in poor countries generally.

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CHAPTER TWO

LITERATURE REVIEW

2.0. Defining waste

The *Longman Dictionary of Contemporary English* defines waste as “the unwanted material or substance that is left after you have used something” while the *New Shorter Oxford English Dictionary on Historical Principles* defines it as “the unusable material left over from a process of manufacture, the use of consumer goods etc., or the useless by-products of a process.” Gilpin (1996) provides a more elaborate definition of the term waste. According to him, the concept of waste embraces “all unwanted and economically unusable by-products or residuals at any given place and time, and any other matter that may be discarded accidentally or otherwise into the environment” (Gilpin, 1996). Gilpin also suggests that what constitutes waste must “occur in such a volume, concentration, constituency or manner 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.

2.1. The classification of waste

A number of criteria are usually employed to classify wastes into types including their sources, physical state, material composition and the level of risk associated with waste substances (Table 1). Such classification of waste provides a basis for the development of appropriate waste management practice.

Table 1. Classification of waste

Criteria for waste	Examples of waste types
Sources or premises of generation	Residential, commercial, industrial, municipal services, building and construction, agricultural areas
Physical state of waste	Liquid, solid, gaseous, radioactive
Material composition of waste	Organic food waste, paper and card, plastic, inert, metal, glass, textile waste
Level of risk	Hazardous, non-hazardous

The classification of waste is based on the fact that waste emanates from different sectors of society such as residential, commercial and industrial sources. A good example of the source classification was provided by the World Bank (1999) in a study in Asia which identified the sources of waste as residential, commercial, industrial, municipal services, construction and demolition, processing and agricultural sources. The UK Environment Council (2000) also employed source classification to identify the major sources of waste as municipal sources, commerce and industry, agricultural sources, demolition and construction activities, dredged spoils, sewage sludge and mining and quarrying operations. Classifying wastes by their sources is a useful way of determining the relative contributions of the different sectors of society to the waste stream and how to plan for their collection and disposal.

Frequently, the material composition of the waste stream is also used to classify wastes into such types as organic waste, paper and cardboard, plastic, glass, ceramics, textiles metal and inert waste (Table 2). An example of waste classification based on material composition was conducted by the Surrey County, UK in 2002/2003. An analysis of household waste streams in the country identified nine main types of materials:

paper/card, plastic film, dense plastic, textiles, miscellaneous combustibles, glass, ferrous metal, garden waste and food waste (Surreywaste.info, online).

Table 2: Material classification of waste

Waste type	Examples
Paper	Newspapers, cardboards, office waste paper, magazine/glossy
Plastics	Bottles, expanded polystyrene, film plastic, other rigid plastics
Glass	Clear glass, green glass, amber glass, non-recyclable glass
Metals	Steel cans, aluminum cans, other ferrous, other aluminum
Organics	Yard waste-grass, yard waste-other, wood, textiles, diapers, fines, other organics
Inorganic	Electronics, carpets, drywall, other construction and demolition, other inorganic

Using the physical state of waste substances, the materials in the waste stream can also be categorised into liquid, solid, gaseous and radioactive wastes. Examples of these types are shown in Table 3.

Table 3: Classification of waste based on physical state of waste substances

Waste type	Examples
Liquid waste	Sewage sludge, waste water from bathhouse and kitchens
Solid waste	Food waste, paper, plastic, metal, debris
Gaseous waste	Factory smoke, vehicle exhaust smoke, fumes from burning waste dumps
Radioactive waste	Radiation, uranium, plutonium, excess energy

Furthermore, the potential health or pollution risk of waste materials is used to classify wastes into hazardous or non-hazardous waste (Table 1). On the one hand, hazardous waste refers to wastes with properties that make them potentially harmful to human health or the environment (US EPA, 2008). According to the US EPA (2008), hazardous wastes can be liquids, solids, contained gases, or sludge and can be the by-products of manufacturing processes or simply discarded commercial products like cleaning fluids or pesticides. Because of their potential pollution danger, hazardous waste materials require rigorous and cautions means of disposal (DELM, 2003).

In the US EPA's *Hazardous Waste Listings* (2008) the categories of hazardous wastes include ignitable waste, corrosive waste, reactive waste, toxicity characteristic waste, acute hazardous waste and toxic waste. Special waste is one type of hazardous waste which is usually so dangerous to treat, keep or dispose of that it requires special disposal arrangements (US EPA, 2008). Examples include hard clinical waste such as human parts, contaminated swab and sharps. On the other hand, non-hazardous waste does not pose a danger and can be dealt with easily, examples being inert materials such as uncontaminated earth and excavated waste such as bricks, sand, gravel and concrete slates (Environment Council, 2000).

Waste can also be classified by whether it is biodegradable or non-biodegradable waste. 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 (Lapidos,

2007). In contrast with biodegradable waste, non-biodegradable waste, which includes most plastics, metals and ceramics, are waste substances that cannot be broken down by natural processes or living organisms (Lapidos, 2007).

The classification of waste into types, as discussed above, is very important for waste management planning. Among other things, it provides useful information that enables municipal authorities to organize waste management operations including the frequency and means of collection, and appropriate disposal methods. The developed countries have made great advances in waste data generation and analysis which have enabled them to improve waste management over the years. In most developing countries, however, even the most basic data on waste such as the quantities generated and composition of the waste stream are lacking, making it difficult to organise waste management effectively (Hardoy *et al.*, 2001).

2.2. The concept of waste management

The business of keeping our environment free from the contaminating effects of waste materials is generally termed waste management. Gbekor (2003), for instance, has referred to waste management as involving “the collection, transport, treatment and disposal of waste including after care of disposal sites”. Similarly, Gilpin (1996) has defined waste management as “purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner” while Schubeller *et al.* (1996) focus on municipal solid waste management which they define as “the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas”.

It can be deduced from these definitions that waste management is the practice of protecting the environment from the polluting effects of waste materials in order to protect public health and the natural environment. Thus, the priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment (Cooper, 1999). Further, Gilpin (1996) regards the business of waste management as a professional practice which goes beyond the physical aspects of handling waste. It also “involves preparing policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public” (Gilpin, 1996). Waste management, therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment. Effective waste management is, however, a growing challenge to all municipal governments, especially in developing countries.

2.3. The goals of waste management

In 1976, the United States Congress enacted the Resource Conservation and Recovery Act (RCRA) which authorized the EPA to regulate waste management and disposal practices. The goals of waste management that were set by the RCRA included:

1. the protection of human health and the environment from the hazards posed by waste disposal
2. the conservation of energy and natural resources through waste recycling and recovery
3. reducing or eliminating the amount of waste generated, and

4. ensuring that wastes are managed in an environmentally-safe manner (RCRA, 1976)

Other writers agree with these objectives of waste management. For example, Schubeller *et al.* (1996) have stated the goals of municipal solid waste management as protecting environmental health, protecting the quality of the environment, supporting the efficiency and productivity of the economy and the generation of employment and income for people. On her part, Cointreau (2001:online) argued that “the overall goal of urban solid waste management is to collect, treat and dispose of solid waste generated by all urban population groups in an environmentally and socially satisfactory manner, using the most economical means available”.

Similarly, the Ghana Environmental Protection Agency has noted that waste management is essential in the present day context for the following reasons:

1. To protect human health against waste-related hazards and risks
2. To prevent pollution of the environment and its natural resources like air, water and land
3. To produce energy which could be an alternative for the fast depleting fossil fuels and other conventional sources of energy
4. To make optimum use of the waste generated
5. For a better and sustainable future (Ghana EPA, 2002).

It can be concluded from the above that the main objective of waste management is to protect public health against waste-related hazards and risks, and to maintain ecosystem services by preventing the pollution of the natural environment and its resources such as land, water and air as well as the aesthetic quality of the environment.

To achieve the goals of municipal solid waste management, it is necessary to establish sustainable systems of solid waste management which will meet the needs of the entire urban population including the poor. The systems put in place for solid waste management must be appropriate to the particular circumstances of the city and its various localities. To achieve sustainable waste management, such a system must harness and develop the capacities of all stakeholders in the waste sector (Schubeller *et al.* 1996) including civil society, businesses, private sector waste companies and government agencies. Due to their low technical, financial and managerial capacities, most municipal authorities in developing countries fail to achieve the goals of waste management and are, therefore, unable to achieve the basic objective of waste management which is to protect public health and the natural environment against waste pollution (Hardoy *et al.*, 2001; Pacione, 2006).

2.4. The principles of waste management

The principles of waste management, as identified by Schubeller *et al.* (1996), are “to minimize waste generation, maximize waste recycling and reuse, and ensure the safe and environmentally sound disposal of waste”. This means that waste management should be approached from the perspective of the entire cycle of material use which includes production, distribution and consumption as well as waste collection and disposal. While immediate priority must be given to effective collection and disposal, waste reduction and recycling should be pursued as equally important longer-term objectives (Schubeller *et al.*, 1996).

Cointreau (2001) has also identified ten principles that should guide a sustainable and integrated solid waste management programme. According to her scheme, such a programme should:

1. Be supportive of good governance
2. Provide economic service delivery
3. Establish cost recovery mechanisms for long-term financial sustainability
4. Conserve natural resources
5. Embrace public participation
6. Foster environmentally appropriate technologies and sites
7. Seek appropriate levels of source segregation, recycling and resource recovery
8. Conduct strategic facility planning and development
9. Build institutional capacity
10. Invite private sector involvement

In line with Gilpin's (1996) notion of waste management, this means that waste management involves much more than the practical organization of waste collection, transportation, treatment and disposal. While these are important aspects of waste management, several other issues are equally important including good governance, public and private sector participation (Cointreau, 2001). The waste management situations in most developing countries show that the goals and principles of waste management are far from being achieved (Schubeller *et al.*, 1996; Hardoy *et al.*, 2001; Pacione, 2005).

2.5. Integrated waste management and the waste hierarchy

In recent years, the concept of integrated waste management (IWM) has become popular as a new approach to waste management. As defined by the World Resource Foundation (WRF, cited in Environment Council, 2000), IWM refers to “the use of a range of different waste management options rather than using a single option”. In other words,

IWM is an approach which relies not only on technical solutions to the waste problem, but on a wide range of complementary techniques in a holistic approach. The approach involves the selection and application of appropriate technologies, techniques and management practices to design a programme that achieves the objectives of waste management (Tchobanoglous *et al.*, 1993).

2.6. Sustainable waste management

Another important concept of waste management is ‘sustainable waste management’ (SWM). SWM is an integral part of sustainable development (the Brundtland Commission’s approach to development which seeks to “meet the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987) because the amount of waste generated and how it is managed has profound implications for the quality of the environment and for the prospects of future generations. Thus, in keeping with the objectives of sustainable development, sustainable waste management can be regarded as an approach to waste management that, in addition to protecting human health and the environment, ensures that the scarce resources of the earth are conserved for both present and future generations of humanity. It therefore becomes important to minimize natural resource extraction and consumption by recycling waste materials, and conduct waste management efficiently to curtail the environmental impacts of waste disposal and protect ecosystem services for both current and future generations (Millennium Assessment Report, 2005).

In line with the waste hierarchy, the best way to achieve sustainable waste management is to reduce the amounts of waste we produce (Girling, 2005). Where waste is unavoidable a sustainable approach is to encourage re-use and recycling of products to

prevent them from getting into the waste stream. Finally, where waste prevention/reduction, re-use and recycling are economically impossible, waste is processed to recover their intrinsic values such as energy. Sustainable waste management also seeks to increase co-ordination between the producers of goods, retailers, manufacturers, the public, local authorities and all concerned with the management of waste and reusable materials and equipment (London Waste Action, 2007).

2.7. The urban solid waste problem in developing countries

The rapid urbanization which is currently occurring in the developing parts of the world has many positive impacts including economic growth and modernization but it is also accompanied by problems of a social, economic and environmental nature. Thus, while cities in these countries grapple with socio-economic problems such as poor shelter, unemployment, poverty and misery, there are also mounting environmental problems including poor sanitation and water quality, slum development and a worsening solid waste situation which, among other problems, have become great challenges to municipal authorities (Kwawe, 1995; Hardoy *et al.*, 2001; Pacione, 2005).

In particular, the urban solid waste situation in most poor countries is worrying. The growing consumption of products among the rapidly increasing urban populations is leading to mounting waste generation well above the capacities of municipal authorities responsible for waste management. Most municipal authorities in developing countries are, therefore, overwhelmed by an intractable waste situation as shown by recent studies in major urban centres in Africa, Asia and Latin America (Pacione, 2005). Most cities in the developing world are, therefore, drowning in waste (Chazan, 2002).

The appalling solid waste situation in the world's poor cities has attracted attention even at the global level. For instance, the waste problem was considered so important that in 1992, a whole chapter (Chapter 21) of the United Nations programme for sustainable development in the 21st century (Agenda 21) was devoted to it, titled *Environmentally Sound Management of Solid Wastes and Sewage Related Issues* (UN Department of Economic and Social Affairs, Division of Sustainable Development, 2004). In Section 1, paragraph 12 (g) of its Resolution 44/288, the UN General Assembly “affirmed that environmentally sound management of wastes was among the environmental issues of major concern in maintaining the quality of the Earth's environment and especially in achieving environmentally sound and sustainable development of all countries”. To address the waste problem confronting the world, four major programme areas were identified which were:

- Minimizing wastes
- Maximizing environmentally sound waste reuse and recycling
- Promoting environmentally sound waste disposal and treatment
- Extending waste service coverage

The waste problem is, however, not only limited to cities in poor countries. While the developed countries have largely overcome the problem of waste removal from human settlements, they still grapple with the difficulties and high costs of collection and struggle with the implementation of sustainable waste management strategies (Pacione, 2005). Besides, growing land scarcity and stricter environmental standards now make it difficult for many rich cities to find adequate and suitable disposal sites for the large volumes of waste being generated by their urban populations (Pacione, 2005; Chazan, 2002). For some rich countries, a way out of this dilemma is to export waste to poor

countries and it is estimated that 50 to 80 percent of all waste collected for recycling in Western countries end up in developing countries (Basel Action Network, 2008). In 2006 for example, Britain alone is said to have exported over 200,000 tonnes of plastic waste to China for recycling, along with more than 2 million tonnes of used paper or cardboard and large quantities of steel and redundant electrical goods (Basel Action Network, 2008).

2.8. The nature of the waste problem in developing countries

While data is generally lacking in the waste sector of developing countries, available studies on the topic suggest that solid waste management is generally characterized by inefficient collection methods, insufficient coverage of the collection systems and improper disposal of municipal waste (Hardoy *et al.*, 2001; Pacione, 2005). Major urban settlements are, therefore, characterised by waste accumulations and poor environmental sanitation (Hardoy *et al.*, 2001; Pacione, 2005; Palczynski and Scotia, 2002).

In many Third World cities, (Hardoy *et al.*, 2001; Pacione, 2005) suggest that large proportions (between 30 and 50 percent) of the solid waste generated by the residents are never collected for disposal and end up rotting on the streets, in drains and in streams (Hardoy *et al.*, 2001; Pacione, 2005). Hardoy *et al.* (2001) for instance have reported the extensive lack of solid waste collection in cities across the developing world. Pacione (2005) has also commented on the lack of provision for urban waste management in poor countries and the resulting poor environmental conditions in the cities. According to him, most poor city governments have great difficulty regarding the collection and safe disposal of solid wastes. He estimates that between one third and one half of all solid waste generated in Third World cities remains uncollected and the collection rate could be

as low as 10 – 20 percent in some cases. Depicting a similar picture of the problem, Cointreau (2001), has estimated that in some cases, up to 60 percent of solid waste generated within urban centres in poor countries remains uncollected and such refuse accumulates on lands and streets, sometimes to the point of blocking roads.

Table 4: Solid waste collection in selected cities in developing countries

City(Country)	Percentage of solid waste	Year
Accra (Ghana)	10	1989
Addis Ababa (Ethiopia)	60	1998
Ahmedabad (India)	65	2000
Baroda (India)	05	1994
Kampala (Uganda)	10	1993
Kumasi(Ghana)	30	2000
Latin American cities	50-70	1999
Lusaka and other cities (Zambia)	10	1997
Mombassa (Kenya)	40	2000
Ouagadougou (Burkina Faso)	30	1995
Sao Paolo (Brazil)	70	1998

Source: Hardoy *et al.* (2001)

The above analysis has shown that even though cities in poor countries generally have low levels of solid waste collection and disposal, there seems to be great variations in the scale of the waste problem across regions and countries (Hardoy *et al.*, 2001). Regionally, Latin American cities appear to have better environmental management than African and Asian cities. This is reflected in the high level of waste collection (up to 70 percent in some cases) in Latin American cities compared with the very low levels of waste collection in African and Asian cities. What this means is that while all developing country cities grapple with solid waste collection and disposal, some are doing relatively better than others. Regionally, Africa seems to have the worst situation with regard to urban solid waste management (Hardoy *et al.*, 2001).

2.9. Spatial disparities in the magnitude of the solid waste problem

While city authorities in developing country cities are generally unable to provide adequate solid waste disposal services within their jurisdictions, the literature on the topic also shows that there are spatial disparities in the scale of the waste disposal problem within cities.

These disparities are socio-spatial in nature as waste collection services are concentrated in, if not confined to, official areas and wealthy residential neighbourhoods while the low-income communities receive little or no attention. In particular, many writers have described solid waste collection services in the cities which show enormous disparities between rich and poor residential areas.

2.1.0. Causes of the solid waste problem in developing countries

Researchers have identified several factors that militate against solid waste management efforts in poor country cities. In a GEF/UNDP/IMO Regional Programme report, for instance, Linden *et al.* (1997) identified ten common constraints to be militating against solid waste management efforts in Asian countries. These were:

1. Inappropriate technologies/processes
2. Enforcement inefficiencies/non-existent; illegal dumping
3. Lack of financing
4. Lack of training/human resource
5. Lack of political support
6. Lack of legislation Policy conflict among levels of government/overlapping responsibilities

7. Rapid increase in waste generation/limited data
8. Lack of awareness among public, and
9. Limited land areas; land tenure issues

(Linden *et al.*, 1997: online).

These factors, according to the report, frustrated the waste management efforts of municipal authorities in Asia and made it difficult for them to keep their city environments clean and safe for the populations. After studying the solid waste problem in Tanzania, Kironde (1999) has also attributed the abysmal performance of the waste sector to resource constraints including the scarcity of financial, physical, human and technical resources for the organization of waste management operations.

In a study of the solid waste problem confronting the city of Kampala, Uganda, researchers from the Namilyango College (2001) identified several causes of the waste problem including the lack of dumping sites, ignorance of the masses about the need for proper waste disposal, inefficient collection methods, poor government attitude towards waste management, poverty of the people, corruption among public officials and lack of trained personnel for waste management. These have posed serious constraints to the waste sector and dampened efforts towards waste management in the city. Many other writers have elaborated on how the factors cited above (plus others) interact to aggravate the solid waste problem in poor country cities. What follows from here is a detailed examination of the factors responsible for the abysmal waste situation in poor country cities.

2.1.1. Financial and economic constraints

Many writers have cited the scarcity of funds as a major constraint to solid waste management in all developing countries (Cointreau, 2001; Ogawa, 2002; Lohse, 2003;

Pacione, 2005). Lohse (2003) has described the problem of municipal finance in developing countries as “the gap between financial resources and municipal expenditure needs”. According to him, this fiscal gap is widening as urban populations expand, increasing the demand for infrastructure and services including waste disposal. Lohse (2003) explains that one reason for the municipal finance gap is that “most municipalities lack the autonomy to establish their tax basis, rate structures, and enforcement procedures, and so cannot raise revenues commensurate with their expenditure requirements. Ogawa (2002) has also observed that the finance problem in developing countries is most acute at the municipal government level where the local taxation system is inadequately developed and therefore the financial basis for public services is weak. He attributed the problem of finance to the low capacity of local governments for cost recovery and their heavy reliance on state subsidies for waste management operations.

2.1.2. Inadequate personnel for waste management

The poor waste disposal situation in poor country cities has also been attributed to the general dearth of qualified personnel in the waste sector (Ogawa, 2002). Ogawa (2002) corroborates this observation when he notes that developing countries characteristically lack the technical expertise required for solid waste management planning and operation and this is usually the case at both national and local levels. He argues that many officers in charge of solid waste management have little or no technical background training in engineering or management. Without sufficiently trained personnel, however, solid waste management projects cannot be effective and sustainable. Ogawa (2002) has observed that in many cases, solid waste management programmes initiated by external consultants have collapsed in the hands of local management due to the lack of expertise

and loss of funding. Lohse (2003) has also observed that local governments in developing countries generally lack the required capacity and technical expertise to accomplish effective and sustainable waste management programmes. The lack of qualified waste management personnel has been blamed on the lack of training and poor conditions of service in the sector. Generally, employees in the waste sector are poorly paid and have very poor conditions of service which makes many people shun jobs in the sector, including labourers (Kironde, 1999).

2.1.3. Technological constraints

The technologies employed in municipal solid waste management in most developing countries are also said to be inappropriate and inadequate. Zurbrugg (2002) has observed that adoption of the conventional waste collection vehicles used in rich countries constrain solid waste management operations in developing countries. Apart from the high acquisition and maintenance costs involved, developing countries actually lack the engineering capacity to support the operation and maintenance of such sophisticated equipment like compactors and skip lifts. Yet, this is the equipment usually employed by municipal authorities and private sector waste contractors in many poor countries (Armah, 1993; Achankang, 2003). Besides, the high cost of new equipment compels many poor country municipal governments to import used equipment from western countries. Such vehicles arrive already near the end of their useful life and so frequently require repairs due to breakdowns. In the absence of spare parts and the required engineering skills to maintain the trucks, only a small part of the fleet usually remains in operation after a short period of their use (Achankang, 2003).

In Tanzania, Kironde (1999) found that shortage of equipment was a major problem facing the waste disposal operations of the Dar es Salaam City Council. At the time of their study in 1999, only about one-third of the 43 pieces of equipment for the Ibadan waste management office were in working order. In Uganda, the waste management department in the capital city, Kampala, was said to lack basic equipment like trucks for waste collection and equipment for maintenance of disposal sites (Namilyango College, 2001).

Besides the shortage of suitable equipment, the poor spatial organization of many developing country cities, characterized by unplanned housing developments, poor road quality and poor access within settlements does not support use of the large and heavy western type waste collection vehicles (Armah, 1993). There is, therefore, the need to design and manufacture appropriate but inexpensive waste management equipment that is suitable for the conditions in developing countries. This calls for research into waste management technologies that will suit local conditions.

2.1.4. Institutional constraints

Inefficient institutional arrangements adversely affect urban management in poor countries generally and environmental service delivery in particular (UN-Habitat, 1989; Ogawa, 2002; Zurbrugg, 2002). According to UN-Habitat (1989), it is characteristic of developing countries to have several agencies involved in the delivery of solid waste and other municipal services. Furthermore, Ogawa (2002) has observed that there are often no clear roles or functions of the various agencies involved in urban environmental management. At the same time, no single agency is usually designated to coordinate the activities of waste sector agencies (Armah, 1993; Attahi, 1999). Ogawa (2002) has, therefore, observed that the lack of coordination among the relevant urban sector

agencies often results in different agencies duplicating one function. In the case of externally supported solid waste management projects, it is common for different agencies within the same country or city to act as counterparts of external support agencies for different waste management projects without any collaboration of efforts (Ogawa, 2002).

2.1.5. Lack of legislation and enforcement

The lack of legislation on solid waste management has also been cited as being partially responsible for the undefined roles of agencies in the waste sector as well as the lack of coordination among them. In the report of their African Development Bank (ADB) sponsored literature-based study of solid waste management options for Africa, Palczynski et al (2002) noted that “no country (in the study) has a specific waste management legislation even though legislation is being drafted now in some countries”. Ogawa (2002) has also observed that legislation related to solid waste management in developing countries is usually fragmented and several acts (such as public health, local government and environmental protection acts) include clauses relating to solid waste management. Such rules and regulations are, therefore, to be enforced by different agencies with duplication of responsibilities and gaps in the regulatory provisions which constrain the development of effective solid waste management systems. Furthermore, some of the laws are completely out of date and therefore of little use. The lack of adequate legislation makes it difficult to assign clear mandates to urban sector institutions connected with waste management, a situation which greatly constrains the waste sector.

Besides the scarcity of legislation on waste management, Attahi (1999) has also noted the inability or unwillingness of municipal officials to enforce existing laws on environmental sanitation including the scanty legislation on waste disposal. This situation is particularly grave in the major cities where there is a general lack of public compliance with waste disposal laws (Ogawa, 2002) if they exist at all.

2.1.6. Lack of good governance and civil society

The low status of environmental services in poor country cities has also been blamed on the lack of good governance which promotes the well-being of the people, and on the lack of civil society action to exert pressure on governments to live up to their social responsibilities (Devas, 1999; Kwawe, 1995; Hashmi, 2007). Due to 'bad governance', municipal governments in poor countries show little regard for the well-being of the citizens and so renege on their responsibility to provide basic infrastructure and services to keep the cities clean, healthy and safe (Hashmi, 2007). Commonly, autocratic styles of administration by supposedly democratic regimes alienate public opinion and participation in urban management (Devas and Korboe, 2000; Hashmi, 2007), a situation which does not augur well for effective waste management. From a governance point of view, the fact that the ordinary residents of cities, especially the poor, are denied participation in decision-making about issues that affect them means that their concerns may never be taken on board and their needs for such services as water, sanitation and waste disposal are therefore unlikely to be met (Devas, 1999; Devas and Korboe, 2000). The problem of poor urban governance is further compounded by the lack of effective civil society action to compel governments to enact and enforce environmental laws, and to carry out their responsibilities to the citizenry.

2.1.7. Political neglect

While the various factors discussed above are important contributors to the poor solid waste situation in poor country cities, some researchers find political neglect to be the root cause of the waste problem in poor country cities. Both national and municipal governments in poor countries seem to lack the political will to manage the rapidly growing cities and to provide infrastructure and services for environmental maintenance.

From the analysis above, it can be concluded that the quality of solid waste management is directly affected by the level of financing and investment in waste management equipment, the level of training and motivation of waste management personnel, the level of enforcement of waste disposal legislation and the level of public education and involvement in the planning and organisation of waste management, factors which are themselves affected by the level of political commitment to the solid waste problem (Figure 1).

Figure 1: Conceptual model of the factors affecting the quality of solid waste management



Source: Devas (1999)

A government that regards waste management as a priority would demonstrate its commitment by providing an enabling framework within which waste management can be organised effectively to protect public health and the environment. Strong political commitment to solving the waste problem in any city therefore is reflected in adequate investment. The poor solid waste disposal situation that currently confronts developing country cities can therefore be ultimately attributed to the low political commitments of their governments to the issue of solid waste management.

As a typical developing country, Ghana also has a serious waste management problem in all its major cities. Urban settlements in the country are characterised with worsening waste disposal situations which the authorities seem unable to deal with.

2.1.8. Environmental injustice and municipal solid waste disposal

Numerous studies show that in both rich and poor countries, residents of poor communities and disadvantaged geographical locations suffer environmental injustice in relation to waste disposal (Camacho, 1998; Hardoy *et al.*, 2001; Bullard, 2005). In the United States where there is a very high correlation between race and socio-economic status, communities of colour and ethnic minorities are frequently the major victims of environmental injustice (Timney, 1998; Bullard, 2005) and researchers have come up with significant evidence to support the claim that race is the central determining factor with toxic exposure from waste. Attention has therefore been focused on examining the racial composition and income levels of communities living near toxic municipal solid waste landfills and the demographics of hazardous waste facility locations (e.g. Heiman, 1996; Camacho, 1998; Timney, 1998; Bullard, 2005).

CHAPTER THREE

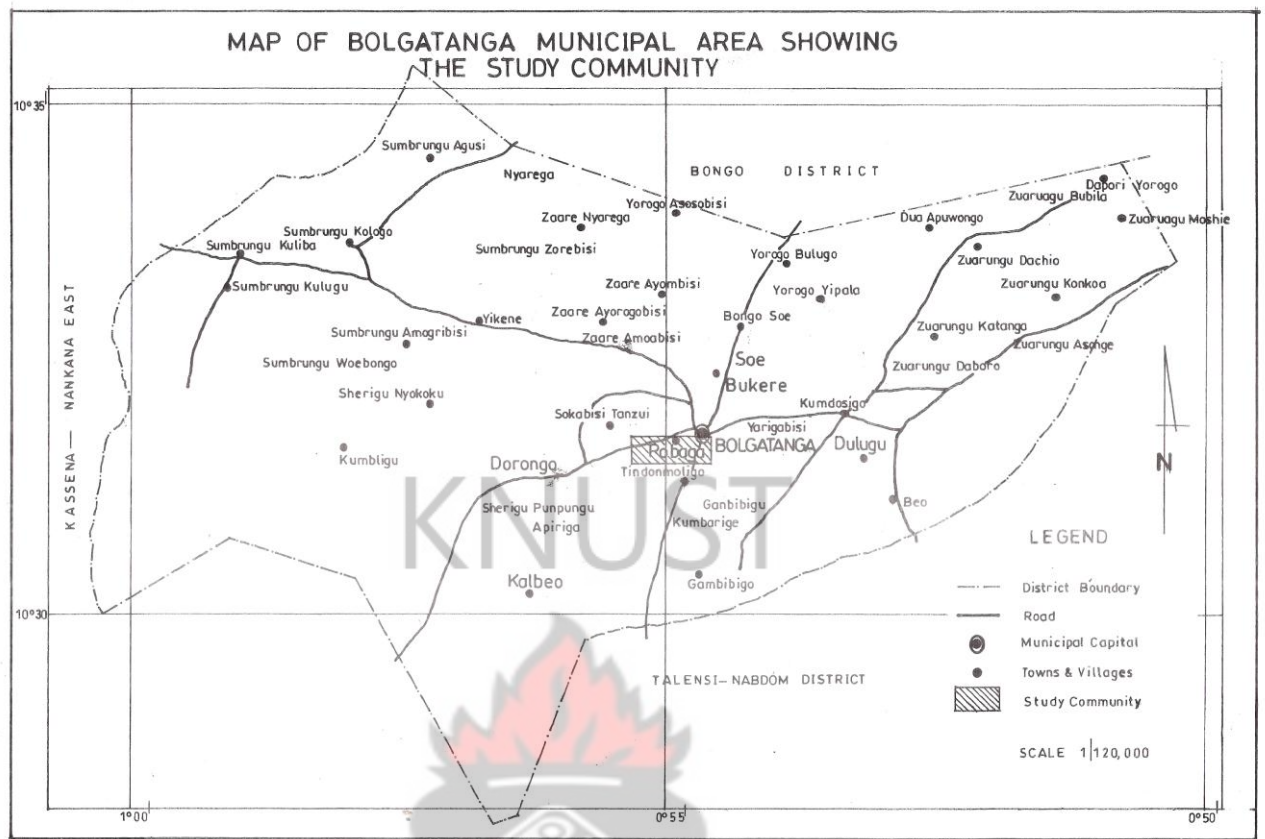
MATERIALS AND METHODS

3.0. The study area

The Bolgatanga Municipality in the Upper East Region of Ghana is bordered to the west by Kassena/Nankana District, to the north by the Bongo District, to the east by the Bawku West District, and to the south by the West Mamprusi District, which is part of the Northern Region (Figure 2).

Bolgatanga township has a cosmopolitan population, which is about 72,768 (Ghana Statistical Service, PHC, 2000). Although majority of the inhabitants are from northern ethnic origins, there have been a huge influx of other major ethnic groupings of Ghana including the Akans, Ewes and Ga-Adangbes into the town because of its regional capital status. Most of these ethnic groupings are organized around chiefs and leaders, while others come together as social groupings. There are over 5000 houses in the township with over 15,000 households. Bolgatanga Municipality has a total land area of 729 sq km and it was established by LI 1797 (2004) (Ghana Districts.com).

Study was conducted in Pobaga in Bolgatanga township of Upper East Region. Pobaga is one of the busiest and biggest suburbs of Bolgatanga Municipality. It shares boundaries with Tanzui to the north, Doringo to the east, Tindongmoligo to the south and Yarigabisi to the west.



SOURCE: Bolgatanga Municipal Assembly



Figure 2 Map of Ghana showing location of the study area, Pobaga in the Bolgatanga Municipality of the Upper East Region.

3.1 Methods of data collection

The study employed interviews, semi-structured questionnaires, field observations and documentary analysis.

3.2. Structured interviews

Interviewing is a useful way of collecting qualitative data because the technique is 'introspective' and allows respondents to report on themselves, their views, their beliefs, practices, interactions and concerns (Freebody, 2003). Besides, most people are more willing to talk in an interview than the case would be if they were asked to write or fill out a questionnaire. The interview technique is associated with a number of advantages over questionnaires and these showed up in the interviews I conducted. Interview creates the opportunity for interviewees to ask for clarification when they do not understand a question just as the interviewer can ask for elaborations on answers given by interviewees. Furthermore, there is the guarantee that all questions would be answered or, at least, attempted by the interviewee (once he/she can allow enough time for the interview) which ensures a high response rate. Moreover, it becomes possible to check on the reliability of a response by asking the same question differently and at different stages of the interview (Freebody, 2003).

The interview technique was employed to obtain data from a number of stakeholder groups in the study. The criteria used to select stake holders was to identify those who would actually participate in the interview, discussions and the questionnaire survey.

These were:

- Officials of the municipal waste departments
- Officials of urban sector public institutions (EPA, T&CPD, DfUR and LC)
- Private waste companies and informal waste collectors
- Residents of Pobaga where the study was carried out.
- Owners/operators of businesses and staff of institutions
- Residents of communities residing around waste disposal facilities.

3.3. Developing the interview guides

Adequate preparations were made before the encounter with the interviewees. In doing this, the following points were considered:

- developing interview guides based on the research questions
- avoiding double barrelled or multiple barrelled questions
- the identification of possible interview themes or subjects
- identifying the possible respondents from a given population
- deciding the mode of recording the interview (note-taking, tape recording or both)
- seeking permission from interviewees, and
- arranging suitable time and place for the interviews

3.4. Conducting the interviews

The key stakeholders (namely the municipal waste departments, the waste companies and four public institutions) were written to (Appendix 1) to inform them of the study and to request interviews with them. Two 'appointment for interview' slips (Appendix 2) were attached to the letters on which participants were to indicate the names of their institutions/ organisations, their own rank or title and contact telephone number/email. They also indicated on the slip, their preferred date, time and venue for the interview. This was later followed up with visits. During the visits, the appointment slips were retrieved. Each participant kept a copy of the appointment slip.

The interview with non-elite participants such as the private informal waste collectors, owners of businesses and residents of communities around waste disposal facilities did not need elaborate preparation beyond designing the interview schedules. For the

communities near the waste disposal facilities, however, initial visits were made and talked with a few people in order to make familiarization with the research field.

3.5. Questionnaire

The questionnaire is one of the most widely used instruments for collecting data in survey research. Bryman (2004) suggests that the appeal of the questionnaire partly stems from its cheapness and quickness in terms of administration, the absence of the interviewer effect and its convenience for correspondence. Apart from these advantages, the survey questionnaire also enables one to collect standardised information in respect of the same variables for everyone in the sample selected (Zahari, 2007). This makes the questionnaire an indispensable tool in gathering primary data about people, their behaviour, attitudes, opinions and awareness of specific issues.

3.6. Development and testing of the questionnaire

Questionnaires were developed for each of the different participant groups (listed above) in order to address issues specific to their respective roles in waste management. The questionnaire for the municipal waste departments (Appendix 3) was the most detailed and was divided into appropriate sections to deal with the various issues in waste management. The themes which were covered by the questions included stakeholders in the waste sector, the waste situation in the city, resources for waste management, constraints and participation. The questionnaire for the private waste companies also covered issues relating to their contracts, finance and logistics, personnel and constraints to their operations (Appendix 4). Separate questionnaires were also designed for public institutions in the waste management sector (namely the EPA, and T&CPD). These schedules (Appendix 5) were simple but covered relevant issues relating to their

functions and how these influenced waste management in the cities.

Apart from the above, separate questionnaires were developed for businesses and institutions (Appendix 6) together with 90 householders who were selected using the stratified random sampling (Appendix 7). Much like in the household questionnaires, the issues raised with the businesses and institutions concerned their waste generation activities and means of waste disposal, available services for waste removal, payments for the service and their general perceptions about the waste situation around their premises and in the cities. The questionnaire with residents of communities located near the waste disposal sites (Appendix 8) also sought to find out how their communities came to host the facilities, their concerns about the siting of the facilities in their communities and how waste disposal at the sites affected them. The final questionnaire (Appendix 9) was designed for staff at the waste disposal site.

3.7. Ensuring validity and reliability of the questionnaire

Care was taken to ensure that the questionnaires were valid and reliable. First of all, the themes on which the questionnaires were developed were drawn from the objectives stated for the study. After developing the guide, it was given to two research students (who had also used interviews in their own research) to review and comment on its structure and contents. After this, the interview guide was given to the project supervisor who provided useful advice for improvement. The responses obtained were also compared with the study objectives and it became evident that the interview schedule was very reliable as it generated the right kind of data.

The questionnaire for the household survey was developed to cover an aspect of the objectives of the study which was to investigate issues concerning household waste generation and disposal practices, availability and type of waste disposal services, payments for waste disposal services, householders' perceptions about the waste 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 standardised 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) (Appendix 7). Thus, some sections of the questionnaire were answered by all participating householders but other sections were specific to households in the different socio-economic areas in the cities.

3.8. Administering the questionnaire

A number of factors including the absence of clear boundaries separating residential communities in the study areas, the unplanned nature of settlements and the absence of household sample frames for the selected communities precluded the use of any random means of selecting the participating households. Faced with this situation, an ingenious way of selecting participating households had to be found. Attempts were made to achieve some kind of spatial representation of the households selected within each participating community by spreading the participating households evenly within the communities selected.

Ninety households were selected using stratified random sampling and administered questionnaires in March, 2012 (Appendix 7). Thirty each of high, middle and low income

residents. By Livelihood Standard for Ghana's Development, high income earners are people whose wages are above the minimum wage, middle income earn wages that are equal or a little above the minimum wage and low income earn lower wages than the minimum wage. Households were asked to state the major solid waste items generated in their waste (Table 9).

3.9. Field observation

According to Yin (1994), observations are a form of evidence that do not depend on the study directly. This involved the observation of waste situations and other conditions that could affect waste management in the study areas such as the layout of settlements and road access within residential communities. 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, waste storage containers, the transportation and final disposal site of waste.

The field observations undertaken to collect data for this study were largely unobtrusive. The situations observed were mostly waste scenes like street litter, choked drains, waste containers and disposal sites and this was done in ways that did not usually attract the attention of people around. Also, since the observations covered the effects of human action (e.g. street litter) and not human action itself (e.g. littering), the reactive actions of people were largely avoided. Even where the observations covered human actions such as people throwing litter around, they were usually unaware of the observation although there were some exceptions where people were directly made aware of the observations going on. Thus labourers were very much aware that their activities were being observed

as they were interacted with. The field observations were used to compare the actual waste situations in the cities with the information gathered through interviews, household questionnaire surveys and documentary analysis.

3.1.0. Documentary analysis

The analysis of documents is yet another important source of data for social science research. As observed by Miller and Brewer (2004) documents are a good place to search for answers and they provide a useful check on primary information gathered through interviews and questionnaires.

Part of the information for this study was obtained from both the traditional documentary sources like reports and newspaper articles as well as from electronic media sources including television and radio programmes. As part of the data collection process, these sources were critically examined for information relating to the issue of solid waste management in the country. A number of studies including (Cooper, 1999, Gilpin, 1996) were available that had investigated aspects of the urban environment including sanitation, water and waste disposal (see Chapter 1; Justification for the study). These were reviewed to draw relevant data for this study. The print media also provided a rich source of information about the state of solid waste management in various cities in the country. These included reports of workshops and press conferences on issues about the urban environment including sanitation, water pollution and waste disposal. The documentary data thus obtained were used to supplement the information gathered from the interviews, the household questionnaire survey and field observations. Thus, four different methods of data collection - interviews, questionnaires, field observation and documentary analysis - were triangulated to elicit information for the current study of solid waste management in Bolgatanga. This combination of methods allowed for the

collection of a more inclusive data set for the study.

3.1.1. Field work

Permission was sought from nine households (three each in high-income, middle-income and low-income areas of Pobaga community) to weigh their solid waste output for seven consecutive days in order to calculate their daily per capita solid waste production. Pobaga was put into three zones. The stratified random sampling was used. The zones constituted the high-income, the middle-income and the low-income earners. Three households were randomly selected from each category to form a sample size of nine. The weighing was carried out in the evening for 7 days consecutively. The Super Samson 1 kg Spring balance was used to measure the masses of solid waste generated daily by the households. At the end of the seventh day, the total solid waste generated by each household was divided by seven to get the average solid waste generated. Average solid waste was calculated for each category per household. Average was then calculated to get the average solid waste generated daily in Pobaga, Bolgatanga (Table 10).

3.1.2. Data analysis

Both quantitative and qualitative data were gathered for the study using questionnaires, interviews, field observation and documentary sources. After cleaning up the data from the household questionnaire survey, the data were coded and fed into SPSS 14.0. for Windows. Analysis was undertaken to generate a descriptive picture of the data gathered on such themes as household waste generation and handling practices, services available to households for waste disposal and householders' satisfaction with the quality of service. This also covered question items relating to the funding of waste disposal and environmental concerns of waste disposal. Simple percentages and means (central

tendencies) were used to analyze the quantitative data obtained from the household questionnaire administration.

The qualitative data from interviews conducted with all other categories of respondents were analyzed manually by making summaries of the views of the respondents and supporting these with relevant quotations that captured these views, supported with data from documentary sources and field observations of the waste situations in the city. The analysis is organized under themes derived from the data and the research questions that guided the entire investigation.



CHAPTER FOUR

RESULTS

The main objective of this study was to assess the efficiency of solid waste collection and disposal in Pobaga, Bolgatanga Municipality. In line with this objective, fieldwork was undertaken in the city to collect primary data on the waste situations.

4.0. Major sources of solid waste generated in Pobaga

Table 5 shows the major sources of solid waste and the estimated percentages generated by the waste management department of the Bolgatanga Municipal Assembly (BMA). The major sources of solid waste identified by the waste management departments of Bolgatanga Municipality were domestic, commercial, institutions and industries. Estimates made by the waste department (Table 5) suggest that waste from domestic sources alone constitutes 47% of the total waste output in the city while commercial activities (including trading activities in the open-air market, stores and street trading activities) generate about a third 31% of the solid waste output. Institutional sources such as schools, research centres, offices, health centres and laboratories together contribute 13% of the waste output with industries generating 6.0%. All other sources generated the remaining 3% percent of the city's solid waste output.

Table 5. Major sources of solid waste generation in Pobaga

Source of waste generated	Percentage of waste generated (%)
Domestic	47.0
Commercial	31.0
Institutions : schools, offices, etc	13.0
Industries	6.0
Others	3.0

4.2. Composition of solid waste generated

The waste composition data obtained from the BMA waste department are shown in Table 6. The data show the predominance of organic materials which form as much as 65% of the total waste output, coming mainly from residential and commercial premises. This is followed by inert materials like sand, ashes and wood which form 6% of the waste stream, coming from such sources as construction activities, household and street sweepings. Other important components of the waste stream are paper, plastic, glass, metals and textiles. Paper constitutes 17.5% of the total waste output in the municipality and includes newspapers, packaging cardboards and office waste paper. Plastic waste, including shopping bags, water sachets, bottles and other containers form 3.3% while glass constitutes 4.0%. Others are metals 2.5% coming mainly from household utensils, spare part shops and auto repair garages; and textile wastes which are mainly produced by garment making shops, plus household rags and upholsteries.

Table 6 : Composition of solid waste stream in Bolgatanga.

Waste type	Major items	Percentage of waste output at Pobaga (%)
Organic waste	Vegetable and fruit parts, left-over foods, garden trimmings, wood.	65
Inert waste	Rubble, ashes, compounds and, bones .	6
Plastic	Bottles, other containers, polythene bags, parts of electrical and electronic goods, worn-out tyres.	3.3
Paper	Cardboard, newspapers, old/torn books, ruffled paper etc.	17.5
Metal	Cans, household utensils, wires, auto and bike scraps, imported goods scraps	2.5
Textile and leather	Clothes, footwear, bags cuttings from tailoring shops	1.7
Glass	Bottles, drinking glass, jars, mirrors, louvres, auto windscreens, computer monitor screens ,etc.	4

Source :BMA Waste Department, 2007

4.3. Household waste storage

The storage of waste prior to collection or disposal is an important aspect of household waste handling practices, so the survey sought from householders how they stored their waste before disposal. Table 7 shows the various methods of household waste storage containers.

Table 7. Means of household waste storage

Type of waste storage container	No. of households using storage type (90)	Percentage of households using storage type (%)
Closed container	47	52.2
Open container	23	25.6
Polythene bag/sack	12	13.3
Others	8	8.9

The majority of householders who participated in the survey (52.2%) indicated that they stored their waste in closed containers which were either wheeled bins, barrels or other closed containers. These were mainly from the middle income communities (Plate 1). The remaining middle-income householders stored their waste in a variety of containers including old barrels or buckets, polythene bags, sacks and empty cartons. Similar containers were in use in the low-income communities except that a greater proportion of households used open containers, polythene bags, sacks and empty cartons. The ways in which most middle-income households store their waste are a source of great concern.



Plate 1. Waste storage in a middle-income community in Pobaga.

4.4. Household waste disposal arrangements and field observations.

Data gathered on waste disposal arrangements showed that official household waste disposal arrangements in the study communities include house-to-house collection, roadside collection, truck visits and central container collection (Table 8). Twenty five households representing 27.8% of the sample of ninety indicated that they had home collection while four households (4.4%) had roadside collection. Five households (5.6%) indicated that they kept their waste in the home until a waste truck visited their neighbourhood or employed the services of informal private collectors whenever the waste trucks failed to come for a long time. Thirty four households representing 37.8% disposed of their waste in communal containers located within their communities. Seventeen households (18.9%) disposed of their waste on communal dumps while the remaining five resorted to any convenient means of disposal of waste including dumping into drains or bushes, burying and burning waste in their backyard.

Table 8. Household waste disposal arrangements

Ways of household waste disposal	No. of households (90)	Percentage of households (%)
Home collection	25	27.8
Roadside collection	4	4.4
Taken to truck (or private waste collector)	5	5.6
Central container	34	37.8
Waste dump	17	18.9
Others	5	5.6

The field observation which was done alongside the household survey showed that households without waste collection services were not only found in low-income communities. Some of the high and middle-income households were located in newly developing areas in the city where waste collectors do not extend their operations. In such areas, some residents dumped their waste at any convenient location including depressions, roadsides, bushes and drains (Plate 2) while others employed the services of informal waste collectors.



Plate 2: Waste dumped along roadside in a newly developing area in Pobaga-Bolgatanga

4.5. Industrial waste collection

Interviews with officials of the BMA and Zoomlion Ghana waste departments indicated that offices and residential institutions such as schools and hospitals generate the bulk of waste from the institutional sectors. Follow-up field observations and interviews with a sample of these institutions showed that the bulk of their solid waste outputs consisted of paper and cardboard, plastics and food wastes. Others were glass, cans, and hazardous waste (expired chemicals and sharps). In three major residential educational institutions that were visited (Zamse Secondary Technical School, Mount Sinai Educational Complex and Victory Day Care), paper and cardboard, plastics and organic food wastes were the preponderant waste items found at their waste collection stations but there were also substantial quantities of glass and cans. Interviews with conservancy staff in these institutions indicated that the waste largely emanates from offices, halls of residence and restaurants on the campuses.

At the Bolgatanga Regional Hospital and The Municipal Health Centre in Bolgatanga discussions with some cleaning staff and observations made at their transfer stations where segregation of solid waste was done showed that the wastes arising from healthcare premises include clinical wastes such as blood-stained bandages and swabs, sharps like needles and blades and expired pharmaceuticals which are treated and disposed of in special ways.

4.6. Major household solid waste generation

Data gathered through questionnaire showed that the majority of households (83.33%) representing 75 households generated more organic waste than any other waste type (Table 9). A small number of households listed paper/cardboard (8.89%) and

plastics/polythene (4.44%) as the waste items most commonly generated in their homes. Textiles were listed by one household representing 1.11% and dust by only two respondents representing 2.22%.

Table 9. Major household waste generation

Major waste items generated	No. households (90)	Percentage of households (%)
• Organic materials (e.g. food waste, garden waste).	75	83.33
• Paper/cardboard (e.g. packaging materials, newspapers, office waste paper).	8	8.89
• Plastic/polythene (water sachet, shopping, bags, bottles) .	4	4.44
• Leather/textile (e.g. footwear, clothes, bags, upholstery).	1	1.11
• Dust (e.g. ashes, compound sweepings).	2	2.22

Fieldwork, 2011

4.7. Total amount of waste generated per head

Table 10 shows the average per capita daily waste for nine households in Pobaga. Weighing of waste was done in nine households (three each in high-income, middle-income and low-income communities) for seven consecutive days in order to calculate their daily per capita waste production based on the size of each household. The wastes were weighed using a spring balance daily. The total waste weighed per each household was divided by seven to get the daily solid waste generated by each household. The total solid waste generated by all the nine households was divided by nine to get the average solid waste generated daily.

Table 10 Calculation of per capita waste generation in Pobaga-Bolgatanga

Class of Residential area	Waste generated (kg)			Per capita daily waste
	Household 1	Household 2	Household 3	
Low-income	0.61	0.54	0.47	0.54
Middle-income	0.62	0.57	0.55	0.58
High-income	0.53	0.63	0.52	0.56
Average per capita daily waste				0.56

Fieldwork, 2011

4.8. Final solid waste disposal in Bolgatanga

In Bolgatanga, the BMA waste department operates one final disposal facility. It is located at Sirigu at the outskirts of Bolgatanga.

The landfill has been receiving waste for the past 4 years. The dumping ground is not engineered so there are no provisions to extract the landfill gas and drain off leachate from the decomposing waste. Wastes brought to this facility by the waste companies are simply dumped and spread around. Observations at the site by the student researcher showed that its waste-receiving capacity has not been exceeded yet.

Interview with a residents of Sirigu who lived near the landfill site noted that “*we have even lost appetite for food because of the smell ... and the mosquitoes are always biting my children and making them ill*”. The resident also complained about the polluting landfill and how it made life in the community unbearable. Among other things, the residents also complained of the presence of flies (including mosquitoes) and the stench from the site and the flow of leachate-contaminated water from the landfill into their

community. Another resident, a middle-aged man complained about wind-blown waste materials from the dump into the community. From the research observation, the decomposing wastes exude an unbearable stench while flies and scavenging animals also abound in the area, scattering the waste and exacerbating the foul odour.

At the entrance to the landfill site a caterpillar was used to push and spread the heaps further into the waste yard. The ghastly conditions at the dump notwithstanding, there were several waste pickers busily salvaging items from the freshly tipped loads when the student researcher visited. Among the items recovered by the waste pickers were plastic and glass bottles, wood and metals. Interactions with some of the pickers revealed that most of the recovered items were sold to recyclers but some were reused by the pickers themselves.



CHAPTER FIVE

DISCUSSION

5.1. Sources of solid waste

The major sources of waste identified by the waste management department of Bolgatanga are domestic, commercial, institutions and industries. The fact that domestic and commercial sources produce the bulk of the solid waste outputs was corroborated by private waste companies operating in the city who also reported that they collect most of their waste from residential areas, followed by commercial areas. Even though these claims could not be supported with any statistics, the general impression is that residential and commercial sources contribute most of the solid waste in the municipality. It should be noted that the waste generation statistics provided by the waste department is an estimate since, according to them no waste audits had been conducted to generate actual data on the sources of solid waste. The lack of accurate data on waste generation is bound to affect the planning and effective organization of solid waste management in the city.

5.2. Composition of solid waste

The high proportion of organic components in the waste stream can be explained by the fact that Bolgatanga's economy is agro-based and there is a high level of consumption of fresh food products from the farm. Furthermore, most of the staple food products including corn, millet, yams, fruits and vegetables yield a lot of waste during preparation and consumption. In addition, industries such as Mawums Ventures that use raw agricultural materials such as fruits, vegetables, tubers and cereals also generate a lot of organic waste in their production processes. Besides, due to the lack of storage facilities for perishable food products on the farms and in the markets, post

harvest losses are very high in Pobaga. Much of the food products brought from distant rural areas arrive in the city markets already spoilt and add to the waste stream. While advantage could have been taken of the high organic content of the waste stream to produce compost for farming and reduce the amount of waste going to landfills, this has not been achieved.

It is worth commenting on the major components of the solid waste stream. The data obtained from the questionnaires showed that organic waste constituted the largest percentage of waste generated in the municipality (65% and 83.33%) (Table 6 and 9), inert materials which formed 6% and 2.22% of the waste output in the city largely emanate from street and house compound sweepings, ashes and rubble from construction and demolition work. In Bolgatanga, rubble from construction and demolition works are often used to fill up pot holes on roads and so are rarely disposed of as waste. Sand from street and compound sweepings, however, form a significant proportion of the municipal solid waste stream. Except for its weight, inert waste does not pose much of a problem for waste management since it is a stable component of the waste stream and has no immediate adverse environmental impact compared with organic wastes which decompose rapidly and contaminate the environment.

In spite of the insignificant proportions of metals in the waste streams of Pobaga (2.5%), the problem it poses for waste disposal is in sharp decline. Until recently, scrap metal was a much more dominant item in the solid waste stream in the country, emanating from abandoned vehicles, imported goods, industrial sources and household hardwares. Presently, there is a surge in scrap metal recycling for iron rod production in the country. Scrap metal is, therefore, in high demand and it is common to see young men rummaging

for every piece of metal including scrap auto parts, metals in imported goods, bicycle parts, pressing irons, etc. These are cleaned and sold to buyers who in turn sell them to the recycling firms. Interviews with two scrap metal buyers showed that scrap metal collection is now a lucrative venture. As a result, dealers who act as middlemen between the collectors and smelter factories now travel around the country to buy scrap metal. Scrap metal recycling factories are springing up in several cities including Accra, Tema and Kumasi and according to the BMA, this has greatly reduced the proportion of metal in the waste stream. On the contrary plastic waste is a growing menace in Ghanaian cities, accounting for an increasingly large proportion of the waste stream (IRIN, 2007). The sharp increase in the use of plastic shopping bags and the boom in the sachet water (drinking water in plastic bags) business in recent years together with the ‘throw-it-where-you-like’ attitude of many Ghanaians have greatly increased the volume of plastic in the waste stream. Over the years, plastic has replaced leaves, paper, glass and metal as a cheaper and more convenient container and means of packaging in Ghana. But on the down-side, indiscriminate disposal of plastic materials poses major environmental problems including the clogging of drains and streams and threat to animals. This could have contributed to the increase in plastic/ rubber in our waste generation (4.44%).

Paper and cardboard also have a substantial presence in the waste stream, contributing 6.0% and 8.89% of the total output of solid waste in Bolgatanga. Much like plastic, paper wastes cause visual intrusion on the streets and contribute to the clogging of drains and streams in the city. In spite of this, the shorter time period taken by paper to decompose makes it a less problematic component of the waste stream than plastic. In a number of cities including Accra, Kumasi and Bolgatanga in Ghana, newspapers and other clean sources of paper are recycled by toilet tissue manufacturers. Old newspapers are also sold at the entrances to public latrines for use as toilet tissue. The interviews conducted

in Pobaga showed that many institutions like schools, offices and hospitals burn their old records including examination papers, office and hospital records when these are no longer needed. With the gradual computerization of institutions and the transfer of data from paper to computers, paper waste generation could reduce in the country.

Glass and textiles were also reported to be important elements in the waste stream. Generated mainly by drinking bars, hotels, households and institutions, broken glass is a major hazard and a common source of injury especially among waste pickers who rummage waste dumps for saleable products and children in low-income communities who play on, or near waste dumps. The study, found that there is a high level of re-use of both plastic and glass bottles in the country by the bead industries. Children and women rummage waste dumps for bottles and gallons for sale to clients. Waste pickers who were found salvaging glass and plastic bottles during the fieldwork said they clean these and sell them to producers of traditional medicines for use as containers.

Some plastic waste container pickers also said they sell their collections to producers of traditional drinks like *pito* (brewed from guinea corn or maize), *zom com* and Hausa beer (brewed from millet and maize respectively) who, in the past, used calabash, gourds and earthen pots as containers for their products. However, the bottle pickers and their clients can only be interested in the undamaged ones while the damaged ones remain waste. One good practice of breweries in Ghana (including Coca Cola, Accra and Kumasi Breweries) is that they all reuse their glass bottles.

Textile and upholstery 1.11% percent of the waste output emanating largely from the numerous dressmaking shops and from homes as discarded clothes, footwear, bags,

furniture parts, mattresses and carpets. Other sources are residential institutions, hospitals, auto interior décor workshops and furniture and mattress factories. Like paper, textile waste causes visual pollution and contributes to the choking of drains and pollution of gutters in Bolgatanga. However, much like paper, it has a short lifespan in the environment and is not a major worry to the authorities. The study also found that there is some amount of reuse and recycling of textile and upholstery waste. For example, interviews conducted with some dressmakers showed that pieces of cloth that result from the cutting of patterns are used in stuffing pillows and for making door mats for sale. Furthermore, discarded leather bags are also salvaged and the leather cut for making sandals and other items for sale. Generally, therefore, it is only the practically unusable textile and leather items such as very old and badly torn clothes, bags and footwear that really remain as waste. On the whole, textile, paper, inert waste and to some extent glass and metals are not as worrying as plastic and organic waste which remain real menaces in the city environments and cause problems to the authorities and all who value environmental cleanliness.

5.3. Means of household waste storage

The ways in which most middle-income households store their waste are a source of great concern. Uncovered containers such as torn polythene bags, sacks, old buckets and cartons frequently attract animals such as dogs, goats, sheep, pigs as well as rodents to rummage for food in the waste piles which are usually left at the front of their houses. Furthermore, the waste which usually remains for long periods before it is removed by the waste managers easily gets scattered on to roads and gutters leading to contamination and drain blockage.

Apart from those households located very close to the central containers, low-income households may, therefore, have less direct exposure to decomposing waste which is a serious problem in most of the middle-income communities where waste may be kept in the house until collection vehicles come around.

5.4. Household waste disposal arrangements

Areas that do not have any solid waste arrangements for disposal of their waste resort to any means to dispose of their solid wastes including burning, burying and throwing into drains.

5.6. Household waste generation

Most of the households generated organic waste as the commonest household waste and this can be attributed to the general household consumption pattern in Ghana where fresh food items like fruits, tubers, roots and vegetables form the bulk of purchases of the average household. The processing and consumption of these food items generate a lot of organic waste in the home.

Paper/cardboard was listed by only 8 of the 90 households as the commonest waste item generated while plastic, leather/textile and dust were listed by four, one and two households respectively. It is suspected that the households which generated paper and plastic as the most frequently generated waste materials engaged in some kind of home-based business activities in which paper or plastic were used as raw materials. Similarly, the two households which generated dust as the commonest waste item in the home may also be engaged in an activity which generates a lot of dust. On the whole, the household survey data on major household waste items corroborates the waste composition data

obtained from the Bolgatanga Municipal Assembly waste departments which also indicated the dominance of organic materials in the waste streams.

In general, the notion among the city waste department and the waste companies was that waste from poorer homes contained more organic materials than waste from wealthy homes which reportedly consisted of more packaging materials. Wastes from the low-income communities decompose more quickly because they have plenty of organic content and high moisture. Poor households usually purchase cheaper and bulkier raw food items like tubers, roots, vegetables and fruits which yield lots of organic waste during preparation and consumption. This compares with the wealthier householders who usually shop in the supermarkets and purchase elaborately packaged foreign food products, the waste from which largely consists of paper, cardboard, plastic and cans. The inspection of the contents of samples of household waste containers also confirmed the preponderance of organic materials in waste containers in poorer communities compared with those in the wealthier communities.

Considering the fact that the solid wastes generated in the poorer communities have very high organic content relative to those from the wealthier communities, the low-income communities need more frequent collection services to prevent waste decomposition and contamination of their surroundings. This is, however, not the case in Ghanaian cities where waste collection efforts are rather concentrated in the wealthier communities where the waste generated largely consists of packaging materials and should thus require less regular collection. The city authorities usual argument for providing less service for the poor is that they (the poor) do not pay for waste disposal.

5.7. Quantity of waste generated

Because the total populations of Bolgatanga have not been accurately determined, any attempt to measure the total daily waste output for the city (even if the per capita output is known) becomes problematic. In Bolgatanga for instance, using the estimated functional population of about one hundred and fifty thousand (about 150,000 residents) and the per capita daily waste output of 0.5 kg as quoted by the Ghana Statistical Service (2002) to calculate the total daily waste output yields 75 tonnes, which is below the 285 tonnes estimated by the BMA waste department in 2007. It would require a total population of 570,000 generating waste at 0.5 kg per capita each day to obtain the daily total output of 285 tonnes. It can, therefore, be concluded that either the city's functional population or its per capita waste output (or both) has been overestimated by the city authorities.

As a way of testing this, permission was sought from nine households (three each in high-income, middle-income and low-income communities) to weigh their waste output for seven consecutive days in order to calculate their daily per capita waste production based on the size of each household. The results of the tests (Table 10) suggested a higher per capita daily waste output of 0.56 kg. The sample of nine households was insignificant and the weighing of the waste was done for only seven days so the results obtained cannot be used to draw any valid inference on waste generation in Bolgatanga. However, the results highlight the point that any attempt to measure waste generation in the city should be done with care.

According to projections made by the Bolgatanga waste management department for the period 2006 to 2011, the city's total daily waste output in 2007 was 285 tonnes and

waste generation in the municipality would increase from 268 tonnes in 2006 to 308 tonnes in 2010, while total annual waste generation for the city is expected to increase from 97,820 tonnes to 112,420 tonnes during the same period (BMA Waste Department, (2007). It is interesting to note that even if the slightly higher experimental result of 0.56 kg per capita per day is used for the calculation, the daily waste output for the metropolis still falls short of the current estimate of 285 tonnes. As noted above, it would require a total population of about 570,000, generating waste at a rate of 0.56 kg per capita each day, to obtain a daily waste output of 285 tonnes for the city.

The lack of accurate waste generation and characterization data is one of the factors that seriously constrain effective planning and organization of waste disposal in Ghanaian cities. Proper waste audits would need to be carried out to determine the actual rates of waste generation for the various cities in the country and this should be checked against the national average figure which may no longer be valid due to reasons stated earlier. The lack of reliable data on waste generation in Ghanaian cities confirms the assertion by Hardoy *et al.* (2001) that reliable data on waste generation and characterization is generally lacking in poor cities around the world. This situation greatly affects the planning and organization of solid waste management in Ghanaian cities.

The scarcity of data notwithstanding, one thing that is clear is that waste generation is on the increase in Ghanaian cities. The current waste situations in most Ghanaian cities makes it evident that available resources for waste management do not match waste generation and this leads to inadequate collection in the cities. It becomes clear to anyone who is familiar with Ghana that the urban waste situation is getting out of hand and there is every indication that the situation will worsen in the future if remedial actions are not taken.

5.8. The final disposal of solid waste in Bolgatanga

The final disposal of solid waste is an issue of major concern in Ghanaian cities. Traditionally, the means of solid waste disposal in Ghanaian settlements has been the communal dumping ground. Small towns and large villages usually have communal waste dumps, located at the outskirts of the settlements where households carry their waste for disposal. In the past, most suburbs in the large cities also had their own dumping ground so urban settlements in the country were dotted with numerous waste dumps. With the introduction of modern waste management systems whereby waste can now be transported to landfills far from the points of generation, city authorities in the country have officially closed the communal waste dumps and now maintain one or two major disposal sites. Currently, the waste disposal facilities in most Ghanaian cities are landfills, which are generally poorly maintained.

5.9. Industrial waste collection

Beside the use of vehicle and occasional burning of solid wastes from these institutions, some special wastes from these institutions are disposed off in special ways. For instance clinical wastes such as blood-stained bandages and swabs, sharps like needles and blades and expired drugs are treated in special ways.

The lack of comprehensive waste policy for the country poses major constraints to effect waste management in the cities. As a result municipal authorities (stake holders in solid waste management) charged with the responsibility of waste management within their jurisdictions have no guiding framework for the organization of waste management. There is also no indication of how waste management operations should be funded. It became evident from the interviews conducted with the various stake holders in the municipality are neither adequate nor clearly defined.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The major sources of solid waste identified by the study and the waste management department of Bolgatanga are domestic, followed by commercial, institutions and industries. The fact that domestic and commercial sources produce the bulk of the solid waste outputs is corroborated by private waste companies operating in Pobaga.

The high proportion of organic components in the waste stream in Pobaga is due to the fact that Bolgatanga's economy is agro-based and there is a high level of consumption of fresh food products. Most of the staple food products yield a lot of waste during processing and consumption. The 0.56 kg per capita waste obtained from field work was a little higher than the 0.5 kg projected by the Ghana Statistical Service (2002).

According to projections made by the BMA waste management department for the period 2006 to 2011, the city's total daily waste output in 2006 was 284 tonnes and waste generation in the municipality increased from 284 tonnes in 2006 to 308 tonnes in 2010, while total annual waste generation for the city is expected to increase from 97,686 tonnes to 112,237 tonnes during the same period. It is however interesting to note that even when the slightly higher experimental result of 0.56kg per capita per day which was obtained from this study, was used for the calculation, the daily waste output for Pobaga still fell short of the estimated 308 tonnes expected in 2011. As noted above it would require the population of about 550,000, to generate waste at a rate of 0.56 kg per capita each day.

It is worth mentioning that majority of the population in Pobaga used the central waste disposal system and the mode of waste storage is

Recommendations

The present study has examined the urban solid waste problem in a Ghanaian town focusing on the solid waste situation in Pobaga, Bolgatanga Municipality. In the course of the study, however, a number of challenges have been identified that critically affect the organisation of solid waste management but which remain under researched.

It is recommended that

1. Appropriate strategies and technologies for solid waste such as the Integrated Solid Waste Management which includes aerobic treatment of solid waste, recycling and composting must be employed.
2. Public and government must share the waste management cost since government alone cannot meet the financial obligation of the waste department.
3. Good urban land use and housing planning must be employed to enhance access to all parts of the community for easy collection and transportation of solid waste.
4. Recycling companies should be exempted from paying tax to encourage more private enterprises to go into recycling.
5. Farmers should be encouraged to use organic rather than inorganic fertilizer for the cultivation of crops since this would encourage more private companies into compost production.

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APPENDIXES

Appendix 1

Letter of introduction

Bolgatanga Girls' Senior High School
P. O. Box 60,
Bolgatanga

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

Dear Sir/Madam

REQUEST FOR INTERVIEW

I am a graduate student of the University of Science and Technology, Kumasi carrying out a study on the solid waste situation in Bolgatanga as part of my research project. As a stakeholder in the waste sector, your views are important in this study and I would be grateful if you could grant me an interview on this important topic.

I would like to assure you that the information you provide in the interview will be treated confidentially and anonymously and will be used solely for the purpose of this research.

If you are able to honour this request, please indicate (on the appointment slip enclosed) your preferred date, time and venue for the interview. Kindly return the slip in the self-addressed and stamped envelop enclosed.

Please find attached a copy of the interview guide for the discussion. Thank you for your assistance.

Mohammed Zakaria Asakia

Contacts:

Phone: 0208779672 / 0244-974962

E-mail: askia201042@yahoo.com

Appendix 2

Appointment for interview

Name of Officer:Institution.....
Position/Rank:.....Contact Tel. No:
Preferred date for interview :.....Time:.....
Venue:.....

Interview with officials of municipal waste departments in Bolgatanga

Name of City: Pobaga, Bolgatanga

Designation of officer granting interview.....

Professional background of officer:.....

Job history:

Section A: Stakeholders in waste management

1. Which institutions are involved in the organization of waste management in this city and what are their respective roles?

Institution

Role in waste management

i)

ii)

2. Do you find the institutional arrangement for waste management effective?

• Yes []

• No []

3. Is there adequate capacity for waste management in this city?

• Yes []

• No []

Reason for answer:.....

4. What is your own department's role in waste management?

.....

Section B: The waste situation in the city

5. How would you describe the solid waste situation in this city?

.....

.....

6. Has there been a recent study of the waste situation in this city?

- Yes [] When was this done?
Who did it
- No []

7. Are you able to determine the following?

- Per capita waste output in the city? Yes [] No []
- Total daily waste output for the city? Yes [] No []
- Rate of increase in waste output? Yes [] No []

8. Has the city's waste output been increasing in recent years?

- Yes [] What could be causing the increase?
- No []

9. Can you provide the following information about the city's waste stream?

Major components of the waste stream	% of output	Main sources
1.....
2.....
3.....
4.....
5.....

10. Has the waste mix been changing?

- Yes [] What is changed in it?.....
- No []

11. Have you made any projections for waste output in the next few years?

- Yes [] What are your projections?
- No []

12. Do you think you will be able to cope with the waste situation in the future?

- Yes [] How are you preparing for this?
- No [] Why not?

13. Can you briefly describe the arrangements for solid waste collection in this city?

.....

14. Are you able to provide waste collection services in all areas of the city?

If Yes []

If No[] Proceed to Q.18

15. Which areas are served?.....

16. Which areas are not served?.....

17. How do communities without waste collection service dispose of their waste?

.....

18. What are the arrangements for waste collection in the following areas? See table

Areas	Method of collection	Freq. of collection	Service
High-income areas			
Middle-income areas			
Low-income areas			

19. What considerations influence the level or quality of service to provide in an area?

.....
.....

20. Is littering a major problem in this city?

Yes [] Can you please elaborate?

No [] (Proceed to Q.22)

21. What do you consider to be the reason for littering in the city?

.....

22. Do you have any by-law against littering/indiscriminate disposal of waste?

Yes [] What are its provisions?.....

No [] (Proceed to Q.24)

23. Are you able to enforce the by-law on waste disposal?

Yes [] How is it enforced?

No [] Why are you unable to enforce it?

24. Are you able to provide enough litterbins in public places?

Yes []

No []

Why.....

25. How regularly are the litterbins scheduled to be emptied?

.....

26. Are you able to meet this schedule?

Yes []

No [] Why not?

27. How will you describe public attitude towards waste disposal in this city?

.....

.....

28. Do you carry out public education on waste disposal?

Yes [] How is it done?

29. Please indicate how the following public places are cleaned

Place	Schedule for Cleaning	Who does the cleaning	Are you able to meet schedule? (yes/no)
Open-air markets			
Lorry stations			
Major streets			

32. Are you able to determine the quantity of solid waste collected for disposal in a day?

- Yes [] What quantity is collected daily?
- No [] Why not?

33. What waste treatment/disposal facilities are operated in the city?

.....

34. (a) What considerations influence the siting of waste disposal facilities?

.....

.....

35. Are all the waste disposal sites/facilities approved by the EPA?

Yes []

No [] How many are approved?.....

36. Who maintain(s) the waste disposal facilities?
.....
37. Are you aware of any environmental problems associated with the disposal sites?
Yes [] What are they?.....
.....
No []
38. Have communities around the disposal facilities complained of any nuisances
Yes [] What have they complained
about?.....
No []

Section C: Resources, private sector participation and commitment for waste management

Equipment

39. How do you acquire equipment for waste management/who provides them?
.....
.....
40. Are you able to adequately maintain equipment for waste management?
Yes []
No [] Why?
41. Do you consider your equipment adequate for your operations?
Yes [] (Proceed to Q. 43)
No []

42. What is the nature of your equipment problem? What equipment do you lack?

.....

.....

43. In your view, how can the equipment problem of the waste sector be solved?

.....

.....

Finance

44. What are your sources of finance?

.....

.....

45. Are you able to acquire adequate funds for your operations?

Yes []

No []

46. What proportion of the required funds are you able to acquire?

.....

47. Do your service clients pay waste disposal levies?

Who pays?..... Rate..... Who do not pay?.....

48. Are there any potential sources where you could generate additional funds

Yes []

No []

49. In your view, what could be the solution to the finance problem of the waste sector.....

.....

50. Is it easy to attract staff to the waste sector?

Yes []

No [] Why?

51. Do you have any programmes for staff training?

Yes [] In what aspect of waste management?

No [] Why? (Proceed to Q53)

Land

51. Are you able to secure enough suitable land for the siting of waste disposal facilities?

Yes [] (Proceed to Q. 55)

No [] Why?

53. How do you respond to the problem of land shortage for waste disposal?

.....

54. What do you consider to be the major constraints to waste management in your city?

What causes the constraint?

How can it be addressed?

Private sector participation

55. Is the private sector involved in waste management in this city?

Yes []

No [] But what role could they play?.....(Proceed to Q.66)

56. When did private sector involvement start in this city?

.....

57. What prompted the involvement of the private sector in waste management?

.....

58. How many private companies participate in waste management in this city?

.....

59. Which sectors of the city are covered by private sector operations? (e.g., *whole city, residential sector, commercial sector, industrial sector*).....

60. How are contracts/franchises awarded to private sector participants?

.....

62. What conditions do companies have to meet to qualify for contract/franchise?

.....

63. Do you have the need to engage more private companies?

Yes [] How many more? Why haven't you done so?

.....

No []

64. How would you describe the performance of the private waste companies?

.....

Commitment for waste management

65. Would you say there is adequate commitment to waste management in this city?

Yes [] How is this shown?.....

No [] Why?

66. What do you consider to be the cause of the waste problem in this city?

.....

67. How can waste management be improved in this city?

.....

.....

.....

68. Would you like to make any other comments or ask questions in relation to this discussion?

.....

.....

.....

.....

Thank you for your time and assistance

Appendix 3

Interview with officials of some public institutions in the urban sector

Name of City: Pobaga, Bolgatanga []

Designation of officer interviewed:.....

Professional background of officer.....

Job history:.....

1. When was your office/department established in this city?

2. What is the mandate of your office/department?

3. Are you adequately resourced to discharge your functions with regard to funds, logistics and personnel?

Yes []

No [] What do you lack?.....

.....

4. How do your functions affect waste management in this city?

.....

Specific to EPA

5. Do you regulate the siting and maintenance of waste disposal facilities?

• Yes []

• No []

6. Are you able to enforce the regulations on waste disposal?

.....

.....

.....

7. What considerations qualify a place as site for a waste disposal facility?

.....

8. Have you approved the siting of any waste disposal facilities in this city?

Yes []

No [] Why.....

9. Are you satisfied with the maintenance of waste disposal facilities in this city?

• Yes []

• No [] Why?.....

Specific to T&CPD

10. Is your department involved in the siting of waste disposal facilities?

Yes [] How are you involved?

No [] (Stop interview)

11. What factors do you consider when siting a waste disposal facility?

.....
.....

12. Do the existing waste disposal facilities meet the siting requirement?

Yes []

No []

Specific to Department of Urban Roads (DfUR)

13. Which parts of the city do you consider to have:

• Good roads?:.....

• Bad roads?:.....

14. Why is the road quality poor in some parts of the city?

.....

15. How does road quality affect the organization of waste management in the city?

.....

All Institutions

16. What do you consider to be the cause of the poor solid waste situation in this city?

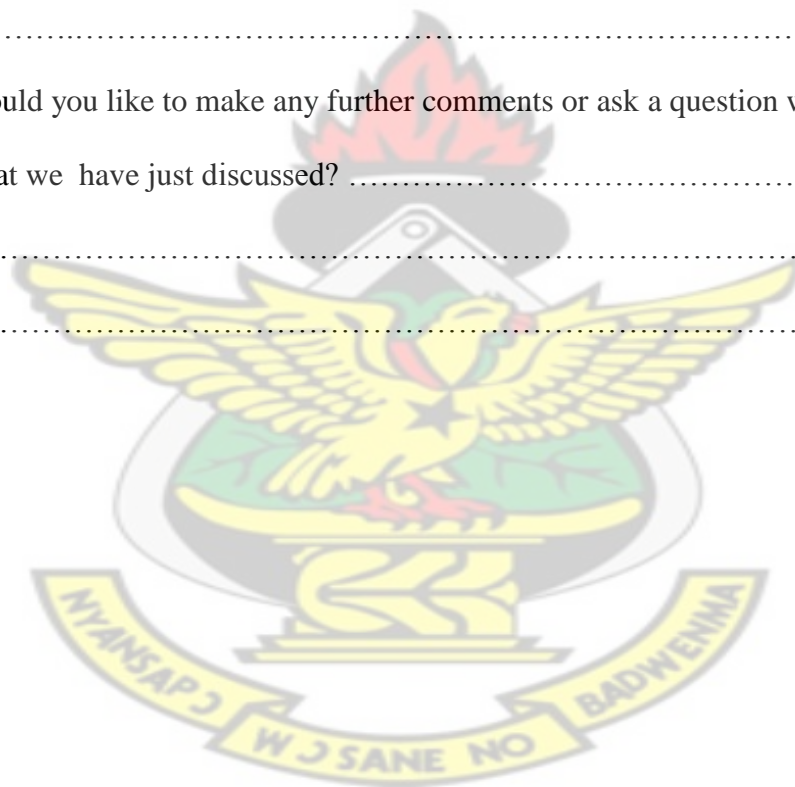
.....

.....

17. Would you like to make any further comments or ask a question with regard to what we have just discussed?

.....

.....



Appendix 4

Interview with private waste collectors

City: Pobaga, Bolgatanga []

1. How long have you worked as a waste collector?(years/months)
2. What equipment/tools do you work with?
.....
3. Who are your clients and how do you charge for your service Clients.
How often do you collect their waste? How do you charge?
.....
4. Where do you dispose of the waste you collect from your clients?.....
5. Are you charged where you dispose of your collection?
 - Yes [] How much do you pay?
 - How often do you pay?
 - Who do you pay to?.....(Proceed to Q. 7)
 - No []
6. Will you be willing to pay if asked to?
 - Yes [] Why will you?
.....
 - No [] Why not?
.....
7. About how much do you earn on a working day? GH¢.....
8. Would you like to be employed by the city waste department to do this same work?
 - Yes, I would [] Why?
 - No, I wouldn't [] Why not?

9. Are you a native of this city?

- Yes []
- No [] where do you originally come from?.....

10. What motivated you into this work?

11. Do you have anything else to say about your work or a question to ask with regard to this discussion?

.....
.....

Thank you for your time and assistance



Appendix 5
Interview with residents of communities around waste disposal facilities

City: Bolgatanga []

Name of suburb:

1. How long have you lived in this community?

3. What do you consider to be the major problems affecting this community?

.....
.....

4. Do you have any concerns about the siting and maintenance of the waste disposal facility in your community?

Yes [] What are your concerns?

No []

5. Does the waste disposal facility pose any nuisance to the residents of this community?

Yes [] What nuisance(s) does it cause?

No [] (go to 13)

7. How does the nuisance(s) affect the community?

.....
.....

8. As residents, have you collectively complained about conditions at the facility to the municipal authorities or the EPA?

Yes []

No [] Why?

10. What was the complaint about?

11. How did the authorities respond to your concerns?

.....

.....

12. What do you think should be done about the waste disposal facility?

.....

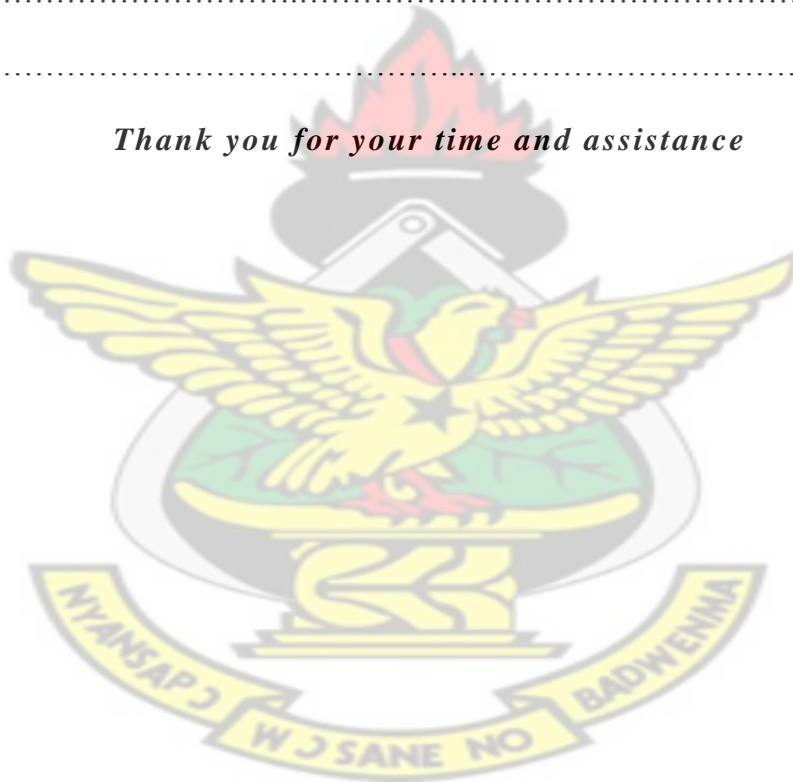
.....

13. Do you have any other comments or questions with regard to what we have discussed?

.....

.....

Thank you for your time and assistance



Appendix 6

Interview with staff at waste disposal facility:

1. When did waste disposal start at this facility?

2. Which agency is responsible for maintenance of the disposal site?

Equipment type	Number required	Number available	Number operational

3. Who bring waste here for disposal?

4. About how much waste is brought here in a day?

5. What types of waste are brought here? (e.g. household, commercial)

.....

6. What do you do with the waste you receive? (e.g. composting, recycling, land filling)

7. Do you consider the equipment adequate for your operations?

- Yes []
- No []

10. Do you charge those who bring waste here for disposal?

- Yes []
- No [] Why not?.....(Proceed to Q.14).

11. How do you charge them/ how do you determine the charge? (e.g. by weight or per trip)

12. Do you consider environmental conditions at the facility to be satisfactory?

Yes ☐

No ☐ Why not?

13. Do you know of any nuisances or environmental problems associated with this facility?

Yes ☐ What are they?

No ☐

14. Have residents of the host communities ever complained of any nuisance from the facilities?

Yes ☐ What about

No ☐

15. How do you respond to their complaints?

.....
.....

16. Do you have any problems or difficulties in managing this facility?

• Yes ☐ What are they?

• No ☐

17. Do you have any further comments or questions regarding this discussion?

.....
.....

Thank you for your time and assistance

Appendix 7

Questionnaire for household survey

Dear resident,

We are carrying out a study to assess the solid waste situation in this city. The purpose of this questionnaire is to find out about your household waste disposal needs, the waste disposal services you receive, and how you perceive the solid waste situation in this city. The ultimate goal of the study is to find ways of improving solid waste management in the city.

As a resident of this city your views and ideas are considered very important for the success of this study and it would be very much appreciated if you could spend a little time to answer this questionnaire.

Thank you for your assistance.

A

- i. City: Pobaga, Bolgatanga []
- ii. Name of suburb
- iii. How long have you lived in this neighbourhood? Years Months.....
- iv. How many people live in your house?

B

Household waste generation and disposal practices

1. Please indicate the items commonly found in your household waste and how often you generate them

2. How do you store your waste before disposal?

In a closed container []

In an opened container []

In an opened polythene [] Other []

3. In the table below, please indicate with a tick (¥) the type of waste collection service available to your household.

Waste collection service	(¥)	Question to proceed to
Home collection		
Roadside collection		
Truck visit		
Communal container		Proceed to Q. 6
Waste dump		proceed to Q. 10
Other (Please indicate		Proceed to Q. 14

4. In the table below, please indicate your service provider and frequency of the service.

Service provider	Frequency of service

5. Is your service provider able to keep to the agreed schedule for waste collection?

- Yes []
- No [] What do you do with your waste then?

Proceed to Q.17

Is the waste container close to your home or other homes in the neighbourhood?

- Yes [] How close?(e.g. distance in meters)
- No []

7. Is the waste container emptied regularly?

- Yes ☐ How regularly is it emptied?
- No ☐ Do you know why?
- Yes ☐ State reason

.....

- No ☐

8. How will you describe the sanitation situation around the waste container?

- Very satisfactory ☐
- Satisfactory ☐
- Poor ☐
- Very poor ☐

9. Do you suffer any nuisance from the waste container site?

Yes ☐ What do you suffer from?.....

No ☐ Proceed to Q.17

10. Is the waste dump close to your home or other homes?

- Yes ☐ How close is it to the nearest homes?.....(e.g. distance in meters)
- No ☐

11. Is the waste dump maintained (e.g. is the waste regularly removed or burned)

- Yes ☐ Who maintains it?
- No ☐

12. Do you suffer any nuisance associated with the waste dump?

- Yes ☐ What do you suffer from?
- No ☐

13. How will you describe the sanitation situation at the waste dump?

- Very satisfactory
- Satisfactory
- Poor
- Very poor

Proceed to Q.17

14. Please indicate how you dispose of your waste

- Burning ☐
- In the bush/ roadside/ drain ☐
- Burying ☐
- Other method ☐

15. Why do you dispose of your waste by this method?

- I have no waste collection service ☐
- I cannot afford service fee ☐
- Other reason (please indicate) ☐

16. Do you know of any environmental problems associated with your method of waste disposal?

- Yes ☐ What are they?
- No ☐

17. Do you find your waste disposal arrangement convenient?

- Yes ☐
- No ☐. Why is it not convenient?.....

18. How will you describe the general waste situation in your neighbourhood?

- Very satisfactory []
- Satisfactory []
- Poor []
- Very poor []

19. Do you pay for your waste disposal service?

- Yes. []
- No. [] Are you willing to pay for your waste disposal service?
- Yes [] Why? (Go to Q.21)
- No [] Why? (Go to Q. 21)

20. In the table below, please indicate how you pay for your waste collection service

How often do you pay?	How much do you pay?	Who do you pay to?	Is it affordable?
-----------------------	----------------------	--------------------	-------------------

Proceed to Q.23

21. Are you willing to pay for waste disposal services?

- Yes []
- No []

22. How much are you willing to pay each month for the following types of service?

Weekly home	Weekly roadside	Regular block or communal container
Collection	collection	Service
GHC	GHC	GHC

23. Do you think all households/businesses in this city should pay for waste disposal?

- Yes [] Why do you think so?
- No [] Why do you think so?

Who should pay?

Who should not pay?

24. How will you describe the quality of waste disposal service you receive?
- Very satisfactory []
 - Satisfactory []
 - Poor []
 - Very poor []
25. Do you and your neighbours ever discuss the waste situation in this neighbourhood?
- Yes [] What have you?
 - No [] Why don't you?
26. If you were to compare with other communities or suburbs in this city, would you say your community receives a fair share of resources for waste disposal?
- Yes []
- No []. Why?
27. How would you rank environmental sanitation in your community in relation to others in the city?
- One of the cleanest neighbourhoods
 - Averagely clean
 - Dirty
 - One of the dirtiest communities in the city
28. In your view, how can waste disposal be improved in your community?
-
-
29. Would you like to ask any question or make some further comments with regard to what we have just discussed?
-
-

30. What is the highest educational attainment of your household head?

- Tertiary (University/Polytechnic) []
- Secondary (College, SSCE) []
- Primary []
- No formal education []

31. What is the employment status of your household head?

- Employed
- Self-employed
- Unemployed

KNUST

Thank you for your time and assistance



Appendix 8

Semi-structured questionnaire for businesses and institutions

CITY: Pobaga, Bolgatanga []

1. Name of business/institution:

Location:.....

2. About how much waste do you generate in a day? (in kg or other measure:

3. What are the major items of waste you commonly generate?

.....

4. Do you have a waste collection service?

- Yes []
- No [] (Proceed to Q.12)

5. Who is your waste collection service provider?

.....

6. How often is your waste collected by your service provider?.....

7. Do you find your waste collection service satisfactory?

- Yes []
- No [] Why not?.....

9. How do you store your waste before collection/disposal?.....

10. Do you pay for your waste collection service?

- Yes []
- No []

11. How much do you pay?

How often do you pay?.....

12. How do you dispose of your waste?

13. Do you need a waste collection service?

- Yes []
- No [] Why?(Stop interview)

14. How regularly will you want such a service?

15. Will you be willing to pay for the waste collection service if it is provided?

- Yes []
- No [] Why not?(Stop interview).

16. How much will you be willing to pay for the service?.....(refer Q. 14).

17. Are you happy with the waste situation in your surroundings?

Yes []

No [] Why not.....

18. In your view, how can waste disposal be improved in this city?

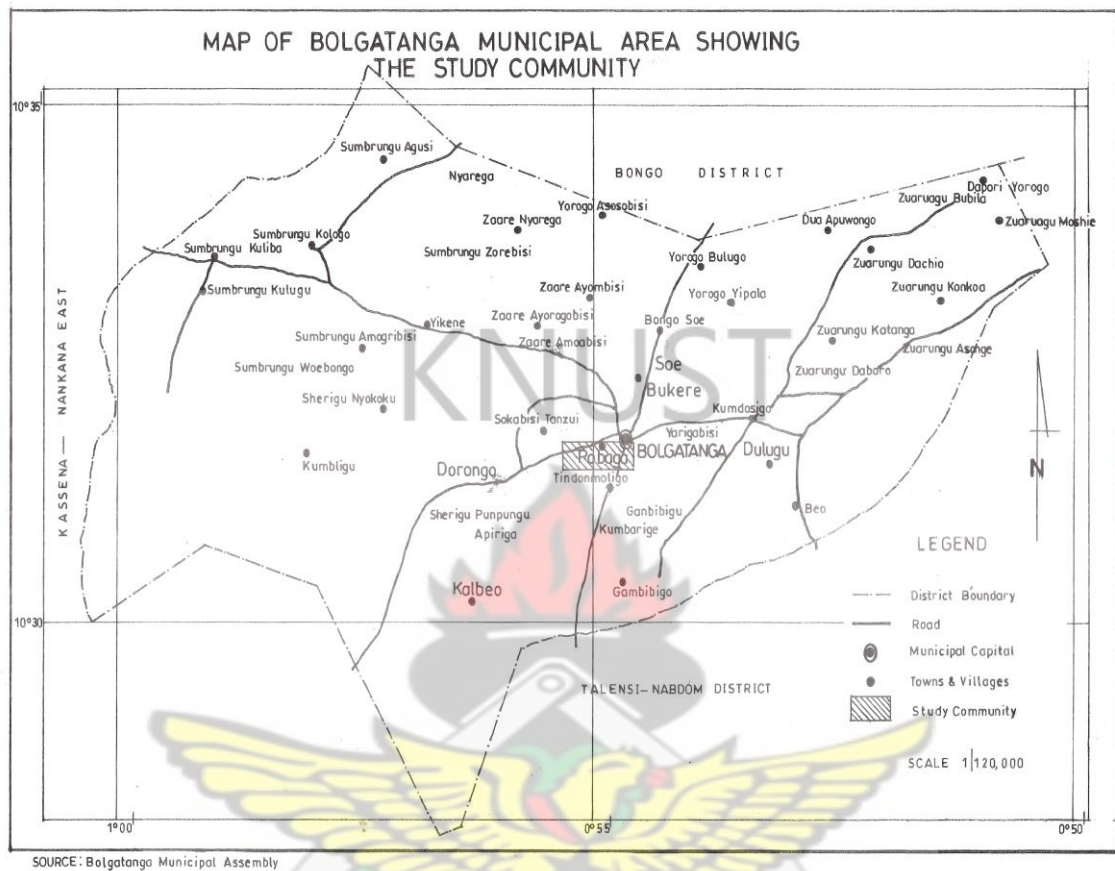
.....
.....

19. Do you have any further comments or questions regarding this discussion?

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

Thank you for your time and assistance

Appendix 9



Map of Bolgatanga Municipality showing the study area, Pobaga