UNIVERSITY OF CAPE COAST

ASSESSMENT OF SOLID WASTE RECYCLING AS A MEANS OF IMPROVING ENVIRONMENTAL QUALITY IN ACCRA METROPOLITAN AREA

BY

SAUMEL DONKOH

JUNE, 2016

UNIVERSITY OF CAPE COAST

ASSESSMENT OF SOLID WASTE RECYCLING AS A MEANS OF IMPROVING ENVIRONMENTAL QUALITY IN ACCRA METROPOLITAN AREA.

BY

SAUMEL DONKOH

Thesis submitted to the Department of Geography and Regional Planning of The Faculty of Social Sciences, College of Humanities & Legal Studies, University of Cape Coast, in Partial fulfillment of the requirements for the award of Master of Philosophy degree in Geography and Regional Planning

JUNE, 2016

DECLARATION

Candidate's Declaration

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

Candidate's Signature:…… Date:…….

Name: Samuel Donkoh

Supervisor's Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on the supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature: ……. Date:……

Name: Prof. Kwabena Barima Antwi

Co-supervisor's Signature:…….. Date:……..

Name: Dr. Comfort Ogunleye Adetona

ABSTRACT

Accra Metropolitan Assembly (AMA) is unable to dispose off all the 2500 tonnes of solid waste generated daily in Accra Metropolis. AMA is also confronted with the problem of finding appropriate locations and dispose all the daily generated solid waste in Accra. Brainstorming to find solutions to the problems, AMA has identified solid waste recycling by some enterprises as one of the ways by which solid waste management could be addressed. This study therefore sought to assess solid waste recycling as a means of improving environmental quality in Accra Metropolitan Area. Survey research design was employed for the study and multi-stage sampling method was used to obtain 108 respondents and 3 keys informants who were purposively selected. Questionnaires, interview schedule and observation checklist were the instruments used to collect the data. The data were analysed using SPSS version 18, while content analysis was used for the key informant interviews. The results established that despite the benefits such as employment, production of household utensils, revenue generation and aesthetic environment that solid waste recycling provides in the study area, only 5 percent of the daily generated solid waste was recycled. It was further revealed that the low rate of recycling was due to few enterprises involved in solid waste recycling and most households not involved in this activity. It is recommended that the central and local governments implement the following measures: getting actively involved in solid waste recycling, encouraging households to participate actively through public education and motivation in order to reduce solid waste significantly in the Area Metropolitan Area.

ACKNOWLEDGEMENTS

The completion of this programme has become a reality as a result of the immense support that I received from many people for whom I owe much gratitude. I would like to express my profound gratitude to my principal supervisor, Professor Kwabena Barima Antwi, for offering his rich experience to guide me throughout the work by providing very constructive suggestions and having patience in correcting all my mistakes and for his commitment and dedication to ensure that I did a good work, I am highly indebted to him.

I would also like to sincerely thank Dr (Mrs.) Comfort Ogunleye Adetona, my co-supervisor, who also complemented the effort of my principal supervisor to improve the quality of this thesis. I would not like to leave out Mr. Dauda, a Principal Research Assistant (PRH) of the Geography Department in my appreciation since his doors were widely opened for me to occasionally consult him for assistance on this thesis.

Lastly, my immeasurable gratitude is also extended to Mr. Kuranchie of AMA and Mr. George Amoasah of Global communities who together directed me to registered recycling enterprises and composting facilities where I collected the primary data for my thesis. I am equally indebted to all the respondents for participating in the study.

DEDICATION

To my parents, Rev. and Mrs. John Donkoh, my lovely wife, Mrs. Georgina Donkoh, and our children, Isaac, Victoria, and Beatrice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS/ACRONYMS

ACRONYM	MEANING
ACF	Avenor Compositing Facility
ACS	American Community Survey
AGY	Asuogyaman Wood Processing Company
AMA	Accra Metropolitan Assembly
ATC	Avenor Trashy Centre
BNARI	Biotechnology and Nuclear Agricultural Research Institute
BP	Blowplast Limited
CBO	Community Based Organisations
CCMA	Cape Coast Metropolitan Assembly
CFC	Chloro-Floro Carbon
CHF	Community Housing Foundation
CSR	Corporate Social Responsibilities
DCOs	District Cleansing Officers
DTC	Dworwulu Trashy Centre
EA	Environmental Act
EEA	European Environmental Agency
EGSSAA	Environmental Guidelines for Small-Scale Activities in Africa
ENV	Environplast Company
ESAs	External Support Agencies

INC.	Incorporated
KEEA	Komenda Edina Eguafo Abirem
LAWMA	Lagos Waste Management Authority
LCA	Life Cycle Assessment
MMDAs	Metropolitan /Municipal/District Assemblies
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organization
NHIS	National Health Insurance Scheme
SDC	Swiss Development Cooperation
SPSS	Statistical Product and Service Solutions
SWM	Solid Waste Management
TOP	Top Industries Limited
U.S.EPA	United Sctates Environmental Protection Agency
UMP	United Management Programme
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
WMD	Waste Management Department
WTE	Waste-to-Energy
ZCF	Zekora Composting Facility

CHAPTER ONE

INTRODUCTION

Background to Study

Solid waste has been defined by Zerbeck (2003) as a non- hazardous industrial, commercial and domestic waste including household organic trash, street sweepings, institutional garbage and construction wastes. Enger and Smith (2000) also defined solid waste as all the waste emanating from human and animal activities and are mostly solid but at times liquid that are discarded as unwanted . Charas (1998) on other hand defines solid waste "as discarded paper, metals, leftover food, other items that come from business, hospital, airports schools, stores and homes"(p. 473).In a nutshell, solid waste may be defined as any solid material that arises from human activities such as domestic, industrial, commercial, agricultural and others, as well as animal activities that are normally regarded as unwanted.

Growth of population, increasing urbanization, and rising standards of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, mining, domestic and agricultural activities (Yoshizawa, Tanaka, & Shekdar, 2004). Globally, the estimated quantity of solid wastes generation was 11 billion tonnes as at year

2000 and about 19 billion tonnes of solid wastes are expected to be generated by the year 2025 (Yoshizawa et al, 2004). The persistent increase both in the quantity and variety of solid waste necessitated the need for their effective utilization by some countries as one of the ways of managing their solid waste (Asokan, Saxena, & Asokeler, 2004), rather than relying on traditional forms such as collection, transportation and disposal. This has brought about socio- economic development and improvement in the environmental quality of such countries such as Netherlands and Germany (United Nations Conference on Environment and Development, 2000).

Johnson, Ambrose, Basselt, Bowen, Crummey and Isaacson (1997) explained environmental quality as a set of properties and characteristics of the environment either generalized or local; as they impinge on human beings and other organisms. It is a measure of the condition of an environment relative to the requirements of one or more species and or to any human need or purpose. European Environment Agency (2012) also explain environmental quality as a general term which can refer to varied characteristics that relate to the natural environment as well as the built environment such as air and water purity or pollution, noise and the potential effects which such characteristics may have on physical and mental health. The explanations of Johnson et al (1997) and European Environment Agency (2012) on environmental quality suggest that environmental quality is measured based on the conditions or characteristics of the natural environment and built environment and how such conditions or characteristics affect human beings and organisms. This means that solid waste

recycling as a means of improving environmental quality could be assessed based on how solid waste recycling activities either improve or worsen environmental characteristics or conditions which may ultimately improve or worsen the physical and mental health of human and other organisms.

Generally, societies that effectively make use of large amount of its solid waste are most likely to remove a significant proportion of its solid waste from their environment and consequently minimize solid waste greatly and improve or sustain environmental quality. This is prevalent mostly in developed countries such as the Netherlands where solid waste is utilized effectively through re-cycling, re-use, generation of renewable form of energy called biogas, harnessing them into compost for improved agriculture among others (Environmental Guidelines for Small- Scale Activities in Africa, 2009). These solid waste utilization methods greatly minimize accumulation of solid waste in towns and cities. In addition, effective solid waste utilization brings about clean and serene environment, revenue generation, employment creation, production of essential products, reducing government's expenditure on imported goods and effecting favorable Terms of Trade (Cooney, 1975).

In contrast, societies that utilize little amount of its generated solid waste are most likely to encounter solid waste disposal and accumulation problems (Marbell & Tsiboe, 2004). People may be compelled to dispose off the generated solid waste at unapproved places since they may not have designated places for the disposal of their waste. This situation is common in many developing countries where solid waste is dumped largely at unapproved places such as near

market places, near public toilet and final disposal sites (Marbell & Tsiboe, 2004). For instance, in many cities in Ghana, people dump solid waste into large containers placed near market centres and public toilets, and at times dumped very close to residential areas and along beaches (Metcalfe, 2011). With time, the level of solid waste accumulation increases and causes the spread of epidemic such as malaria, cholera, typhoid, etc among people and posing environmental degradation (Islam, 2010).

In some developing countries, including Ghana, the problem is being ameliorated by both rural and urban dwellers by either burning the solid waste, burying them in dugout holes with intentions of using them as means of improving soil fertility, using them as feed to hogs, or ploughing them into soils (Bizunesh, 2011). Others dispose their waste into water bodies causing water pollution and adversely affecting the survival of the aquatic organisms (Coffie, 2010). These measures have, however, not solved the problem of waste disposal. Though the utilization of solid waste for compost generation, biogas generation, recycling among others is carried out in developing countries like Ghana, one is not sure whether the utilization process in cities has contributed significantly in minimizing solid waste accumulation (Tchobanoglous, Theisen & Vigil, 1993). This is due to the fact that there are huge waste dumps in several areas in Accra such as those at Odorkor, Oblogo, Sarbah and others (Akordor, 2011).

Recycling is one of the techniques adopted in solid waste utilization. The other techniques of solid waste utilization are reuse, reduce, burning in incinerations, etc. The Global Environment Centre Foundation (2006) defines

recycling as the act of using all or a part of a used product as a raw material in the same or other products. This is done through shredding, recovery of valuable metal and plastics, composting or other measures. The Centre further explains that recycling keeps items out of landfills and conserve natural resources. Recycling is the process of changing waste into new products to prevent loss of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, and reduce air pollution from incineration and water pollution from landfilling by reducing the need for 'conventional' waste disposal and lower greenhouse gas emissions. (The League of Women Voters, 1993). In conclusion, recycling is the processing of used materials into new products to save resources and energy.

Statement of the Problem

Most cities and towns in all the regions of Ghana are characterized by one common environmental menace, the accumulation of solid waste at unapproved spot. Among the cities in Ghana, Accra Metropolis is confirmed to harbor the highest amount of solid waste accumulation by generating about 2500 tons of solid waste per day (Waste Management Department, Accra Metropolitan Assembly, 2013).Within the city of Accra large waste containers are placed just behind market complexes like those at Kansehie, Agbogloshie, and Tudu. These containers are often overfilled with large amounts of solid waste which are usually a concern to residents, pedestrians, and traders. Also, there are huge dump site sited around Teshie, Odorkor, Apenkwa, Mallam, Oblogo, Kwashiebu and Sarbah emitting bad odour to residents staying close to them (Peterson, 2001).

In addition, most people residing close to the major drains in the city dump their solid waste in the drains because they do not have alternative appropriate dumping sites. For instance, floods that hit Accra after several hours of torrential rains is the result of drains being clogged by solid waste materials and therefore causing water not to flow freely (Boadi & Kuitunen,2002). Residents, industrialists, health workers and stakeholders like the Ministry of Environment, Science, and Technology as well as Accra Metropolitan Assembly (AMA) have also resorted to the operation of landfills.

Landfilling is a method of getting rid of very large amounts of rubbish by burying it in a large deep hole (Collins, 2009). The operation of landfills at certain areas within Accra has however come with very daunting challenges and people who reside close to them and the general public oppose their operation because they feel it violates their right to live in healthy and hazard free environments (Osei, Fianko, Adomako, Laar, Anim, Ganyalo, Nyarku & Nyarku, 2011). Some residents staying close to some landfills have been affected with leukemia because their well water had been contaminated by toxic substances from nearby landfills (Coffie, 2010). Others have suffered from eye irritations and respiratory disease stemming from unpleasant gases from landfill (Coffie, 2010). Contaminated groundwater from accumulated solid waste on landfills flow into nearby water bodies and pollute them (Coffie, 2010). Consequently, residents living around Sarbah and Abokobi landfills have threatened to close down the dump sites because they are experiencing some of the health hazards such as leukemia and eye irritations (Osei et al, 2011). It is confirmed that the last two

final disposal sites at Sarbah and Abokobi have reached their limits and requires a closure (Akordor, 2011).

Accra Metropolitan Assembly, the institution responsible for the overall collection and disposal of solid waste in Accra metropolis in recent times having a difficulty of securing areas to finally dispose off the collected solid waste at the end of the day. It is obvious that an urgent solution needs to be sought since it is becoming difficult to find an acceptable location to dispose wastes. The challenging problem now is what should be done to deal with the problem of increasing solid waste accumulation in Accra Metropolitan Area? As AMA brainstorm to look for improved options of managing solid waste in the Accra metropolis, recycling of solid waste by some enterprises has been identified as one of the options that can significantly address the problem. As to whether their activities have contributed significantly to solid waste reduction and improved environmental quality in Accra metropolis will be examined by this research work on solid waste recycling.

Thus the worrying and pertinent questions that the researcher intends to find answers to in the light of the situation described above are as follows.

Research Questions

1. What are the various categories of solid waste that are recycled in the Accra Metropolitan Area?
2. What is the rationale for solid waste recycling in the Accra Metropolitan area?

3. What is the extent of government's participation in solid waste recycling in Accra Metropolitan area?
4. Does solid waste recycling have useful socio-economic benefits in the study area?
5. How does solid waste recycling affect environmental quality in the Accra Metropolitan area?

Research Objectives

The main objective of the study was to assess the effects of recycling of solid waste on the environmental quality in Accra Metropolitan area.

The specific objectives of the study were to:

1. Categorise the various types of solid waste that are recycled in Accra Metropolitan area;
2. Examine the rationale for solid waste recycling in Accra Metropolitan area;
3. Assess the extent of government's participation in solid waste recycling in the area;
4. Determine the socio –economic benefits of solid wastes recycling;
5. Explain how recycling of solid waste affect environmental quality;

Significance of the Study

Policy makers: The findings of such a study will contribute information that can inform the public sector waste management stakeholders such as the

Ministry of Environment, Science and Technology; Metropolitan Municipal and District Assemblies (MMDAs) and private sector establishments such as Zoomlion Company Ltd to adopt pragmatic approaches in waste management such as recycling compost generation, etc.

Socio Economic standard. The pragmatic approaches in waste management that will be identified through the study can be adopted by governments, entrepreneurs, businessmen and economists to create employment avenues for citizens and minimize the level of unemployment. Individuals with special skills in recycling will be employed to display those skills in such organizations.

Environmental education: The outcome of the study could give credence to the need for the incorporation of waste management programs in the school curriculum by bodies such as the Ghana Education Service. It can also help MMDAs to educate the public through the media and the National Commission for Civil Education so that citizens will be enlightened and help people to desist or change their attitude on indiscriminate disposal of solid waste such as the disposal of solid wastes in water bodies like Korle Lagoon.

Reference Document: Outcome will contribute knowledge to the literature on waste management and serve as a source of reference for academics, researchers and students who may be undertaking future studies on the subject of waste management.

Organization of the Study

This thesis has been organized into five chapters. Chapter one is the introduction one. Following this introductory chapter is chapter two which reviews the related literature on the topic being investigated. It thus examines some existing theoretical and conceptual frameworks on solid waste management. Chapter three describes the methodological approaches used for the study and provides the profile of the study area based on its administrative structure, location, position, size and population, as well as its physical characteristics. It also justifies the research design, describes the target population, and explains the sample size determination and sampling procedures. The data collection instruments and data sources as well as data analysis techniques are also covered. It also describes the limitations associated with the research instruments used to gather data on the field. Chapter four presents the results and discussion within the context of the literature review and conceptual framework. Chapter five provides a summary of the major findings, conclusions, recommendations and areas for further studies.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter reviews the relevant theories and concepts on solid waste recycling and management. Basically, the content focuses on the theoretical framework, models, conceptual review and framework, municipal and waste management. The chapter also reviews empirical studies that have been done on solid waste recycling as a means of improving environmental quality in urban/metropolitan centres in a developed country, a developing country and in Sub-Saharan Africa.

Conceptual Review

Concept on waste

Withgott and Scott (2008) defined waste as any unwanted material or substance that results from a human activity or process (p.631). It must be understood that waste may not be wanted by the generators, but may be needed by others for manufacturing or other purposes. Raven, Berg, and Johnson (1995, p.519) expressed that waste is an unavoidable consequence of prosperous, high-technology disposable economies. Barrow (1995, p.250) on the other hand explained that waste is a damaged, defective or superfluous material which may pose a hazard. The owner has no longer a current or perceived use of it.

Authorities have expressed various views concerning the meaning of waste and in sum, the operational definition of waste for this research work is any defective or superfluous material which may be hazardous or non-hazardous and can be utilized to address a need or manufacture a product.

Types of Waste: Waste can be classified based on form, in which there is liquid and solid waste (Eschooltoday & BusinessGhana, 2010). Here liquid waste is explained as waste existing in non-solid form and also obtained when solid waste is converted to liquid waste for disposal. Examples are discharges such as wastewater from homes, liquids used for cleaning industries and waste detergents (Eschooltoday & BusinessGhana, 2010). Solid waste on the other hand is explained as any waste that is non-liquid and exist in the form of garbage, refuse or rubbish generated from homes and other places. Examples are food waste and broken furniture.

Eschooltoday & BusinessGhana (2010) also classified solid waste based on characteristics and by this criterium identified three kinds of solid waste namely hazardous, organic, and recyclable wastes. Hazardous waste is those that potentially threaten public health or the environment. Examples are fire extinguishers, pesticides, lamps, batteries, old propane tanks. Organic waste comes from plants and animal sources and includes food waste, fruit and vegetable peels, and others. They are biodegradable which means that they can be decomposed by microbes into manures or compost. Recyclable wastes are those that can be processed into new products and include used cans, plastics, glass and paper products.

Barrow (1995,) also classified waste based on their characteristics and identified two solid waste types such as hazardous waste which presents a threat to humans or other organisms as well as the environment e.g. CFC gadgets and toxic wastes which are so poisonous that they kill human cells as they react with them. Barrow (1995, p.274) also identified industrial and agricultural waste and classified others as carcinogenic meaning they are cancer related; mutagenic waste meaning they can cause changes in the cells of humans and animals; and tetarogenic waste meaning they can affect children at birth. With hazardous waste, Tyler (1993, p.274) identified those that are flammable such as waste oils, used organic solvents; waste that are corrosive to materials such as metals or human tissue such as strong acids and bases; toxic ones that are poisonous and can kill cells of man and animals; and waste that are unstable enough to explode or release toxic fumes such as cyanide solvents.

Concept of solid waste

Zerbeck (2003) explained that solid waste is a non-hazardous industrial, commercial, and domestic waste including household organic trash, street sweepings, institutional garbage and construction waste. Charas (1998) also defines solid waste as "discarded paper, metals, leftover food, and other items that come from businesses, hospitals, airports, schools, stores, and homes (p.473). Tyler (1993) described solid waste as any unwanted or discarded material that is not liquid or gas (P. 456). Reflecting on this definition it must be noted that the need for resource recovery including the recovery of waste materials as advocated by Schubeler, Wehrle, and Christein (1996) exposes the fact that

solid waste is not an unwanted or discarded material because if the solid waste owner has no perceived use for it, others may use it as raw materials by processing it into other products or the same brands of products.

Hoomweg and Laura (1999) classified solid waste into various types based on the source and identified residential, industrial, commercial, municipal, institutions and agricultural solid waste. Residential solid waste is generated from single and multifamily dwellings e.g. food wastes, paper, cardboard, plastics, wood, glass, metals, and others. Industrial solid waste is generated from light and heavy manufacturing, fabrication, construction sites, power and chemical plants and others (Hoomweg et al, 1999). Commercial solid waste is generated from stores, hotels, restaurants, markets, offices, buildings, e.g. paper, food waste, plastics. Institutional solid waste generated from schools, hospitals, prisons, and government centers. E.g. paper, cardboard, food waste. Municipal solid waste is generated from street cleaning, landscaping, parks; waste water treatment plants e.g. tree trimmings and others. Agriculture solid waste generated from crops, orchards, vineyards, feedlots, and others (Hoomweg et al, 1999).

Solid waste, can also be classified into municipal, industrial, and hazardous (Withgott and Scott, 2008, p.631). They explained municipal solid waste as a non-liquid waste that comes from homes, institutions and small business; industrial solid waste as solid waste obtained from the production of consumer goods, mining, agriculture, petroleum extraction and refining; and hazardous solid waste as one that is toxic, chemically reactive, flammable or

corrosive. In these studies, solid waste is explained as the type of waste that is not liquid or gaseous, generated from residential, industrial, commercial, municipal, institutional, and agricultural activities, and which can be hazardous or non-hazardous, and may be used to address a need or manufacture products. It must be noted that various waste types which include solid waste are generated from various human activities within the environment(Withgott&Scott,2008,p.157).It is therefore important and appropriate for the word 'environment' to be understood in details and this leads to the concept of environment.

The concept of environment

The word environment comes from a French word *environner* meaning 'to surround'. It is used to describe everything that surrounds an organism and include air, soil, climate, and food supply, and a myriad of other external conditions (Kellert, 1997, p. 66). Ashworth and Little (2001) explained environment as the total setting in which a given object rests or a given action takes place including all physical, chemical, biological, physiological, and psychological factors. The term can be modified and restricted by specifying the object or the action. Therefore the word environment is the environment immediately surrounding a job to be done, including not only the walls of the room, but lighting, temperature, humidity and noise levels, interactions with colleagues and other persons, air quality, presence or absence of superiors and so forth. Used without a modifier the term environment means the 'natural environment' that is, all things in a given area or region that are not created by man (Kellert, 1997, p.66).

Cooper and Reinhold (1996) also explained environment as the sum of all external conditions affecting the life, development, and sustenance of an organism. Environment includes water, air and land and the interrelationship that exist among and between water, air and land and all living things (Cooper & Reinhold, 1996, p.229). Crystal (2000) was also of the view that environment is the conditions and influences of the place in which an organism lives. The large number of different types of environment such as urban environment, physical environment, others, makes it impossible to formulate a single definition. Crystal (2000) explained that physical environment describes the characteristic of a landscape such as climate, geology which have not been changed markedly by human impact, whereas geographical environment include the physical environment that has experienced human modification through agricultural systems, industrialization and urbanization (p. 520).

Eblen and Eblen (1994) explained environment as the setting in which the organism develops and functions, and refers to all the factors of the external world that affect biological and social activities. Simply put, it is the sum of the abiotic (physical), biotic (living) and cultural (social) factors and conditions directly or indirectly affecting the development, life, and activities of organisms and populations (P. 208). In sum, the definition of environment in this research work is the sum of all the external conditions which directly or indirectly affect the development, life, and activities of man and other organisms. The physical factors include air, soil, climate, water bodies, land and others; while the biological factors are the influences of living things such as plants and animals and

interrelationships. The social or cultural factors are the influences of human activities such as industrialization, commerce, agriculture, mining, and others. The biotic, abiotic, and social factors of the environment that directly and indirectly affect the development, life, and the activities of man, and other living organisms provide the environment its unique qualities which have been explained by some authorities.

The concept of environmental quality

Johnson et al (1997) explained environmental quality as a set of properties and characteristics of the environment either generalized or local as they impinge on human beings and other organisms. They explained that it is a measure of the condition of an environment relative to the requirement of one or more species and to any human need or purpose. European Environmental Agency (2012) were also of the view that environmental quality refer to varied characteristics that relate to the natural environment as well as the built environment such as air, land and water purity or pollution, noise and the potential effects which such characteristics may have on physical and mental health. Environmental quality standards are measured based on the maximum limits or concentrations of pollutants that are permitted in air, land and water. This means that standard are based on the maximum acceptable levels considered safe to public health and welfare, wildlife and the environment (Cooper & Reinhold, 1996). Maintaining a safe environment requires the drastic reduction of various forms of waste including solid waste since some of the waste forms are hazardous and toxic (Cunningham & Saigo, 1997) and as well pollutes the environment (Barrow,

1995). Their reduction can be done through the application of various waste management methods and one of them being recycling (UNEP, 2005a).

The concept of recycling

Hornby (2006) explained recycling as treating things that have already been used so that they can be used again (p.1219). Ashworth and Little (2001) also described recycling as the use of waste in the form of raw materials to make different goods (p.324). Eblen and Eblen (1994) defined recycling as a complex chain of activities in which waste has to be collected and processed and used for making new products (p.598). From the point of view of Withgott and Scott (2008), recycling involves sending used goods to facilities that extract and reprocess raw materials from the used goods to manufacture new goods. Examples of such used goods are newspapers, white papers, glass, metals cans, and plastic containers (p.631). Global Environment Centre Foundation (2006) also defined recycling as the act of using all or a part of a used product as a raw material in the same or other products.

The recycling of organic wastes is called composting (Miller, 1997, p. 338). Composting under natural environment involves piling up of organic materials and allowing sometime for the materials to decay (EPA and CHF, n.d.). According to EPA and CHF (n.d.), the main type, aerobic composting occurs in the presence of oxygen. The microbes responsible for the breakdown of the composting materials require oxygen to survive. The piled organic waste is turned every 3 or 4 days so that it is well aerated and at the same time maintaining

sufficient moisture and temperature levels. EPA and CHF (n.d.) further explain that the regular turning avoids a build of methane gases in the facility and active composting should have temperature ranges between 40^0 and 75^0 .

EPA and CHF (n.d.) explain that there is also anaerobic composting which refers to composting without oxygen. They explain that anaerobic microbes breakdown organic materials leading to the release of methane and carbon dioxide gases and organic waste undergo fermentation which results in the release of ammonia gas with an offensive smell. They further stress that bad odor during composting indicates anaerobic composting and there is the community system composting facility which is a medium sized type that handles organic waste from households, restaurants and places of organic waste production at the community level. They caution that providers have to adopt a sound management practice to avoid emission of odor, attraction of pest and the outflow of leachates so that they do not contaminate the environment and water bodies.

EPA and CHF (n.d.) point out that potential adverse impacts resulting from composting includes the contamination of air by odours and particulate matter, potential hazards such as fire and explosions as well as water and soil pollution. They indicate that organics such as food, meat, fish, fatty and oily sludges contain sufficient moisture that can generate leachate; while garden wood and fibrous materials soaked with water to produce leachate that are acidic and can cause the dissolution of metals and metallic compounds that can pollute ground water and surface water bodies. They add that other adverse impacts include loss of amenity, particulate odours, the presence of vermin in

excessive numbers, excessive noise from equipment, wind-blown litter and particulate matter from delivery trucks and earthmoving equipment. Composting can also result in greenhouse impact and the production of contaminated organic products.

Some authorities are of the view that composting is an alternative solid waste management method to recycling and therefore of the perception that composting and recycling are different independent solid waste management methods (UNEP, 2005a), while others are of the opinion that composting is an aspect of recycling as explained by Global Environment Centre Foundation (2006) in the 3Rs theory of solid waste management in Japan as indicated in Appendix F. In this study, therefore, the researcher perceives composting as an aspect of recycling (Global Environment Centre Foundation, 2006).

Empirical Review

Ning (2006) conducted an empirical study on the challenges of sustainable urban planning in U.S. The process of data collection started with county selection process. In the first place, a list of 3,141 counties was gathered from the U.S. Census. Secondly, 1,100 counties that were located in metropolitan areas were identified using the U.S. Census. At the third stage, the population growth rates between 2000 and 2005 for each metropolitan county were calculated using census data and compared to the national average (5.3%). A total of 500 metropolitan counties whose growth rates were more than the national average were selected for the next stage of the study. At the fourth stage, counties that had 250,000 residents as at year 2000 were selected. 100 counties were selected and

this was covered in the American Community Survey (ACS) and ACS supplement survey. Finally after going through each of the 100 growing counties, 39 of them provided the required statistics of waste management for the purpose of study. The selection process is summarised in Table1.

Table 1: County selection process

Selection criteria	Number qualified
Counties	3141
Located in Metropolitan Area	1100
Experience faster population growth than national average (2000 to 2005)	500
Over 250,000 residents in 2000 Covered by American surveys	100
Wastes statistics confirmed at the county level (Total sample)	39

Source: Ning (2006)

On the basis of empirical data across 39 counties in the US, this study found that population growth did not necessarily bring about increases in waste generation. Six counties in different states achieved waste reduction even when its population growth was higher than the national average between 2000 and 2005. Economic incentives proved to be the effective cause for this waste reduction. Charging households by the volume of their waste generation brought an increase in recycling and this reduced waste disposal. In addition, counties with a higher percentage of white population tend to generate less waste. Those with median

household income recycled more. Counties with older buildings generate more waste. It was also discovered that the positive correlations between median building age and waste generation can be attributed to the followings: older buildings may need more maintenance and generate more waste; also, older buildings are frequently located at business centres with a high density of employment. Waste generated from commercial, institutional and non-hazardous industrial activities may all contribute to a higher rate of waste generation on per capital basis.

As part of assessing the impacts of waste management on economic development the study investigated the costs of four waste management options: siting a new landfill, expanding landfill capacity, adopting waste-to-energy option (incineration) or recycling. The result of the study indicated that recycling consistently helped reduce the cost of waste management as compared to other options (Ning, 2006). The external costs of emissions from incineration varied because at certain times the cost became the highest among the waste management options, while in other cases the cost came next to that of siting a new landfill. Also, expanding landfill capacity incurred lower cost than siting a new landfill.

The empirical findings suggested that public policy could play a role in waste reduction, and resume a stronger presence in waste management. This meant that the government should play an active role in waste management through initiation of waste reduction policies such as recycling, composting and others. The researcher's use of the whole of the United States of America as the

study area was too large that it posed a major research problem such as data entries and ent practices. The target population for the study included waste workers, administrators, cleaning committee members of each sub-city, health office workers, beautification and cleaning department workers, as well as workers of Environmental Protection Authority (Benti,2007). The research design was the survey research design, and employed a range of sampling techniques namely stratified sampling, systematic random sampling and purposive sampling to reach respondents. Data was collected by observation through the use of checklists, qualitative survey through the use of interviews, focus group discussion and case studies, and quantitative survey by making use of structured interview schedule as well as secondary sources.

The study revealed that solid waste management in the city was poor and several reasons were deduced for this. The first was technical and included inaccessibility of the city due to the geographical and urban structure, lack of properly designed collection route system and time schedule, inadequate and malfunctioning operation equipments, opening burning of garbage, poor conditions of the final dump site, and littering of the corner around the skips which encouraged illegal dumping. (Mohammed, 2003). Secondly, there were identified problems which were classified as financial. These problems were as a result of insufficient funds resulting in the lack of promotion of waste reduction strategies such as recycling, cost recovering, practice of energy option, waste separation and composting.

Furthermore, there were social problems. These included the lack of public awareness, illegal dumping, poor conditions of waste workers, lack of private sector and community involvement. Again, institutional challenges were identified which included organizations not having the required equipment for operation, low staff manpower qualification and inadequate number of in-service training. Recommendations that were made in the light of these problems were as follows. First, waste management parties made up of individuals, industries and governmental department should co-operate and take collective decisions that will provide a long lasting sustainable solution to waste management problems.

Secondly, the study revealed that over 75% of solid waste from households is biodegradable organic waste (Nigatu, Rajan & Bizunesh, 2011). Through composting most of this organic waste can be converted into organic fertilizers to replace the inorganic fertilizers to save foreign exchange earnings. The organic fertilizers are far less expensive to produce than the imported inorganic fertilizers and its application on the land for crop production is more environmentally friendly than the inorganic ones. Furthermore, waste needs proper management, and this can be done by segregating the waste at generating points into re-usable and non –reusable parts, and utilizing the re-usable part into financially viable materials. Also, segregating the hazardous solid waste from the non- hazardous ones in order to ensure the safety of waste workers.

The focus of the study was to find out the challenges and opportunities of solid waste management in Addis Ababa city in Ethopia. However, the result of the study revealed in details the challenges, but did not discuss the opportunities.

The current study is therefore meant to bridge this knowledge gap by investigating the socio-economic benefits of solid recycling by registered enterprises in the Accra Metropolis.

Yetunde (2012) also conducted an empirical study on the sustainability of municipal solid waste management in Lagos city in Nigeria. This study was conducted at the time in which solid waste management at the national level was carried out by the Federal Ministry of Environment and the National Environmental Standards and Regulations Agency. The Federal Ministry of Environment oversaw the protection of the environment and the preservation of natural resources in a sustainable manner. This body therefore promulgated environmental laws, enforced and monitored it. It also ensured that citizens and organizations complied with international environmental guidelines. The National Environmental Standards and Regulations Agency also enforced environmental laws and maintained effective interaction between national and international actors who dealt with environmental issues. The Federal Ministry of Environment also provided all states the capacity to establish environmental laws to protect the environment in their various states. Within each state, the local government ensured the management of solid waste (Ogwueleka, 2009).

Efficiency in the management of solid waste in various states has not been attained especially in major cities such as Owerrri, Aba, Enugu, Port-Harcourt, Kaduna, Ibadan and Lagos (Idowu, Omirin & Osagie, 2011). In such cities are piles of municipal solid waste generated from household, markets and commercial activities (Momodu, Dimuna & Dimuna, 2011). Households are known to

generate the highest forms of solid waste ranging from organic waste, plastics, glass, metal scraps, paper, batteries, and vehicular parts (Magutu & Onsongo, 2011).

The researcher focused on Lagos for the research work since it has been named the dirtiest state in the country and having a high level of waste management problems (Kotoworola, 2007). Lagos Waste Management Authority (LAWMA), 2011 indicated that approximately 9000 metric tonnes of solid waste is generated on daily basis. The choice was also due to its most populous nature in Nigeria, the centre of commercial activities and its significant population size. Its consistent increase in population made it suitable for the study. Lagos was chosen as a case study in this research because of its socio-economic importance and serving as a pace setter for development for other states. An improvement in the management of solid waste in the city of Lagos would be emulated by other cities in Nigeria. The objective of the study was to find the current state of waste management in Lagos with special emphasis on how households handle their solid waste, how the municipal manages the waste generated from household and the sustainable options in solid management that ensured environmental safety and resource recovery.

The Case study methodology was adopted for the study. According to the Yetunde (2012), this method involves the study of phenomena at different levels of complexity, in which there is an organized collection of data about individuals or group of individuals through different means and furnishing better understanding of the study topic. The researcher employed the case study method

since it focused on municipal solid waste management in a specific geographical region (Lagos state) within a country (Nigeria). Data was obtained for the study by combining several data techniques. The researcher utilized a qualitative approach in the collection by focusing more on the quality of data obtained rather than the quantity (Bryman, 2004). Data was obtained from both primary and secondary sources with the primary sources obtained through field observation and interviews of stakeholders in waste management such as households, private operators, LAWMA personnels and scavengers, while secondary resources were obtained through the search of relevant desk literature. Materials used for interviews were the tape recorder, whiles photographic cameras were used to take pictures of waste category and activities on the field.

Content Analysis method was employed which involves a thorough evaluation of data for the purpose of bias or trend identification and interpretation (Berg, 2009). As a result, the researcher analyzed the data by employing the interpretative technique by identifying categories, trends and themes and drawing out inferences from interviewees' responses and field observation through comparison within groups and across groups.

The results indicated that there is a direct relationship existing between population size and volume of waste generated in Lagos. Increase in population could cause space constraints for landfill disposal sites since in the near future population increase would generate higher volume of solid waste and reduce the life span for landfills.

It was also revealed that a high proportion of solid waste from household in Lagos were organic. The reason was that residents rely on home cooking in which the waste generated contained mainly the non-edible components during food preparation such as yam peels, plantain peels, beans chaff and fish bones. Most of the food and fruits consumed have high proportion of non edible part. The same composition was observed across low, middle and high income status suggesting that social status had less influence on the content of food waste generated. However, the same trend was not observed for the socio-economic groups in Lagos since the volume and content of inorganic waste generated was highest for middle and high income households but relatively low for low income household.

The interviews and observation in the study show that waste is not segregated by households in Lagos. However, the ability to introduce and sustain waste segregation would serve as the basis for exploitation of other waste management options. The results also indicated that not all areas enjoy effective waste collection services due to truck break down, non-accessible roads and financial constraints from cost recovery challenges. Some local government areas appear to be better served by private operators than others, indicating that waste collection services rendered are not uniform throughout the state. It was explained that the observed non-uniformity in services rendered by the private sector could be due to the continuous use of unconventional waste disposal methods such as carting and indiscriminate dumping in street corners or drainages by households. Though, many households expressed willingness to pay for improved waste

collection services it appear that many do not pay. In the light of the problems revealed through the data collection and analysis, the following recommendations were made.

In the first place, increase in population could result in increase in waste generated such that in the near future there will be no land to be used as landfills. Therefore the increasing use of disposal items should be coupled with the full adoption of more sustainable waste management options, specifically those that significantly reduce the amount of solid waste in waste disposal sites. Secondly, waste management workers should have knowledge of waste composition in communities so that they can efficiently determine the type of sorting, storage and transportation needed as well as resource recovery systems that need to be adopted (UNEP, 2005b). Also, waste bins should be made available near buildings, and residents made to pay subsidized fees for their disposal instead of the high land use tax which is a burden to tenants and their landlords.

The study did not investigate the environmental consequences of the poor solid waste management attitudes in Lagos city, and therefore urging the current researcher to address that knowledge deficiency by including the environmental implications of solid waste recycling in the objectives. The study disclosed that there was solid waste collection services, but did not indicate the specific volume of solid waste removed daily from the environment for disposal, and the benefits of the waste collection services to the environment. The current study is therefore to investigate into the volume of solid waste often removed daily from the environment and the positive impact of this removal on the environment.

Conceptual Framework

Global framework and approaches

Globally, responsible societies provide policies that ensure a safe environment and address public health issues arising from waste generation (Nabegu, 2010). Solid Waste Management(SWM) systems, therefore, considers polices that ensure reduction of waste, recycling, recovery of waste, utilization of appropriate waste treatment methods and more environmentally friendly technology, and appropriate final disposal methods (Kotoworola,2007). SWM and corresponding legislative requirements has evolved and improved over the years to their current state, in most developed countries (Williams, 2005). Most developed countries have developed current national strategies to ensure efficient and sustainable waste management system.

The United States of America developed the 1965 Solid Waste Disposal Act which was amended under the Resource Conservation Recovery Act in 1976. This amended Act dealt with solid waste disposal issues and provided a framework for environmentally friendly solid waste management. In Asian countries such as China, there were polices and frameworks promulgated that addressed challenges posed from managing solid waste. In Hong Kong, there was the Waste Disposal Plan developed in 1989, which later amended into the Waste Reduction Framework Plan (Ko & Poon, 2009).In 2005, the government in Hong Kong established a MSWM policy framework and the goals to be achieved based on the strategies adopted within the framework include a reduction of MSW

produced in the city every year and an increase in the total rate at which MSW is recovered by 45 percent by 2009 (Ko & Poon, 2009).

In Europe, several Acts and treaties have been established, all having a common goal of environmental protection and improvement. The 1st, 2nd and 3rd Environmental Act (E.A) emphasized avoidance of waste and pollution, re-use, recycling and solid waste disposal through environmentally friendly methods. There was also the development of the 4th E.A which introduced a hierarchy of continuous means of executing management of community waste as well as the application of non-pollution technology (Williams, 2005). The 5th and 6th E.A. encourages harmonization of sustainable development, environmental regulations, and decision formulation with EU policies and strategies.

Solid waste management hierarchy

It is a hierarchy of waste management which is built on the concept of the 3Rs of reduces, reuse and recycle and focuses on maximum utilization of resources with minimum generation of resultant waste (UNEP, 2005b). It is regarded as one of the foundations of modern day waste management system, and adopted by many countries (UNEP, 2005a). The 3Rs refer to reduction in the amount of waste generated; the reuse of the items prior to becoming waste and the recycling of waste items. An expounded version of the waste management hierarchy includes waste prevention/reduction, reuse, recycling and composting, energy recovery and finally landfilling.

The hierarchy's function is to aid in the management of waste whilst ensuring that there is little impact on the environment and to safeguard public health. In most countries, prioritization of components in the hierarchy involves giving preference first to waste prevention/reduction, reuse, recycling, energy recovery and landfilling.

Table 2: Hierarchical Arrangement of Solid Waste Management Options

Solid waste management option	Advocated desirability	Global trend
Prevention/ reduction	Most desired	Least practiced
Reuse		
Recycling/ composting		
Energy recovery		
Landfilling	Least desired	Most practiced

Source: (UNEP, 2005b)

Waste prevention and reduction

Waste prevention occupies the top most rank in the waste management hierarchy. Waste prevention involves decreases in the amount of waste produced through the prolongment of a product's life span and its reuse; decrease in the environmental and health impacts from waste produced and decrease in the quantity of poisonous substances in products (European Commission, 2010). The concept of waste prevention and reduction is applied along the entire process of production namely the extraction of raw materials, the manufacturing, distribution and its utilization.

It is worthy to note that waste prevention and reduction can be applied at all stages involved in the production of a product, but its application at the earlier stages of productions has a greater impact on the later stages. Waste prevention at source is based on the adoption of a suitable process, adjustment in the usage of raw materials as well as the production process (Williams, 2005). Some waste such as food waste may be prevented from occurring, while others by their nature cannot be prevented, for example the shells or bones of animals (unavoidable waste). Waste prevention is achieved by purchasing only what is required to be used at a given time (European Commission, 2011).

Reuse

On the hierarchy, the next best option for SWM is reuse which refers to the utilization of an item after its initial use, either for a purpose similar to that which was intended or for an entirely new one. Examples are the reutilization of bottles and plastic bags from stores (William, 2005).

Reuse slows down the entrance of items into the waste stream and prevents the amount of items that become waste (European Commission 2010). This results in the reduction of the use of virgin materials and energy utilized in the production of items. However, this call for the production of quality items which can be used for longer periods and such items needs more resource for their production (Williams, 2005).

Recycling

Recycling comes next to reuse on the solid waste management hierarchy. It is the act of making use of products once used to produce the same items like the original or main items (Global Environment Centre Foundation, 2006) taking into consideration cost effectiveness, marketability and environmental impact it may have (William, 2005). The recycling process comprises collection, segregation, and processing of waste with productive value (Pattnik & Reddy, 2009) and therefore the inorganic components of municipal solid waste such as paper, metal, plastic, and glass materials may be recycled (Williams 2005). Energy resource used during the process of recycling as well as the resultant pollution should be minimal when compared with the utilization of fresh production material. The effectiveness of cost and marketability should also be considered.

Recovery of inorganic materials from MSW is a significant aspect of the management of waste (Sharholy, Ahmad, Mahmood & Triveli, 2007). In some developed countries recycling rates is quite high. For example, in Germany and Austria, recycling rates is over 25 percent, while composting rate in Austria was about 40 percent in the early 90s (European Environmental Agency, 2007). However, for most developing countries, recycling rates is low and dominated by uncontrolled salvaging of inorganic materials by scavengers (UNEP, 2005a). Among African countries, East African countries like Kenya have made significant strikes in recycling than West African countries (Gakungu, 2011).

Composting is the biological decomposition of biodegradable solid waste under controlled predominantly aerobic conditions to a state that is sufficiently stable for nuisance free storage and handling and is satisfactorily matured for safe use in agriculture (UNEP,2005a, p.197). Organic components in solid waste management such as food waste or market waste are considered useful materials (Williams, 2005). The end product of compost may be utilized in the conditioning of soils meant for agricultural purposes by providing nitrogen, potassium and phosphorous and improving soil water retention capacity (Ali, 2004; UNEP, 2005b).

Composting is considered a more viable and sustainable option for developing countries because of the high organic component of the solid waste generated (Troschinetz & Mihelcic, 2008) and resource constraints in developing countries (UNEP, 2005b) The advantage of recycling over the other options on the solid waste management hierarchy is its non-rigid requirements, and unsophisticated method. However the environmental benefits of composting that is its ability to reduce organic waste within the solid waste stream, and the economic benefits that is the revenue obtained from the sale of compost can be effectively achieved if only members of households segregate the various components of solid waste including organic waste. The organic waste can also be used to produce carbon dioxide and methane gas through anaerobic digestion that is within an environment lacking oxygen. During the process of anaerobic composting, methane and oxygen gases are emitted. These gases can be used to generate power and also used as fuel (UNEP, 2005b).

Energy recovery

Organic components of MSW are combustible and for this reason can be incinerated to obtain thermal energy or generate electric power for use in building through boilers (William, 2005). Incineration is the process of converting organic solid waste into other useful forms such as heat, steam and ash residues through combustion which at times referred to as Waste- to Energy (WTE) plants (Magutu & Onsong, 2011). Incineration reduces solid waste by 70 to 80 percent and thus minimizes waste sent to landfills. Countries that have landspace problems such as Japan and Singapore seriously resort to incineration (Magutu & Onsongo, 2011, p.6). European countries like Denmark and Sweden have resorted to incineration rather than landfilling due to bans and taxation on landfills (European Environmental Agency, 2007). However, liquid and air discharges through the incineration process pose environmental challenges (Narayana, 2009).

Landfilling

Landfilling is the deposition of waste in a specific land area with the goal of preventing waste from impacting negatively on the environment (Narayana, 2009). Landfilling has the least priority on the solid waste management hierarchy because of the negative environmental impacts through greenhouse emissions and other forms of pollution that affect soils, ground water and land surfaces (European Environmental Agency, 2009). Though it is least desirable on the solid waste management hierarchy, it is the most prevalent approach of waste disposal globally (Remigious, 2010) due to the legislative measures and the well structured

nature of landfills that exist in many developed countries, where they are designed according to specifications which ensure minimal impact on the environment. Specific examples occur in North America, New Zealand and Australia where their operations are controlled according to adherence to corresponding legislative land filling and air quality requirements (Bogner et al, 2007). In the industrialized Asian countries, the landfill method is only adopted when all other methods fail (Zhang, Keat, & Gersberg, 2009). In many countries in Africa, the landfill method is characterized with disposal of waste on open, non-structured area of land without consideration for environmental impact. Again structures for leachate and greenhouse containment are absent (Remigious, 2010).

Municipal solid waste management in low-income countries

Schuebeler, Wehrle and Christien (1996) come out with a concept for municipal solid waste management in low income countries, and their publication was based on the discussions, conclusions and recommendations established at a workshop in Switzerland in 1995. This workshop was a joint initiative of the Swiss Development Cooperation (SDC) and the Urban Management Programme (UMP), aimed at defining critical issues of MSWM in developing countries, identifying the needs and recommending possible directions of development assistance.

In the concept, MSW was defined as refuse from households, non-hazardous solid waste from industrial, commercial and institutional establishments, market waste, yard waste and street sweepings. This did not

include semi-solid waste such as night soils which were rather considered as liquid waste. Management was explained as a cyclical process of setting objectives, establishing long -term plans, programming, budgeting, implementation, operation and maintenance, monitoring and evaluation, cost control, revision of objectives and plans and others (Schuebeler et al, 1996)

MSWM refers to the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas. The overall goals of MSW are as follows. Firstly, MSWM is to protect environmental health; secondly it is meant to promote the quality of the urban environment. Also, MSWM is to support the efficiency and productivity of the economy and finally to generate employment and income. MSWM works on the principles of minimizing waste generation, maximizing waste recycling and reuse, and ensuring the safe and environmentally sound disposal of waste (UNEP, 2005b).

The concept was structured along three dimensions: The scope of waste management activities; the actors and development partners in the waste management; and the strategic objectives to be addressed. The scope of the MSWM concept encompasses planning and management, waste generation and waste handling processes. Planning and Management takes the form of strategic planning, legal and regulatory framework, public participation, financial management, institutional arrangement and disposal facility siting. Waste generation is managed through waste characterization, waste minimization and source separation; while waste handling is done through waste collection, waste transfer, treatment and disposal (Schuebeler et al, 1996).

They indicated that actors and partners comprise a wide range of individuals, groups and organizations concerned with MSWM as service users, service providers, intermediaries and regulators, and these include households and communities, non-governmental organizations, local government, national governmental, private sector enterprises, informal private sector and external support agencies. Household and communities are actors and partners who want effective and dependable waste collection service at affordable prices, so poorly served residents often form Community Based Organizations (CBOs) to upgrade local environmental conditions, improve services and petition the government for service improvement (Schuebeler et al, 1996). CBOs may assist governments in local waste management by managing and financing local wastecollection services and operating waste recovery and composting activities (Janicke,1996).

Non–Governmental organizations (NGOs) operate between the private and governmental realms and motivated basically by humanitarian reasons and developmental concerns. NGOs may help increase the capacity of people or community members to play active roles in local solid waste management by making people aware of waste management problems, serving as channels between government authorities and CBOs and assisting CBO's in municipal and metropolitan planning and implementation process (Schuebeler et al, 1996). NGOs may also provide important support to informal sector waste workers and enterprises by assisting them to organise themselves and improve their working conditions and facilities as well as increase their earnings (Schuebeler et al, 1996).

Local government authorities are responsible for the provision of solid waste collection and disposal services and are authorized by higher authorities to enforce bye-laws and regulations and to mobilise resources required for solid waste management (Scott, 2001). To live up to expectation, local governments set up technical agencies and contract private enterprises to provide waste management services, and are responsible for the provision of infrastructure and equipment for waste management (Scott,2001) .

National Government are responsible for establishing institutional and legal framework for MSWM and ensuring that local government have the necessary power, authority and capacities for effective solid waste management (Janicke,1996). They assist local government to execute their duties creditably by providing them with guidelines and capacity building measures in the fields of administration, financial management, technical systems and environmental protection (McGinty,2002).

Schuebeler et al (1996) explained that private sector enterprises are made up of a wide range of enterprises ranging from micro-enterprises to large business establishments who are profit oriented and generate profit through waste collection, transfer, treatment, recycling or disposal services. Working hand-in-hand with government, private enterprises provide capital, management capacity and technical skills. They provide more efficient and lower cost MSWM services (Scott, 2001).

Schuebeler et al (1996) indicated that informal private sector comprise unregistered, unregulated activities carried out by individuals, families, groups or small enterprises. They explained that in order to generate revenue, informal waste workers are involved in the MSWM as waste collectors or scavengers who collect this solid waste for private sector enterprises for recycling.

External Support Agencies (ESAs) are bilateral and multilateral external support agencies that support MSWM in low –income countries. Some ESAs have acquired considerable expertise in the area of waste management, and aim at improving urban waste management capacities and urban environmental protection (Schuebeler et al, 1996)

Strategic objectives to be addressed take one of the three dimensions of MSWM. These objectives are specific and operate along political, institutional, social, financial, economic, and technical aspects of waste management (Schuebeler et al, 1996). The political objectives are to determine society's goals and priorities for waste management and to mobilize public support for these goals. These objectives provide a distinction for waste management tasks among the concerned government bodies and private sector workers and spell out the roles and responsibilities of service users. The political objectives also include the establishment of legal and regulatory framework that can help responsible authorities to achieve their goals (Janicke, 1996).

Institutional objectives are to devolve responsibility for MSWM, to establish effective institutional arrangement for waste management at the

municipal and metropolitan levels, to build capacities for municipal institutions and staff, to introduce competition and efficiency by involving the private sector, and to lower costs through the participation of communities and service users (Scott, 2001). The social objectives are to orient municipal waste management towards the real service needs and demands of the population to encourage patterns of waste handling and disposal necessary in MSWM, to encourage community members to self –manage their local waste collection, and to protect the health of formal and informal waste workers (Janicke,1996). The objective also include supporting waste workers to improve their working conditions and facilities, increase their earning capacity, ameliorate their social security, as well as access to housing, health and educational facilities, and alleviate their social marginalization. The financial objectives are to establish practical systems of budgeting and cost accounting for MSWM, to mobilise required resources for investment in waste management and reduce the costs and improve the efficiency of waste management operations (Schuebeler et al,1996) .

Schuebeler et al (1996) explain that the economic objectives are to promote productivity and development of the urban economy, ensure the environmentally sound collection, recycling and disposal of all generated waste, including hazardous and commercial wastes, promote waste minimization, material conservation, waste recovery and reuse, generate jobs and earning in the waste management activities, and apply the principle of polluter-pay-principle (U.S.EPA, 2010). Technical objectives introduce coherent technical

systems which are adapted to the requirements and operations of all concerned actors including service users, informal sector workers, private enterprises and public sector waste operations (Janicke, 1996). This objective also recommends composting as a promising approach to waste reduction and recovery of organic materials.

The effectiveness and sustainability of MSWM systems depend upon the adaptations to the same context namely political, socio-cultural, economic and environmental levels. Under the political context, MSWM is influenced by effective relationship between local and central governments (Janicke, 1996). The socio-cultural context influences MSWM by people's attitudes and patterns of waste handling (Scott, 2001) while in the economic context, the level of economic development is the determinant of waste generation and the demand for MSWM services (U.S.EPA, 2010). The environment influences MWSM, since MSWM must be adapted to the physical characteristics of the area, climatic conditions and as well as developmental conditions (Schuebeler et al, 1996).

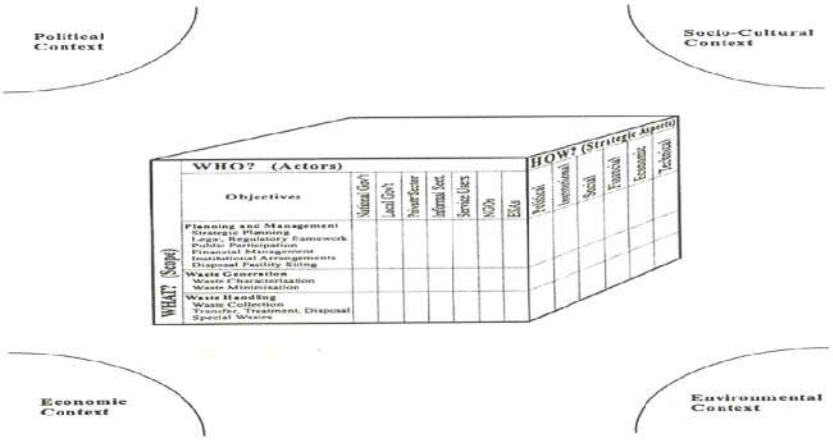

Figure1. The Three Dimensions of MSWM in low income countries

Source: Adapted from MSWM in low income countries (Schuebeler et al, 1996, p.17)

Theoretical Framework

3Rs technologies and techniques of solid waste management in Japan

The Global Environment Centre Foundation (2006) established the 3Rs technologies and techniques of solid waste utilization in Japan which involves the principle of reducing, reusing and recycling waste, resources and products. Reduce was explained as choosing to utilise things with care so that the waste generated is reduced, while reuse involves the repeated use of items including waste that still have the potential of being used. Recycling is explained as the use of waste as a resource. The 3Rs technologies and techniques advocate that waste can efficiently be minimized by focusing first of all on the technologies of reduce, followed by reuse and recycling, and finally energy recovery. Waste or items that cannot be used by any of the above technologies have to dispose by appropriate means. The 3Rs technologies and techniques of solid waste utilization in Japan have been illustrated in Figure 2.

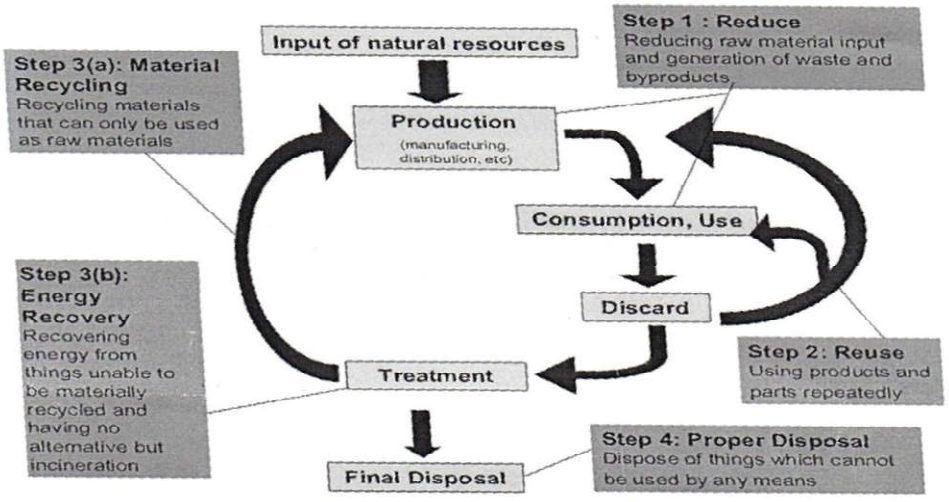

Figure 2.The 3Rs Technologies and Techniques of solid waste utilization in Japan. Source: Adapted from Global Environment Centre Foundation (2006, p.2)

The purpose of reduce is to minimise the amount of natural resources input into the production process and to cut down the amount of waste disposed. Reduce as a technology for minimising waste can be achieved through reducing the amount of raw materials and energy used per product by changing the design of the product, improving the quality of production by extending the product lifelines or improving repairs and maintenance and finally reducing the amount of waste disposed by minimising the volume of waste or selecting recyclable raw materials (Global Environment Centre Foundation, 2006).

Reuse, which has been explained as the repeated use of items that still have the potential of being used can be achieved through repeatedly using products after washing or other proper measures. For example, the use of reusable cups, returnable bottles and used clothing. It can also be achieved by using parts derived from dismantled used products, for example the use of single-use cameras (Williams, 2005).

Recycle involves using all or a part of a used product as raw materials in the same or other products by shredding, recovery of valuable metals or other proper measures. The centre explains that wastes which cannot be materially recycled are incinerated for volume reduction, stabilization and detoxification. During the detoxification process, much thermal energy is released which can be used for electric power generation or heating by people and facilities near the generation plants. Incineration ash is used for cement production and as a soil conditioner (European Commission, 2011).

The 3Rs technologies can be categorised into five main divisions: reduce, reuse, and recycle technologies, appropriate disposal technologies and common fundamental technologies. Within each major division, there are divisions of technologies indicating the various technologies or strategies that are employed within each technology (division) for the management of waste (Global Environment Centre Foundation, 2006). Under the technology of reduce, the division of technologies are resource saving, extension of durable periods of products, the reduction of wastes as well as other reduce technologies. The application of reduce technologies results in resource saving designs and production process, developing resource saving materials, producing long-life products and parts, adopting repairs and maintenance of items and treatment processes that reduce wastes (European Commission, 2011).

Easy dismantlement of products, diagnosing life cycle of products, and other reuse technologies are the division of technology under reuse. The application of the division of technology under reuse involve designing products that can easily be dismantled, inspection of used products and parts and the development of the evaluation of product's life expectancy. Others include management of usage, records of products, segregation of used parts and producing materials with less blemish, blot and wear (Global Environment Centre Foundation, 2006).

Recycling has several divisions of technology according to the 3Rs concept and these are intermediate treatment such as shredding and sorting, recovery technologies such as resource recovery, fuel recovery, thermal recovery,

and other recycle technologies. Recovery of raw materials such as iron, aluminum and plastics are aspects of resource recovery. Also, composting is recovery by conversion of food waste or market waste into compost. Utilization of heat produced by incineration is the thermal energy recovery which is an aspect of recovery and recycling technologies. Appropriate disposal technologies include waste detoxification disposal technologies, reduction of exhausted hazardous substances and ensuring safety for waste disposal.

Common fundamental technologies include inverse manufacturing, life cycle assessment (LCA) and record management. Inverse manufacturing is a manufacturing system that considers the entire product life at the design phase and incorporates the process of collecting, dismantling, separating and reusing used products in the form of components and materials into the design process. Inverse manufacturing in the 3Rs concept is a model for sustainable manufacturing and adopted in production processes of automobiles, copying machines and household appliances. LCA is a tool for the systematic evaluation of the environmental aspects of a product or service system through all stages of its life cycle. The major divisions in the 3Rs technologies, as well as the technologies in each main division and the remarks or techniques in the sub-divisions have been indicated in Appendix G.

The 3Rs concept is applied extensively in the manufacturing sector in Japan and other countries. Specific examples of this application include the manufacturing of thinner steel sheets for automobiles to save iron resources, reduction in the amount of glass used in the manufacturing of camera lenses and

mirrors, and thus reducing the cost of disposal of glass sludge. Again, the development of biodegradable plastics and the reduction of sewage sludge volume by melting technologies by the Osaka municipal government in Japan applies the reduce technology of the 3Rs concept. There is also the shredding technology of purifying plastics for manufacturing which is a recycling technique. Recycling technology is also applied in compost production from sewage sludge in Japan. Usually the sewage sludge is mixed with sub-materials such as sawdust, rice chaff and cow dung to enhance agitation during the fermentation process or to increase nutrients.

Recycling technology is also applied by Osaka municipal government in the production of methane gas. Organic wastes such as wood waste, animal waste, food waste, and sewage sludge are fermented and during the fermentation process, methane gas is obtained for power generation and heating fermentation tanks. Through the fermentation process, waste is reduced.

Capacity building model in solid waste management

Janicke (1996) presented an analytical model for capacity building in environmental protection in three categories characterized into five main aspects as shown in Figure 3

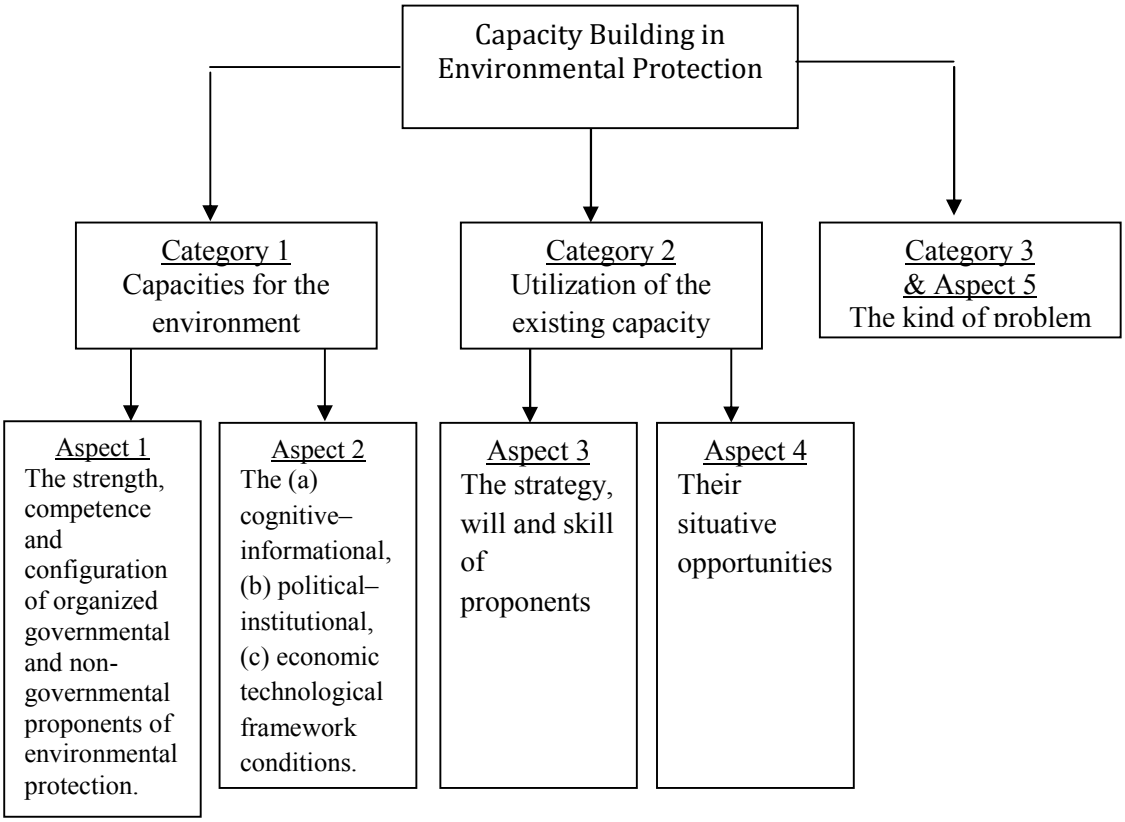

Figure 3: Capacity Building Model in Solid Waste Management

Source: Adapted from Janicke (1996)

Explanation of the model

In the model, Janicke (1996) explained that the first category discusses the capacities for the environment which are constituted firstly by the strength, competence and configuration of organized governmental and non-governmental proponents of environmental protection. This meant that national government are responsible for establishing the institutional and legal framework for municipal solid waste management and ensure that local governments are provided with the necessary authority powers and capacities for effective solid waste management. Janicke (1996) further pointed out that many African central governments are unable to provide adequate capacity building on solid waste management and

environmental protection for local government. Janicke further explained that non-governmental institutions and private companies collaborate with the public sector to equip organizations with capacity building and raised people's awareness on waste management. Capacities for environment are secondly constituted by cognitive –informational framework; political – institutional framework; and economic-technological framework conditions as shown in Figure 3.

Cognitive – information framework means that knowledge and public awareness are essential for influencing environmental management and protection. Cultural traditions and values influence solid waste management and environmental awareness. Janicke (1996) further explained that the functioning of municipal solid waste management systems is influenced by waste handling patterns and attitudes of the public conditioned by the people social and cultural context. A sound understanding of the social and cultural characteristics for disseminating knowledge and skill is essential to improving behavior patterns and attitudes regarding waste management. Political – institutional framework means how political conditions influence environmental management. The existing relationship between central and local government; the form and extent of community participation in public policy making and the role of party politics in local government administration influence the type of waste management systems which is appropriate and possible. On Economic-technological framework conditions, Janicke (1996) inferred from Schuebeler et al (1996) that waste management, technical and organizational nature depends on the economic

condition of the country or municipality. However, economic performance adversely affects environmental capacity, since economic performance has an adverse impact on the environment and capacity to solve environmental problems. Therefore, in the midst of economic performance, there is the need for educational research, communicative and administrative capacities as well as transfer of technology to manage solid waste and ensure environmental protection (Janicke, 1996).

In the capacity model, Janicke (1996) explained that the utilization of the existing capacities fell under the second category which depended first of all on the strategy, will and skill of proponents and secondly their situative opportunities. Janicke (1996) explained strategy as the general plan to tackle a problem. This plan involved making use of instruments, capacities and situative opportunities to achieve long term goals. A strategy can be implemented effectively through long term co-operation among various actors and partners contributing to existing activities and programmes (Schubeler et al, 1999). Janicke (1996) further explained that the strategy of municipal waste management can be sustained by measures relative to political, institutional, social, financial, economic and technical aspects in waste management. Situative opportunities were headlines or issues on concrete environmental problem that generate public debates and have strong influence on environmental change.

The third category and the fifth aspect on the capacity building model by Janicke (1996) is the kind of the problem. This refers to the urgency, power, resources and options of the target group as well as the nature of the problem

which signifies whether it is easy or difficult to solve. An example on pollution is given by Janicke (1996) to explain the urgency of the problem according to how it is perceived by the public to be serious to them or not a threat to future generations. Consequently the problem can view differently if the polluter is for example rich, has strong influence on society or if the responsible institutions are weak or there are opportunities for other solutions. Janicke (1996) pointed out that the structural nature of many problems leads to restrictions which may limit a certain given capacity.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter describes how the research was conducted. It starts with the description of the study area, an explanation of the type of research design that was adopted and a brief description of the target population. It also discloses the data sources, sampling procedures, the research instruments, data collection or fieldwork and challenges encountered, data processing and analysis, and ethical concerns.

Profile of Study Area

Administrative structure: The study area was conducted in the Accra Metropolitan Area (AMA) which forms part of the Greater-Accra administrative region of Ghana. It is made up of ten (10) sub-metropolitan areas created by legislative instrument (L.I.) 1722(AMA, 2012). These sub-metropolitan areas are Ashiedu–Keteke, Osu-Klottey, Ayawaso East, Ayawaso Central, Ayawaso West, Ablekuma South, Ablekuma Central, Ablekuma North, Okai-Koi South, and Okai-Koi North. Among the functions, these sub-metros implement the policies of the Assembly and mobilize revenue. With regard to location and position, the area lies on longitude 05^0 35' North and latitude 0^0 06' West. AMA is bounded to

the east by Ledzokuku-Krowor Municipal Assembly and to the north-east by the Ga-East Municipal Assembly. The north of AMA is bounded largely by the Ga-West Municipal Assembly. The West and the south-western zone are bounded by the Ga–South Municipal Assembly, while the Gulf of Guinea borders the study area to the south as indicated in Figure 4.

Physical characteristics: The area falls with the coastal lowland belt of Ghana with an average elevation of not more than 75 meters (Dickson & Benneh, 1998). The Odaw River is the main river that flows through the area, and main source of water supply is a refined one from river Densu. It lies within the coastal Savannah zone with low annual rainfall averaging 750 to 810 mm distributed over less than 80 days. The rainfall pattern of the area is bimodal with the major season falling between the months of March and June, and a minor rainy season around October. Mean temperatures from 24^0C in August to 27^0C in March.

It is the most urbanized area in Ghana. This is a result of the urban –biased development strategies adopted by policy makers since the colonial era. The concentration of industries, commerce, business activities, education political and administrative functions attract migrants from within and outside the country and this has made the area more urbanized. As a metropolitan and coastal city, the predominant primary economic activity is fishing. Accra metropolitan area was chosen as the study area since it is believed to be the area that generate 2500tonnes per day, which is the highest amount of solid waste generated in Ghana (Waste Management Department, Accra Metropolitan Assembly, 2013). Concerning size and population, it occupies an area of 203 to 240 square

kilometers (km^2), out of which 1,091 hectares is agricultural land. It has a total population of 1,848,614 (Ghana Statistical Service, 2012). Figure 4 illustrates the map showing the Accra Metropolitan area and its location in the regional and national context.

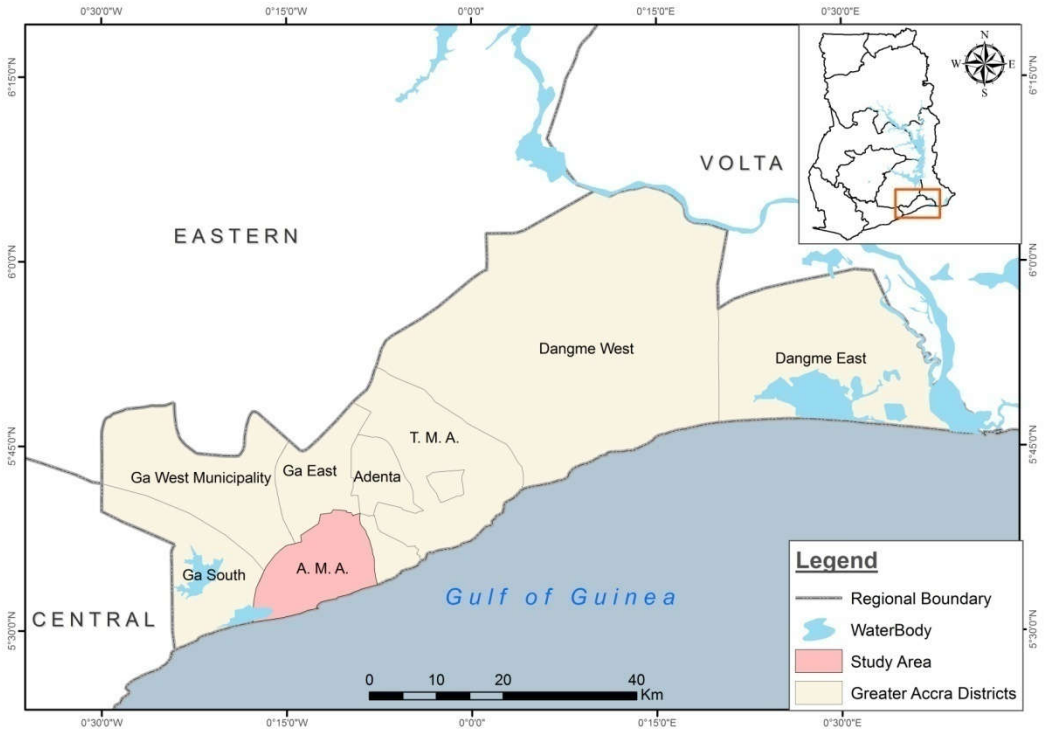

Figure 4: Map of the study area in the Regional and National Context.
Source: Remote Sensing & G.I.S. Division, UCC (2013)

Research Design

Research design refers to the detailed plan laid down by a researcher that guides the execution of a research. This includes where and when the research will be carried out, the size of the respondents, the sampling procedure, and the data collection and analysis method (Sarantakos, 2000, p. 102). Polit & Beck (2008) also explained research design as the overall plan for obtaining answers

and for handling some of the difficulties encountered during the research process (p. 49). Examples of research designs are case study, experimental research, non-experimental research, ethnographic research, and survey. The researcher, however, adopted the survey research design in which data is collected from a sample of individuals through responses to standardized questions. Reasons for adopting the survey design are as follows:

In the first place, this design is versatile and seeks to investigate and enhance understanding of any social issues under investigation. The researcher was, therefore, of the firm conviction that with these approach diverse areas of the research topic could be thoroughly investigated (Weiss, Banilower, Mahon and Smith, 2001, p. 160). Secondly, this design is efficient since it allows researchers to gather data from many respondents at a relatively low cost and within a short duration. Consequently, the research could measure many variables quickly and at a relative low cost (Weiss et al, 2001, p. 160).

The researcher was of the view that this method lend itself to probability sampling from large populations and could lead to obtaining a representative picture of the attitudes, characteristics, and the views of the respondents and therefore, conclusions drawn may hold for the entire population. This research dealt with various recyclers using various solid waste as the basis for the creation of various groups (strata) and sample respondents from each stratum, compare and contrast views from each group as well as analyse the views of various respondents from the groups and measures the relationship among the groups (Weiss et al, 2001,p.160).

Study Population

The study population consisted of recyclers that made use of various categories of solid waste such as plastics, organics, wood residue (sawdust), metal scraps and glass in the Accra Metropolitan area. The researcher could not identify any known household actively engaged in the recycling of solid waste to include in the study. Therefore, household were not included in the study since no known recycler operated at the household level in the study area. However, in the study area, there were firms/enterprises that were actively engaged in the recycling of solid waste such as plastics water sachet, food leftovers and wood residue. These enterprises/firms have been shown on Table 3. The researcher also included one key informant from each of the two public institutions, namely the Environmental Protection Agency (EPA) and the Waste Management Department (WMD) of Accra Metropolitan Assembly(AMA) that regulate the activities of the recycling firms, and another key informant from a non-governmental organization (NGO)i.e. Global Communities (formerly Community Housing Foundation International) in Accra Metropolitan.

Within each recycling enterprise, there were three (3) categories of employees in order of ranking: senior staff, intermediate staff, and junior staff. The senior staff was the managing directors, the departmental managers, the environmental technical officers and the work supervisors. The intermediate staff was the workforce; that is, those directly engaged in the recycling or manufacturing process, while the cleaners, messengers, and security personnel's constitute the junior staff. The researcher's total sample therefore, comprised all

the senior staff who have an in- depth knowledge about recycling and the intermediate staff who are directly involved in the recycling process and gained knowledge through experience which the researcher termed respondents. The researcher also included them in the study because most of them had secondary and tertiary education and could fill the research instrument (questionnaires) which was used to obtain data from most respondents, but did not include the junior staff as part of the respondents since they had little knowledge on recycling. Also, their level of literacy was such they could not fill questionnaires nor respond to structured questions on interview schedules which was another data instrument used by the researcher. The researcher could not translate the questionnaires and interviews into any of their local languages.

Metal scraps such as condemned vehicles, used metal containers, as well as electronic waste such as condemned ceiling fans, damaged computers, condemned fridges, etc are seriously purchased and gathered by metal scraps dealers at Agbogbloshie a suburb in Accra Metropolis. These damage gadgets are either fully made up of or contained metals such as iron, copper, zinc, steel, brass and aluminum. Some of these dealers should have been part of the respondents for data collection since they are dealing in solid waste. However, they were not include since they do not directly recycle the scraps nor sent them to any identified enterprise in Accra Metropolitan Area for recycling. According to the scrap dealers, the final destination of all these scraps for recycling was Tema Steel Company and some other enterprises in Tema which was outside the study area.

Ga-Adangabes are known to be very good in recycling of bottles for making beads. The producers could have been respondent for this research. However, since the actual recycling activity takes place outside Accra Metropolis, and produced in some towns like Agomanya, Odumase Krobo, and Somanya all in Eastern Region made it impossible for the producers to be included as respondents. The beads are only brought to Accra city for commercial purpose.

Data Sources

Data were gathered from both primary and secondary sources. The primary sources were recyclers of used plastics, compost manufactures, and wood processors who were contacted with different research instruments that provided the primary data. Secondary sources were from published and unpublished books, research works, periodicals, newspapers, and internet and policy documents. For example, the National Building Code and Guidelines for the Acquisition of Environmental Permits for compost projects (EPA & CHF, n.d.) were policy documents used as secondary sources.

Sampling Procedures

This involves the sample size determination and sampling methods used by the researcher to reach the respondents. For the primary data collection, the researcher adopted a multi-stage sampling procedure involving both probability and non-probability sampling techniques to select the respondents. The probability technique was stratified sampling, while the non-probability method was purposive sampling. The researcher adopted the multi- stage sampling

procedure because all the known and recognized recyclers in Accra Metropolitan area who served as respondents for the study were workers of registered recycling enterprises in the study area, but did not operate independently at the household level. Therefore, the researcher purposively selected the recycling enterprises first, before purposively selecting the desired number of respondents from the employees of the recycling enterprises.

There were three stages involved in this multi-stage sampling: stage one (1) involved the purposive selection of all registered recycling enterprises in the study area. Stage two (2) dealt with the stratification of the selected recycling enterprises based on the type of solid waste recycled; while stage three (3) involved the determination of the number of respondents selected from each recycling enterprise to obtain the total sample (n). Detailed description of the various activities embarked upon by the researcher at the three main stages is explained below:

Stage one (1) - selection of the recycling companies (enterprises) in the study area

Purposive sampling technique was employed by the researcher to select 9 registered recycling companies out of the total 15 in the Accra Metropolitan area. The researcher purposely selected these companies since they are dealing in recycling activities and could obtain enough and detailed data to address the objectives of the study. The researcher also focused on registered recycling enterprises for the study since such enterprises have been granted permit by the

AMA. In other words, their recycling activities were legal and met the requirement of Environmental Protection Agency (EPA).There were also no registered recycler identified to be operating at household level and that is why only recycling companies were selected.

The nine (9) registered recycling enterprises that were selected have been shown in Table 3. Table 3 also indicates the number of employees in each recycling enterprise and the total number of employees which constituted the total study population (N). Evidence from Table 3 and the third column of Table 4 indicates that the study population was 165. No enterprise was identified to be recycling metal scraps and paper.

Table 3: Registered recycling enterprises in Accra Metropolitan area

Recycling enterprise	Number of Employees(N)
Avenor Composting Facility (ACF)	4
Avenor Trashy Centre (ATC)	5
Asuogyaman Wood Processing(AGY)	6
BNARI	11
Blowplast Ltd (BP)	38
Dworwulu Trashy Centre (DTC)	20
Environplast (ENV)	25
Top Industries(TOP)	50
Zekora Composting Facility(ZCF)	6
Total = 9	N=165

Source: Accra Metropolitan Assembly (2013)

Stage Two (2): The stratification of the selected recycling enterprises based on solid waste category

The main activity at this stage was the stratification of the selected recycling enterprises based on the category of solid waste recycled. The researcher stratified all the nine (9) recycling enterprises based on the three categories of solid waste recycled in the metropolitan area. These three solid waste categories were organics, plastics, and wood residue. Zekora Composting Facility (ZCF), Avenor Composting Facility (ACF) and Biotechnology and Nuclear Agricultural Research Institute (BNARI) were stratified under organics. Top industries (TOP), Avenor Trashy Centre (ATC) and Dworwulu Trashy Centre (DTC), Environplast (ENV) and Blowplast Limited (BP) were stratified under plastics, whiles Asuogyaman Wood Processing Company (AGY) was also stratified under wood residue as shown in columns 1 & 2 of Table 4.

Stage three (3): Determination of the number of respondents from each recycling enterprise and the total sample (n)

The researcher determined the number of respondents (n) to be selected from each recycling enterprise. Table 3 and the third column of Table 4 indicate the number of employees (workers) in each of the 9 recycling enterprises (N). The total number of workers in each recycling enterprise comprises all the senior staff, intermediate staff and the junior staff in each enterprise.

In each recycling enterprise, the researcher purposively selected the entire senior and the intermediate staff to respond to the research instruments: mostly

questionnaires and few interview schedules. The reason is that their educational background and literacy level qualified them to answer the questionnaires or respond to interviews. The senior members had an in-depth knowledge about recycling, while the intermediate working group directly involved in the recycling or manufacturing process had gained knowledge through working experience. There was no statistical computation used to determine the number of respondents from each recycling enterprise since the sampling approach was the non-probability type that is purposive technique (Sarantakos, 2000, p.157).

The junior staff was not included in the respondents because by their educational background and literacy level, they could not answer questionnaires nor respond to interviews. The researcher could not translate the questionnaires nor interviews into their local dialects. The fourth column of Table 4 indicates the number of respondents that was selected from each recycling enterprise given a total sample (n) of 108.

In all, the total sample size was 108 respondents and 3 key informants. Of the 108 respondents, data was gathered from 104 of them through the use of questionnaires, whiles the remaining 4 opted for the interview schedule. These were basic school certificate holders who have risen through the ranks through hardwork and could not answer questionnaires, but could respond to interviews. Two of these respondents were employees in Zekora composing facility (ZCF), one from Avenor composting facility (ACF), and one from Asuogyaman Wood Processing Company (AGY).

Data was obtained from the three key informants through in-depth interviews. The three key informants were the principal programme officer at the Environmental Protection Agency (EPA) Head office, Accra; the senior environmental and safety compliance officer of Global communities, Accra; and the waste management director in charge of solid waste, AMA. They were all purposively sampled from their various organizations.

Table 4: Multi-stage sampling procedure employed to select the respondents

Recycling enterprises	Stratum (h)	No. of employees in each enterprise (N)	No. of respondents selected from each enterprise (n)
ACF	Organics	4	3
BNARI		11	9
ZFC		6	4
ATC		5	4
BP	Plastics	38	25
DTC		20	13
ENV		25	14
TOP		50	32
AGY	Wood Residue	6	4
Total= 9	h=3	N=165	n=108

Study population (N) =165

Total sample (n) = 108

Key informant = 3

Source: Field data (2013)

Instruments of Data Collection

The instruments for data collection were questionnaires, interview schedule, in-depth interview guide and observation checklist. The questionnaire

and interview schedule for the recyclers in the recycling enterprises were developed with sections: Section a dealt with the socio-demographics (characteristics of respondents) whiles section B dealt with the categorization of solid wastes and the rationale of solid waste recycling in Accra Metropolitan area. Section C focused on the extent of government participation in solid waste recycling whiles, section D highlighted on the socio-economic benefits of solid waste recycling. Section E considered the environmental implications of solid waste recycling. The questionnaire and interview schedule contained both open-ended and closed-ended questions, however, the questionnaires had more closed-ended ones (see Appendix B). The interview schedule had more open-ended questions than closed-ended ones (see Appendix A).

An in-depth interview guide was designed for regulatory bodies, Accra Metropolitan Assembly (AMA) and the Environmental Protection Agency (EPA) as well as for the non-governmental organizations (NGO), Global Communities. This guide was also organized into the same number of sections and the same kind of themes as the questionnaire/interview schedule. It also contained both open-ended and closed-ended questions, however, the open –ended questions were more than the closed –ended ones (see Appendix D).

Observation checklist and a digital camera were used to gather information on items observed. The checklist was designed in the form of a table on which specific items which the researcher expected to observe on the field were indicated (see Appendix C).

Pre-testing of Instruments

The interview schedule and questionnaires were pretested at the Elmina Recycling Enterprise in the Komenda Edina Eguafo Abrem (KEEA) Municipality. The researcher observed protocol by obtaining an introductory letter, as shown in Appendix E, from the Department of Geography and Regional Planning and by this letter, some workers at the Elmina Recycling Enterprise accepted to respond to the questionnaires, others responded to the interview schedules, while the director of the Waste Management Department of the Cape Coast Metropolitan Assembly (CCMA) responded to the in- depth interview guide. The responses helped the researcher to be more specific with regards to questions that were posed to the recycling enterprises. The testing also brought the researcher's attention to organize the main questionnaire and interview schedule into sections. Furthermore, it helped the researcher to restructure ambiguous and long questions into clear and abridged ones, making it possible for respondents to take relatively shorter durations to complete the questionnaire.

The in-depth interview guide which was pretested at the Waste Management Department of CCMA helped the researcher to be more clear and specific with his questions on the main interview guides.

Fieldwork /Data Collection

The data was collected in the months of January and February of 2013. This meant that the research instruments were administered within two months. The data collection methods were quantitative, qualitative and observation. Data

was gathered quantitatively by making use of questionnaires and qualitatively by interviews and in-depth interviews. The questionnaires were administered during the month of January, whiles the interviews were conducted during the early part of February. However, data from key informants was gathered during the latter part of February. The researcher also gathered data through the method of observation whiles administering the questionnaires and interview guides. This was done by making use of the observation checklist and taking photographic pictures of the facilities observed. In the administration of the various research instruments, the researcher got the attention and the acceptance of the respondents through the use of the introductory letter which has been shown in Appendix E. The researcher encountered the following challenges and limitations whiles collecting data on the field.

Fieldwork, Challenges, and Lessons Learnt.

In the first place, it was not easy getting in touch with the officials. Scheduled times for interviews were often changed since the interviewees had to attend emergency meetings. The researcher was also stationed far away from his study area and at times reported late for interviews and such planned schedules were called off. This was managed by exercising patience until the appropriate time came for the interviewees to grant such interviews.

Secondly, some respondents were not willing to answer some of the questions on the questionnaires or interviews. Examples were those that centered on income and profit levels as well as environmental threats. Respondents were

assured that the exercise was purely academic and that information would be kept confidential.

Thirdly, respondents were suspicious and afraid that the researcher was out to get information for certain purposes and would betray them one day. Others suspected that the researcher was a political party agent and was only there to obtain information for political reasons. Fears were allayed when the researcher properly identified himself by showing his ID card to respondents. Moreover, respondents did not perceive the usefulness of the exercise. They complained that previously they had been involved in similar exercises which did not benefit them directly and refused to respond. Furthermore, the identity of the respondents and the conditions under which the questionnaires were answered were not known. Again, since the researcher was not available whiles some questionnaires were being filled, questions that seemed controversial or complex to respondents were not clarified and consequently they could not answer such questions properly.

Additionally, the researcher was perceived as an opportunist. Respondents thought that the researcher only wanted to embark on this exercise to acquire skills and make some financial gains and as a result were unwilling to respond. Their perceptions were changed when the researcher explained the exercise as purely academic. Again, some of the respondents did not allow the researcher to record interviews using the tape recorder. In such situations, the researcher recorded the responses by writing them in reporter's notebook

causing proceeding to be quite slow. Finally, some respondents demanded money after answering questionnaires or responding to interviews.

In all, the researcher administered 104 questionnaires and retrieved all of them, meaning that the response rate was 100 percent. Seven (7) interviews were carried out and all were honoured.

Data Processing and Analysis

The 104 questionnaires were analysed using the statistical product and service solutions (SPSS) version 18. Each of the questionnaires was given a serial number and a code for easy identification before entering the responses into the SPSS version 18 software and the frequencies of responses generated for the variables to be put into tables, pie charts or bars. The responses obtained from 4 interview schedules and 3 in-depth interviews were transcribed into themes and used to either support or object to key findings from the analyses of questionnaires. Observations of selected items observed by the researcher from the field were analysed in a table form as shown in Appendix F.

Ethical Concerns

The researcher complied with the following ethical concerns and code of ethics. In the first place, the researcher gave a true picture of himself without providing any false impressions. Secondly, respondents were also assured of their informed consent. This means that respondents were informed about the nature and the objectives of the research upon which they willingly accepted to participate by providing relevant information. Respondents were also given their

right of privacy by respecting respondent's views in situations where respondents were unwilling to respond to some questions. Moreover, the researcher observed respondents rights of anonymity. Names of respondents were withheld and not associated with their responses. Finally, respondents were accorded their right to confidentiality**.** Information disclosed by respondents was to be used by the researcher alone for purely academic work, and not for commercial gains. Table 5 is the summary of the specific objectives, sampling procedure, data collection and analysis methods.

Table 5: Specific objectives, methods of data collection and analysis

Specific objectives	Type of Data	Source	Target Pop.	Sampling Procedures		Instrument	Analytical Method
				Size	Sampling Method		
1.Catgorise the various solid waste types recycled in Accra metropolitan area	Quantitative Qualitative	Primary Primary	165 7	104 7	Multiple stage Multiple stage	Questionnaire, Observation checklist Digital camera Interview schedule In-depth interview guide	Cross-staff tabulation Photographic pictures Content analysis
2. Examining the rationale for solid waste recycling in the study area	Quantitative Qualitative	Primary Primary	165 7	104 7	Multiple stage Multiple stage	Questionnaires Interview schedule In-depth interview guide	SPSS (version 18), Pie chart Content analysis
3.Assess the extent of governments participation in solid waste recycling in the	Quantitative Qualitative	Primary Primary	165 7	104 7	Multiple stage Multiple stage	Questionnaires Interview schedule In-depth interview	Tabulation, Pie chart Content Analysis

Table 5 continued

area						guide	
4.Highlight the socio-economic benefits of solid waste recycling	Quantitative Qualitative	Primary Primary	165 7	104 7	Multiple stage Multiple stage	Questionnaires observation schedule Digital camera Interview schedule, In-depth interview guide	SPSS version 18 Tabulations Pie chart Photographic picture
5.Establish the effects of solid waste recycling on environmental quality	Quantitative Qualitative	Primary Primary	165 7	104 7	Multiple stage Multiple stage	Questionnaires Interview schedule, In-depth interview guide	Tabulations Content analysis

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter discusses the results of the study. As indicated in the previous chapter, the researcher employed the mixed method approach in analyzing the responses of the respondents. In all, there were 111 respondents out of which 104 filled the questionnaires, 4 responded to interview schedules while 3 respondents responded to in-depth-interviews.

The analysis focused on issues relating to the research objectives and besides the socio-demographic characteristics of respondents, discussions centered on the categorization of solid waste recycling, the rationale for solid waste recycling, the extent of government participation in solid waste recycling, socio-economic benefits of solid waste recycling to citizens, metropolitan authorities, the state, as well as the environmental implications of solid waste recycling.

Socio-demographic Characteristics of Respondents

Sex: With regard to the sex of the respondents studied, 69 of them constituting 62.2 percent were males, whiles the rest (42) constituting 37.8 percent were females. This was not surprising due to the fact that a greater proportion of the activities carried out in the recycling enterprises are strenuous. Naturally, since males tend to be stronger than

females and the fact that the physically stronger group were needed might explain why the males dominate.

Rank: With regards to the ranks of the respondents, over half (54.1%) were intermediate staff, whiles the senior staff were 51 in number representing 45.9% as shown in Table 6. The reason for the highest number of intermediate staff in terms of rank could largely be due to the level of education such that tertiary certificate holders represented the senior staff, with secondary becoming intermediate, while's basic school leavers were the junior staff. However, in certain situations, rank determination was also influenced by long and efficient service since some basic school certificate holders through hardwork have risen to become intermediate staff members, while some basic and secondary school certificate holders have also risen to the senior rank.

Table 6: Socio-demographic characteristics of Recyclers

Items	Elements	Frequency	Percent (%)
Sex	Male	69	62.2
	Female	42	37.8
Total		111	100
Rank	Intermediate staff	60	54.1
	Senior staff	51	45.9
Total		111	100
Educational level	Basic	4	3.6
	Secondary	60	54.1
	Tertiary	47	42.3
Total		111	100

Source: Field data (2013).

Categorization of Solid Waste that are Recycled

Respondents identified water sachet plastic, food waste, and sawdust as the three main solid wastes that were recycled in the Accra Metropolis. Of the 104 respondents covered, 86 of them or 82.7 percent identified water sachet plastics as the solid waste type that is mostly recycled and categorized under plastic. Fourteen respondents constituting 13.5 percent identified food waste as the solid waste that is recycled and could be categorized under organics, while 4 respondents (3.8%) of the total respondents were of the view that sawdust is recycled which fall under wood residue category as illustrated in Table 7. This result revealed that water sachet plastic is the most recycled solid waste in the study area therefore the category of solid waste that is mostly recycled in Accra Metropolis is the plastic.

Most of the respondents interviewed confirmed water sachet plastics as the most recycled solid waste and therefore indicated the plastic category of solid waste as the most recycled solid waste in Accra Metropolitan area. The rest identified food waste and sawdust as the other solid waste types recycled under organics and wood residue respectively. This discovery was confirmed by a key informant in a government regulatory organization, who in his response clearly stated:

> *"water sachet plastic mostly recycled in Accra Metropolis belongs to plastic waste category, while food waste belongs to the organic waste category".*

Another key informant in a composting facility declared:

"food waste belongs to the category of organics, while sawdust belongs to the wood waste category".

Withgott and Brennan (2008) cited plastic waste materials as an example of solid waste materials that can be recycled, while Eschooltoday & BusinessGhana (2010) also indicated food waste as an example of solid waste that can be decomposed into compost or manure as identified in the conceptual review of the related literature. The recycling of plastics, food waste, and sawdust lend its support to one of the goals of MSWM for low-income countries which is to support economic development by ensuring the efficient use and conservation of valuable materials and resources. Plates 1 and 2 shows of food waste undergoing aerobic decomposition for the formation of compost at BNARI at Kwabenya, and sawdust which is, shavings, dust and small pieces of wood waste which is produced when wood are sawn observed at Asuogyaman Company near Timber market in Accra.

Table 7: Solid waste types and categorization

Solid waste	Waste category			
	Plastic	Wood residue	Organic	Total
	Figures in percentage (%)			
Sachets	82.6	-	-	82.6
Food waste	-	-	13.5	13.5
Saw dust	-	3.9	-	3.9
Total	82.6	3.9	13.5	100.0

Source: Field data (2013) [n = 104]

Plate 1: Food waste accumulated for composting at BNARI in Kwabenya.
Source: Field data (2013)

Plate 2: Sawdust at Asuogyaman Company used for making chipboard.
Source: Field data (2013)

Rationale for Recycling of Solid Waste

From the respondent's perspectives, three main reasons could explain the purpose for recycling: creation of employment, promotion of environmental sanitation and the production of assorted goods. 45 percent of the responses went in favour of the promotion of environmental sanitation, 43 percent indicated employment creation, and whiles 12 percent of the respondents were of the view that the rationale for solid waste recycling was to produce assorted goods such as plastic bowls, buckets, compost and others as shown in Figure 5. This results show that the main reason for recycling of solid waste in the Accra Metropolitan area is to promote environmental sanitation and employment creation, since the respondents view on the two reasons put together constitute 88 percent of the views of the 104 respondents.

All the respondents interviewed also supported the main view of the 104 respondents that solid waste recycling was to promote environmental sanitation. This intention disclosed by the views of a key informant from an NGO in an in-depth

> *"Basically, the rationale of solid waste recycling is to remove filth including all manner of solid waste from the environment in order to keep the environment clean"*.

interview said:

This assertion seconded by another key informant in a governmental regulatory organization in an interview schedule declared:

"solid waste recycling removes solid waste from the

environment and promotes environmental sanitation".

This finding is in line with some of the overall goals of MSWM for low-income countries outlined by Schuebeler et al (1996) in the review of related literature. These goals state that MSWM is to promote the quality of the urban environment and to generate employment.

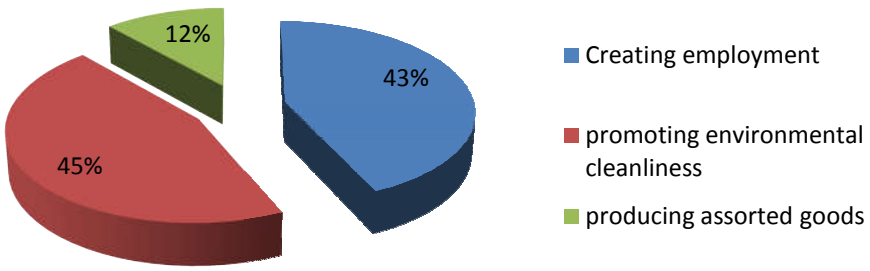

Figure 5: Rationale for recycling solid waste

Source: Field data (2013)

The Extent of Government Participation in Solid Waste Recycling

The analysis on the extent of government participation in solid waste recycling was based on various forms of assistance offered by either the central or local government to recycling enterprises as well as the number of recycling enterprises owned by the metropolitan authority and the central government.

Forms of government assistance:

Respondents indicated that various forms of assistance are provided by the metropolitan and central government to recycling companies as shown in Table 8. Of the 104 respondents, 24 (23.1%) of them were of the view that the government gives tax rebate to recycling enterprises. Fourteen (14) respondents representing 13.5 percent of the total 104 respondents were also of the opinion that government assistance to recycling enterprises was in the form of allowing them to import recycling machines without paying import duties, whiles 13 respondents (12.5%) expressed that District Cleansing Officers (DCO's) who were representatives of the AMA dialogue with inhabitants of sub-metros to accumulate their solid waste for recycling enterprises. Five (5) respondents (4.8%) indicated that AMA representatives negotiate for the acquisition of land for composting projects. The low number of 5 respondents might be due to the fact that the alarming rate at which citizens are acquiring land for building makes land acquisition very difficult for other purposes. This low number might also be due to the low rate of recycling and composting activities in the study area and as result not putting pressure on the AMA to negotiate for land for the purpose of recycling and composting. From this analysis, the researcher could infer that the main form of assistance given by the government to recycling companies in the Accra Metropolitan area is tax rebate. The other forms are importing recycling machines without paying import duties and the negotiation of solid waste on behalf of recycling enterprises by District Cleansing Officers (DCOs) of AMA.

Most of the respondents interviewed expressed that the main government assistance to recycling enterprises has been the technical advice given to the enterprises

by DCO's who are representatives of AMA. This was expressed in the response of a key informant of a recycling enterprise, who declared:

> *"AMA is pleased with our work and offer technical advice on how to handle solid waste such that it does not affect us and the environment."*

The view of the key informant was further supported by a senior staff member of an NGO who in an in-depth interview said:

> *"Government assist recycling enterprises by using district cleansing officers to offer technical advice to recycling workers on how to safely handle solid waste"*.

This corroborates the view of Janicke (1996) in his Capacity building model in solid waste management as explained in the literature review. Janicke (1996) explained that national governments are to ensure that local government are provided with the necessary authority, powers and capacities for effective solid waste management. Janicke (1996) further explained that non-governmental institutions and private companies team up with public sectors such as local government to equip organizations with capacity building and raise people's awareness on solid waste management problems. These capacities are in the fields of administration, financial management, technical systems, and environmental protection.

Table 8: Forms of government assistance to recycling enterprises

Assistance	Frequency	Percent
Offering of tax rebate	24	23.1
No form of assistance	15	14.4
Duty-free import of recycling machines	14	13.5
DCOs negotiations for solid waste on behalf of enterprises	13	12.5
Offering of tax holidays	12	11.5
Government budget allocation	11	10.6
DCO's technical advice on safe solid waste handling	10	9.6
Land acquisition for composting project	5	4.8
Total	104	100

(Source: Field data, 2013).

Government's ownership of recycling organization:

With regard to responses concerning the full or partial ownership of recycling enterprises by the government, over 70 percent (70.2%) expressed the view that the government had no ownership in the existing recycling enterprises, whiles 29.8 percent pointed out that the government owns recycling companies as shown in Figure 6. The results depicted here may mean that though the government provides various forms of assistance in solid waste recycling, participation in partial or full ownership of recycling enterprises has been insignificant. The central government owned only one recycling enterprise which is the Biotechnology and Nuclear enterprise near Legon in the study area, whiles the local government does not own any recycling enterprise in Accra Metropolitan area.

Most of the respondents interviewed were likewise of the view that central government partly own only one recycling enterprise while the local government does not own any. This was revealed in an in-depth interview with the key informant, who said:

> "*The government offer various assistance, but partly owns only one recycling enterprise, BNARI.''*

This was also supported by another key informant who disclosed that:

> *''To the best of my knowledge, the government owns only one recycling enterprise, BNARI''.*

The very low participation of the local and central governments in the direct operation and ownership of recycling enterprises lend its support to the view of Schuebeler et al (1996) in their concept of MSWM in low- income countries that national governments are responsible for establishing the institutional and legal framework for effective solid waste management in municipal and metropolitan areas, and authorize local governments to promulgate bye-laws to regulate and mobilise resources required for solid waste management in their localities. They also asserted that local government are responsible for the collection and disposal of solid waste in their area and entrust the actual recycling of solid waste and its ownership to private enterprises, hence their low participation in the ownership. This is exemplified in Nigeria where the central government represented by the Federal Ministry of Environment and the National Environmental Standards and Regulations Agency oversee the protection of the environment and preservation of natural resources through the promulgation and enforcement of environmental laws and providing the various states the capacity to

establish environmental laws to protect the environment in their various states (Yetunde,2012). It is therefore not surprising that AMA does not own and operate a single solid waste recycling enterprise (Waste Management Department, Accra Metropolitan Assembly, 2013) since their responsibility is to directly establish legal framework for solid waste management.

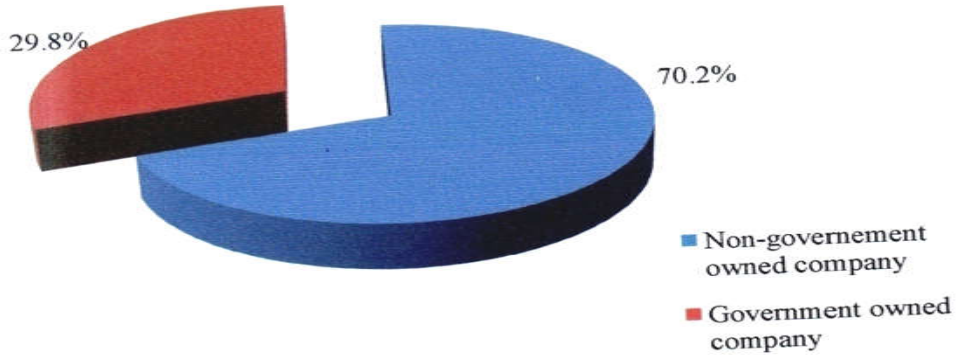

Figure 6: Ownership of recycling enterprises
Source: Field data (2013).

Socio-Economic Benefits of Solid Waste Recycling

The analysis here was based on responses on products for citizens derived from recycling of solid waste; impression about the number of people employed by recycling enterprises; incentives given to employees; corporate social responsibilities of recycling enterprises to citizens of Accra Metropolitan area, and the socio-economic benefits of recycling enterprises to Metropolitan activities or the state.

Product(s) derived from recycling solid waste

Some of the respondents mentioned several products as presented in Table 9. Of the 150 responses that were provided, 30, 21, 14 and 12 of them representing 20.0 percent, 14.0 percent, 9.3 percent and 8.0 percent respectively indicated polythene bags, trashy bags, plastic bowls and raincoats as the top four most produced recycling products

for citizens in the Accra Metropolitan area. Five of the responses (3.3%) also indicated chipboard as the recycled product produced. The low number of responses expressed for chipboard could be attributed to the low rate of production of chipboard due to low demand. The responses show that polythene bags, trashy bags, plastic bowls and raincoats are the most produced products from solid waste recycling in Accra Metropolitan area since all together represent over half (51%) of the total responses obtained.

The asterisk symbol (*) explained as multiple responses just below Tables 9, 10 and 11 all in chapter four means some of the respondents indicated two or more responses on issues that were being analysed, causing the frequency of the responses to be higher than the number of respondents which was 104.

Most of the respondents interviewed on the contrary, indicated plastic wares such as plastic dustbins, bowls, chairs, buckets, compost as the most recycled products produced in the Accra Metropolitan area. In an interview a respondent said:

> *"We obtain a type of organic fertilizer called compost from the recycling of food waste".*

A senior staff in an NGO adding to the previous response said:

> *"We obtain compost, plastic wares such as bowls, dustbins, buckets ,etc".*

The use of various kinds of solid waste such as water sachet plastics and food waste to manufacture products such as polythene bags, plastic bowls, trashy bags,

raincoats, plastic buckets, compost, and others through recycling technology is consistent with the application of the 3Rs technologies and techniques in Japan cited in the review of related literature, where recycling technology is applied to purify plastics for the production of plastic wares. Compost is also produced from sewage sludge through the application of recycling.

Table 9: Products derived from recycling solid waste

Recycling products	Frequency	Percentage
Polythene bags	30	20.0
Trashy bags	21	14.0
Plastic bowls	14	9.3
Raincoats	12	8.0
Plastic dustbins	11	7.3
Pellets materials	11	7.3
Purse and wallets	11	7.3
Compost	10	6.7
Baby Carriers	10	6.7
Plastic buckets	8	5.3
Plastic tables & chairs	7	4.8
Chipboard	5	3.3
Total	*150	100.0

Source: Field data (2013) (*= multiple response)

Plate 3: Plastic Utensils recycled from water sachet plastics at TOPP industries at North Kaneshie.
Source: Field data (2013)

Plate 4: Trashy bags recycled from water sachet plastics at Avenor Trashy Centre.
Source: Field data (2013)

Plate 5: Bags of composts obtained from food waste at BNARI in Kwabenya
Source: Field data (2013)

Plate 6: Chipboard obtained from the recycling of sawdust at Asuogyaman, near Timber market.
Source: Field data (2013)

Impression about the number of people employed by recycling enterprises

The researcher sought respondents' view on the number of people employed by recycling enterprises. As illustrated in Figure 7, 68 respondents (66%) were of the view that recycling enterprises employ 11 to 49 number of workers, 19 respondents (18%) also indicated that recycling employ over 50 number of workers, while 17 respondents (16%) were of the view that the number of people recruited by recycling enterprises was either 10 or less. The result suggests that most recycling enterprises in Accra Metropolitan Area recruit 11 to 49 number of employees.

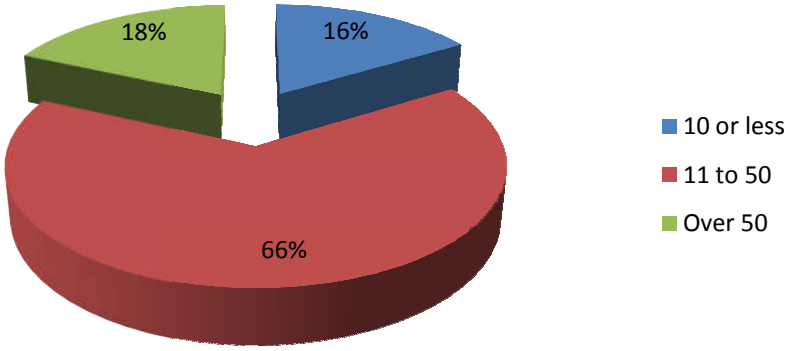

Figure 7: Respondents' view about number of people employed

Source: Field data (2013)

Views from respondents interviewed revealed a number quite different from those expressed by the 104 respondents. Unlike the 104 respondents, they indicated that most recycling enterprises employ over 50 employees. They justify that in addition to the permanent workers, they contract casual workers who collect sachet plastics and food waste making the number of people employed high. In an in-depth interview, a key informant replied:

"Employee recruitment is high and many people are into recycling business since for each recycling enterprise apart from the permanent workers more people are contracted to collect solid waste for the enterprises causing the number of people employed to be high".

The number of employees indicated by the respondents could lend support to one of the goals of MSWM for low-income countries in the conceptual framework which is employment generation. The respondents' views about the number of employees' also support the economic objective in the concept of MSWM for low-income countries in the conceptual framework which stipulates that higher labour productivity and efficiency could also result in an increase in the number of jobs through the expansion of lower - cost services (Schuebeler et al, 1996).

Incentives given to employees of recycling enterprises

As part of the socio-economic benefits offered by solid waste recycling enterprises, the researcher enquired from respondents the type of incentives given to employees by recycling companies. Figure 8 revealed that 99 percent of the respondents indicated that recycling companies offer incentives, whiles the rest (1%) expressed that there were no incentives.

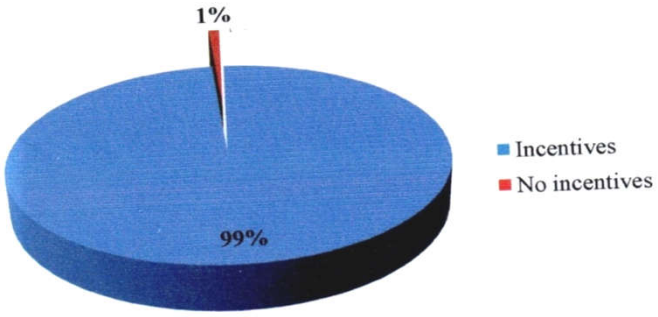

Figure 8: Incentives to employees
Source: Field data (2013)

Respondents provided 180 responses and indicated several incentives as shown in Table 10. Forty-one (41) of the responses (22.8%) indicated that recycling enterprises provide soft loans for the workers, 37 of the responses (20.6%) emphasized the provision of target achievements bonuses, whiles 20 responses (11.1%) were of the view that recycling enterprises make risk allowances available for their workers. Two (2) responses (1.1%) expressed that workers are also given special awards as an incentive. It is revealed from the study that recycling enterprises in the Accra Metropolis mostly provide soft loans, target achievement bonuses and risk allowances for their workers since respondents indicated them as the top three most provided incentives for workers, and the total percentage representation of their responses altogether constitute over 50 percent (54.5%). The low number of responses for special awards might be that it is not an incentive often provided for workers and this could be that recycling enterprises provide enough of other forms of incentive to most of their workers which motivate them much and there is therefore no need to provide so much for special awards which might be for few workers.

Table 10: Incentives given to employees

Incentives	Frequency	Percent (%)
Provision of soft loans	41	22.8
Target achievement bonuses	37	20.6
Risk allowance	20	11.1
NHIS Registration for employees	17	9.4
SSNIT contributions for employees	17	9.4
Funeral Grants	10	5.6
Night Allowance	9	5.0
Christmas Bonuses	8	4.4
T &T	5	2.8
Freebies	4	2.2
Free lunch	4	2.2
Renting of Houses	3	1.7
In-service Training	3	1.7
Special awards	2	1.1
Total	*180	100.0

Source: Field data (2013) (*=multiple response)

The key informants, like the 104 of the responses also mentioned risk allowances, provision of medical care, granting of soft loans and target achievement allowance as incentives provided by recycling enterprises for workers. However, they indicated risk allowance as the most provided form of incentive for workers. A key informant declared:

"recycling enterprises offer final bonuses if they are able to exceed their target of production. In addition some of them offer scholarship to the wards of employees and grant soft loans" .

This was further supported by another key informant who said:

"they offer technical advice to employees so that they can work within acceptable standards. Also, some of them grants loans and scholarships to the wards of workers"

The views by the respondents on the types of incentives such as the provision of soft loans, target achievement bonuses, risk allowance, NHIS registration, scholarship to workers among others is given support from the strategic aspect of MSWM for low-income countries explained by Schuebeler et al (1996) in the conceptual framework. This aspect explains that formal and informal workers of MSWM must enjoy health protection, improvement in their socio-economic security and alleviation from social marginalization.

Socio-economic benefits of recycling enterprises to close communities/Corporate social Responsibilities (CSR)

In recent times the concept of corporate social responsibilities (CSR) has emerged as a form of social enterprise that enables businesses to share their profits with communities where they operate by adopting CSR strategies such as value-addition and

corporate philanthropy. The researcher, therefore, solicited from respondents whether recycling enterprises extend CSR to communities close to them, and if so what kind of responsibilities. Figure 9 revealed 103 respondents (99%) indicated that recycling enterprises offered some benefits, while the rest (1%) stated otherwise. Table 11 shows that of the 130 responses that were stated, 48 responses (37.0%) affirmed that recycling enterprises offered employment to inhabitants of close communities in the Accra Metropolis, 44 responses (33.8%) indicated the promotion of environmental sanitation by recycling enterprises, while 2 respondents (1.5%) are of the view that recycling enterprises train inhabitants in compost making in communities in which they operate. The study reveals that the socio-economic benefits or corporate social responsibilities mostly offered by recycling enterprises in communities in which they operate in Accra Metropolitan area are employment creation and environmental sanitation.

There is a change in the percentage of responses for employment creation and the promotion of environmental sanitation concerning respondents' views on the rationale for solid waste recycling as against corporate social responsibilities of recycling enterprises to close communities though the issues are similar and the respondents the same. This change is observed clearly when figure 5 is compared with table 11. In figure 5, 45 percent of the respondents were of the view that environmental cleanliness is the rationale for solid waste recycling, while 43 percent indicated employment creation as the rationale for solid waste recycling by recycling enterprises in the Accra Metropolis.

In table 11, however, 37.0 percent of the responses indicated employment creation, while 33.8 percent expressed the promotion of environmental sanitation as the corporate social responsibility offered to close communities by recycling enterprises. The

reason is that recycling enterprises provides a special quota to close communities when considering recruitment of employees and that might influence the views of more respondents that close communities benefit in the area of employment than environmental sanitation from recycling enterprises.

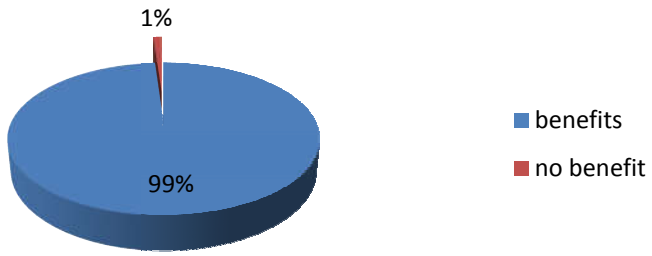

Figure 9: Socio-economic benefits of recycling enterprises to close communities /CSR Source: Fieldwork (2013)

Table 11: Socio-economic benefits of recycling enterprises to close communities /CSR

Socio-economic service	Frequency	Percentage (%)
Offering of employment	48	37.0
Promotion of environmental sanitation	44	33.8
Offering of plastic chairs for Ga Mantse's funerals and AMA programs	14	10.8
Selling of compost at reduce prices to farmers	7	5.5
Equipping nearby farmers with agric knowledge	5	3.8
Table 11 continued	5	3.8
Rehabilitation of school building	5	3.8
Training people in compost making	2	1.5
Total	*130	100.0

Source: Field data (2013) (* = multiple response)

Most of the key informants expressed that recycling enterprises create employment and train some inhabitants in Accra Metropolitan area and close communities in compost making as indicated by some of the 104 respondents. This was confirmed in the response of a key informant who declared:

> *"Recycling enterprises offer employment and recycling product such as compost to close community members".*

Another key informant supporting this opinion, expressed this in the following statement:

> "*They offer employment, provides compost to farmers and train people to acquire knowledge and skills in compost making".*

Analysis of the responses gathered through the administration of questionnaires and interviews on the socio- economic benefits of recycling enterprises to close communities indicates the offer of employment, the promotion of environmental sanitation, and training close inhabitants in compost making. This result gives credence to the goals of MSWM which include the promotion of environmental conditions by controlling pollution and ensuring the sustainability of urban ecosystems; and to generate employment. The result also confirms a technical objective of MSWM which recommends composting as a most promising area for the recovery of organic materials. Composting reduce the volume of solid waste and generate a valuable soil conditioner for agricultural and horticultural use.

Socio-economic benefits to metropolitan authorities and the state

One of the objectives of the study was to seek respondents' opinion on the socio-economic benefits of solid waste recycling to the metropolitan authorities or the state. It came out from the analysis as shown in Table 12 that 63 respondents (60.6%) out of the 104 were of the view that recycling enterprises pay taxes to the state, 14 respondents (13.5%) indicated that solid waste recycling generate employment, while 3 respondents (2.8%) were of the view that recycling enterprises offer equipment such as shovels, rakes, pick- axes, etc. to public institutions like AMA, Ghana Police and others for clean-up exercises. The other benefit has been indicated in Table 12.

Table 12: Socio-economic benefits to Metropolitan authorities and state

Socio-economic services	Frequency	Percentage (%)
Payment of taxes	63	60.6
Employment	14	13.5
Recycling enterprises used as research centres	10	9.6
Promotion of environmental cleanliness	8	7.7
Disease prevention	6	5.8
Provision of cleaning materials for state institutions	3	2.8
Total	104	100.0

Source: Field data (2013)

The key informants also expressed that solid waste recycling generate employment, tax revenue and contribute to agriculture through the use of some of the

recycling centres for research as indicated by the 104 respondents . The views of the respondents were supported by a key informant who is a staff in a composting facility declared:

"it helps in the creation of jobs through training in compost making."

This enforced the assertion of another key informant in a regulatory organization who disclosed that:

"Solid waste recycling generate tax revenue and offer employment."

This finding lends its backing to one of the goals of MSWM in the conceptual framework in which Schuebeler et al (1996) outlined that MSWM aims at generating employment and income.

Environmental Implications of Solid Waste Recycling

Analyses and discussions on the environmental implications of solid waste recycling were based on respondents views on the amount of solid waste removed daily from the environment for the purpose of recycling; the amount of solid waste that is recycled daily; how solid waste recycling improves environmental quality; and how solid waste recycling adversely affect environmental quality. Cooper and Reinhold (1996) explained environmental quality standards as the maximum limits or concentrations of pollutants that are permitted in air, land or water or the maximum acceptable levels considered safe to public health and welfare, wildlife and the environment. Environmental quality in the context of recycling is measured based on the maximum limits or concentrations of pollutants generated through recycling activities into air, land and water considered safe to public health and welfare, wildlife and the environment (Cooper & Reinhold,1996). Therefore, when pollutants generated through recycling

activities into the environments exceeds acceptable limits, the environment quality is adversely affected and provide conditions not safe for the survival of human being and other organisms. Concentrations less than maximum acceptable levels do not adversely affect environmental quality.

Respondents' views on the quantity of plastic waste removed daily from the environment

The researcher sought respondents' views on the quantity of plastic waste removed daily from the environment for the purpose of recycling. Of the 40 responses that were provided by respondents, 21 of them (52.5%) were of the view that each registered recycling enterprise removed 5 to 10 tonnes of plastic waste daily from the environment while 5 of the responses (12.5%) indicated that 16 to 20 tonnes of solid waste were daily removed by each recycling enterprise in Accra Metropolitan area as shown in Figure 10.

This finding imply that most recycling enterprises in Accra Metropolitan area removed between 5 to 10 tonnes of plastic waste daily.

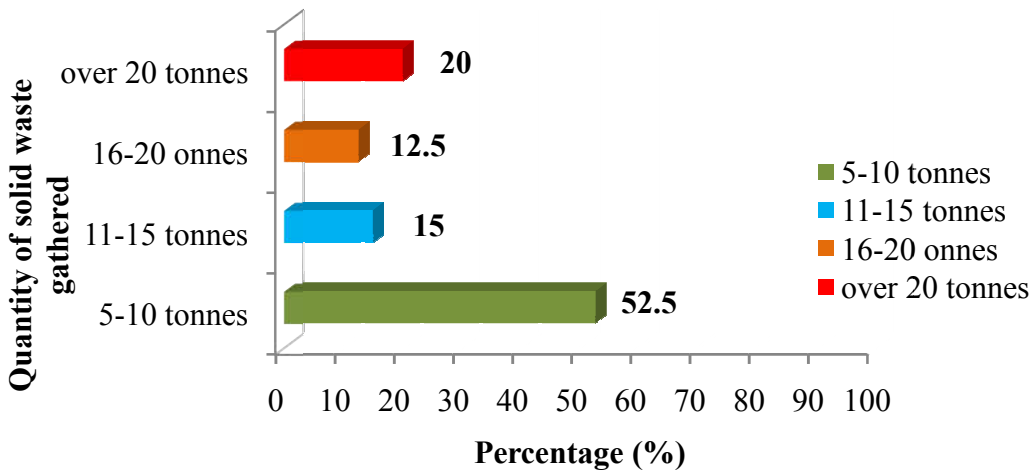

Figure 10: Quantity of plastic waste removed daily from the environment

Source: Field data (2013)

Most of the respondents that were interviewed also confirmed that each composting facility removes between 10 to 15 tonnes of food waste daily from the environment. This finding was substantiated by the response of an interviewee who indicated that:

'*on daily basis we can receive about 12.3 tonnes of*

organic waste at our aerobic composting facility'.

A key informant in a regulatory body was of the view that on a whole about 1200 tonnes of solid waste are collected daily from the environment by both AMA and recycling enterprises in Accra Metropolitan area. This was made evident in his response in an in-depth interview in which he said:

"*About 1200 tonnes of the generated solid waste is gathered*

from the environment by AMA and recycling enterprises".

There is a huge disparity between the responses from recycling enterprises and that of the key informant on the amount of solid waste gathered daily from the environment. That of the key informant is far larger than those of the enterprises because the figure for the enterprises indicates the amount of solid waste mostly removed by each of the recycling enterprises and the type of solid waste gathered here mainly plastics. That of the key informant represented the overall amount of solid waste removed daily by AMA in Accra Metropolis, and the solid waste type not only plastics but all categories of solid waste.

The removal of 1200 tonnes out of the 2500 tonnes of solid waste generated daily in Accra Metropolitan Area (Waste Management Department, Accra Metropolitan Assembly, 2013) creates a huge amount of solid waste not removed. This explains why there are huge waste dumps in several areas in Accra such as Odorkor, Oblogo, Sarbah and others (Akordor 2011). This is due to the low rate of application of waste management methods like recycling, energy recovery practice, composting, and others. This situation confirms the waste management problems revealed in the empirical studies on the challenges and opportunities of Municipal Solid Waste Management in Addis Ababa city in Ethopia indicated in the review of related literature.

Respondents' view about the quantity of solid waste recycled daily by recycling enterprises

The researcher also probed into the quantity of solid waste averagely recycled daily by each recycling enterprise. Thirty-seven (37) respondents expressed four main opinions on the issue as indicated in Figure 11. Twenty five (25) respondents

representing 67.6 percent indicated that each recycling enterprise recycle between 5 to 10 tonnes of plastic waste daily, whiles 2 respondents (5.4%) expressed that over 20 tonnes of plastic waste are recycled by each recycling enterprise. This analysis clearly indicates that most recycling enterprises in the Accra Metropolitan area recycle between 5 to 10 tonnes of plastic waste daily.

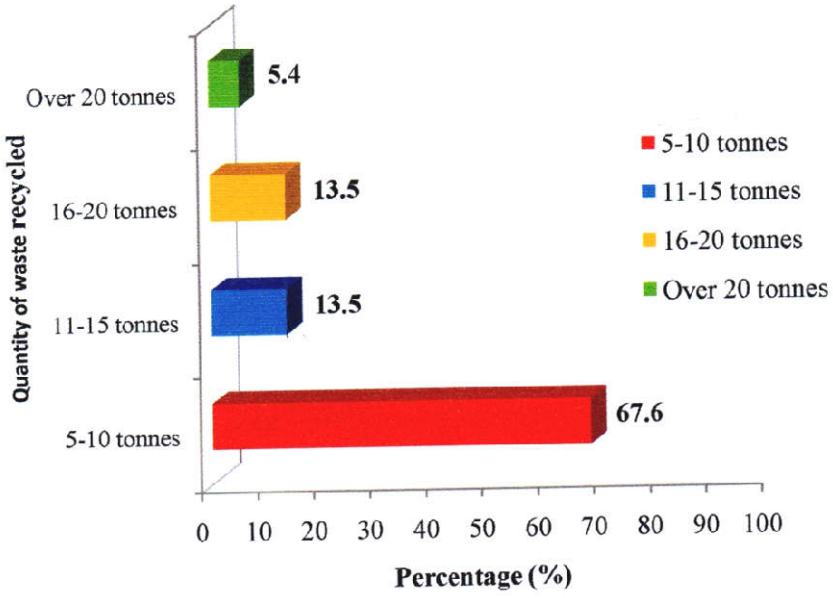

Figure 11: Quantity of solid waste recycled daily

Source: Fieldwork data (2013)

On the contrary most of the key informants expressed that most recycling enterprises recycle organic solid waste ranging from 0.1 to 0.3 tonnes daily. A key informant in a regulatory organization was of the view that together about 125 tonnes out of the 2500 tonnes of the daily generated solid waste is recycled daily by all recycling enterprises in the Accra Metropolitan Area. The findings were disclosed by the response of the key informant in the following statement:

> *"it is important the note that plastic waste constitute 6 percent of the 2500 tonnes of the solid waste generated daily in Accra metropolitan area and 20 percent of the volume of the 2500tonnes. However, the amount of solid waste that is recycled daily out of the 2500 tonnes is 125 tonnes".*

Another key informant supported the finding in which she expressed in a response in an interview scheduled:

> *"the maturation of compost takes place at least 2 months, and after two months, 14.3 tonnes of the compost is realized out of 88 tonnes of organic waste. This worked out on daily basis meant that 0.3 tonnes of compost was produced daily"*

There is also a huge disparity between the figure indicated by the enterprises and that of the key informant on the amount of solid waste recycling daily in Accra. The 5 to 10 tonnes of solid waste indicated by most recycling enterprises was the amount recycled daily by each of the enterprises and the kind of solid waste here, mainly plastics. The 0.1 to 0.3 tonnes of solid waste was the average amount of compost generated daily from food waste by each of the composting facilities, while the 125 tonnes indicated by the key informant represent the total amount of plastic waste recycled by all recycling enterprises in the Accra Metropolis.

The low amount of solid waste recycled is due to the fact that the Accra Metropolis is a city in a developing country where recycling rate is low as indicated in

the explanation of solid waste management methods arranged on the solid waste management hierarchy by UNEP (2005a) in the conceptual framework of related literature. The situation is however contrary to what pertains in many developed countries such as United States where recycling is done not only by recycling enterprises, but also practised by many households as pointed in the empirical studies on the challenges of sustainable urban planning in United States by Ning (2006).

Respondent's views on how solid waste recycling improves environmental quality

Eighty–four (84) responses were expressed by the 104 respondents surveyed on how solid waste recycling improves the quality of the environment. Five (5) main views were expressed by the respondents as indicated in Table 13, in which 45 responses (53 6%) were of the view that removal of sachet plastics for recycling prevents choking of gutters and create aesthetic environments; 21 responses (25.0%) indicated that the removal of sachet plastics for recycling prevents the non-biodegradable effects of the sachet plastics on soils, and their entanglements on organisms, while 2 responses expressed that the use of compost in farming improves soil fertility without causing soil pollution. The results indicates that the removal of water sachet plastics for recycling which causes the prevention of choking of gutters and the promotion of aesthetic environment could be the best approach by which solid waste recycling improves the quality of the environment since together over 50 percent of the responses (53.6%) supported this view. Though, the researcher solicited multiple responses from the 104 respondents surveyed, only 84 responses were expressed on how solid waste recycling improves the quality of the environment. This might be due to the fact that many respondents did not have enough knowledge on the issue so that they could express.

Table 13: Views on how solid waste recycling improves environmental quality

Solid waste recycling environmental improvement activities	Frequency	Percent
• Removal of sachet plastics for recycling prevents choking of gutter and create aesthetic environment.	45	53.6
• Removal of sachet plastics for recycling prevents its non-biodegradable effect on soils and entanglements of organisms	21	25.0
• Removal of food waste for composting reduces public stenches and the spread of diseases.	11	13.2
• Removal of sawdust for chipboard making create space for farming building and construction works.	5	5.7
• The use of compost in farming improves soil fertility and causes little or no pollution.	2	2.5
Total	84	100.0

Source: Fieldwork data (2013)

The views of the key informants was not contrary to those expressed by the 104 respondents and indicated that the removal of solid waste for recycling keeps the environment clean, prevent choking of gutters, minimizes flooding, prevent land and water pollution, and prevent the emission of green house and some poisonous gases such as ammonia, methane and sulphur dioxide when some solid waste substances are left to decompose. This finding was given detailed confirmation in the response of a key informant who said:

" removal of sachet plastics, metal scraps, food waste, and other forms of solid waste makes the environment clean, attracts tourists, and promotes foreign investment. In addition, it prevents land degradation since leaving sachet plastics, metal scraps, food waste on the environment have the potential of turning into toxic substances that enter land and water bodies and contaminate them. Also, the removal of solid waste prevents choking of gutters and flooding, and prevents the emission of some poisonous gases from some waste substances when left on the ground".

The views of the majority of the 104 respondents as well as those of the key informants are consistent with the second goal of MSWM in low-income countries which states that MSWM promotes the quality of the urban environment as indicated by Schuebeler et al (1996) in the review of related literature.

Respondents' view on how solid waste recycling adversely affect environmental quality

The 104 respondents came out with 53 responses when the researcher solicited views on how solid waste recycling adversely affects the quality of the environment in order of seriousness. It came out from the analyses as shown in Table 14 that 16 respondents (30.2%) were of the view that the most serious adverse effect of solid waste recycling on the quality of the environment is when contaminated water resulting from the washing of sachet plastics seep into the land and water bodies and pollute them. Twelve (12) responses (22.6%) indicated that the purification and melting of sachet

plastics by machines during the process of recycling which generate much heat into the atmosphere is the most serious adverse effect of solid waste recycling on the quality of the environment, while 5 responses (9.4%) emphasized that methane and carbon dioxide gases that are consistently emitted during aerobic composting and causing global warming and climatic changes is the most serious adverse effect of solid waste recycling. Two (2) responses (3.8%) also expressed that the most serious adverse effect on environmental quality is when sulphur dioxide gas emitted during aerobic composting of organic waste accelerate the corrosion of metal roofs, rods and concrete walls; and accelerate the discolouration of wall painting. The researcher solicited multiple responses from 104 respondents and expected a higher number of responses than the 53. The reason could be that respondents were cautious not to reveal the environmental adverse effects of their recycling activities since they threaten the survival and existence of their enterprises and employment security.

Table 14: Ways by which solid waste recycling activities adversely affect environmental quality

Solid waste recycling adverse effects on environmental quality	Frequency	Percent
• Contaminated water resulting from washing of sachet plastics pollute land and water bodies	16	30.2
• Purification and melting of sachet plastics during recycling generate much heat into the atmosphere.	12	22.6
• Removal of sawdust from soil surfaces making chipboard reduce rate of humus formation.	8	15.2

Table 14 continued

• Throwing of unwanted materials mixed with bags of water sachet plastics onto the ground and water bodies pollute them.	6	11.3
• Methane and carbon dioxide gases emitted during composting cause global warming and climatic changes.	5	9.4
• Ammonia gas emitted during aerobic composting cause global warming and climatic changes.	4	7.5
• Sulphur dioxide gas emitted during aerobic composting affect corrosion of building metals and discolour wall paintings	2	3.8
Total	53	100.0

Source: Field data (2013)

The views of the key informants were not different from those of the 104 respondents, but to them the emissions of certain gases and leachate during aerobic composting is the most serious adverse effect of solid waste recycling on the quality of the environment. They explained that ammonia in fine particulate form of PM 2.5 when inhaled by human beings cause respiratory diseases such as bronchitis, asthma and coughing. They are also of the view that human exposure to long periods of ammonia gas concentrations of 50 to 150 parts per million (ppm) can lead to decreased oxygenation of tissues and reduced body functions. Chronic emissions of methane gas from landfills or crude dumping grounds cause green house effect, global warming and climatic change. They further explained that leachate also flow out of organic waste during the process of

composting which contain toxic substances like nitrate, cyanide and sulphuric acid which pollute water bodies into which they came into contact. They stressed that water used to wash sachet plastics used for recycling get contaminated and eventually find its way into land and water bodies causing pollution. This finding is evident in the reply of a key informant who said:

> "*Gases such as carbon dioxide, methane are emitted during aerobic composting and this cause global warming. Leachate also flows out of the organic waste during the process of composting which contain toxic substances like nitrate, cyanide and sulphuric acid which pollute water bodies and land*".

Another key informant who is an expert in environmental issues indicated in his response about the effect of ammonia and replied*:*

> *"When ammonia gas of 50 to l00 ppm concentration is exposed to man for a duration beyond 10 minutes, it can lead to infections of the eye, throat, and skin, and decreased oxygenation in man and generate an offensive odour''.*

These emissions of gasses such as carbon dioxide, methane and ammonia during composting indicated by the respondents confirm the explanations provided by EPA and CHF concerning aerobic and anaerobic composting in the related literature. They explained that during aerobic composting the presence of oxygen in the organic waste allows for little emissions of methane gas, while for anaerobic composting the limited supply of oxygen and the fact that organic waste is not turned causes fermentation

resulting in much emissions of carbon dioxide and methane gases as well as ammonia gas that has an offensive smell. The response analysis also support the explanation by EPA and CHF of Ghana that leachate is contaminated liquid generated from composting that can cause the dissolution of metals and the pollution of ground water and surface water bodies as pointed in the review of related literature.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents the summary of the study, major findings, conclusions, recommendations, limitations and ends with suggestions on areas appropriate for further study.

Summary

Accra Metropolis, the capital city of our dear country Ghana, over the years has battled with solid waste management. The problem stemming primarily from high daily solid waste generation; 2000 metric tonnes generated daily as at 2010 which increased to 2500 metric tonnes as at 2012. The Accra Metropolitan Assembly (AMA) has somehow been managing this situation by collecting and disposing a significant volume of the generated solid waste: 1200 metric tonnes as at 2012 and burying them in landfills. This type of solid waste management came along with daunting challenges since people residing close to landfills complained that their health was affected by leukemia acquired through drinking well water contaminated by toxic substances from landfills (Coffie, 2010), while others suffered from eye irritations and respiratory diseases as they inhaled noxious gases from landfills. As the AMA brainstormed to look for improved options of

managing solid waste in the city, recycling has been identified as one of the options that can significantly address the problem.

This study therefore sought to assess solid waste recycling as means of improving environmental quality in Accra Metropolitan area. This was to establish whether solid waste recycling really serve as a means of improving environmental quality or not, and if is really so, the extent to which the improvement has been done.

The researcher adopted the survey research design. The sampling procedure was multi-stage involving both probability and non-probability sampling techniques to select the desired 108 respondents and three key informants. The probability sampling technique was stratified, while the non-probability was purposive sampling technique.

The study established that despite the benefits such as employment, production of household utensils, revenue generation and aesthetic environment that solid waste recycling provides in the study area, five percent of the daily generated solid waste was recycled. The study further revealed that the low rate of recycling was due to few enterprises involved in solid waste recycling and most households not involved in this activity.

It was recommended that the central and local governments implement the following measures: getting actively involved in solid waste recycling, encouraging households to participate actively through public education and motivation so that solid waste can be significantly reduced in the environment. The details of the key findings have been outlined below.

Key findings of the Study

The main findings of the study based on the research questions and objectives are as follows:

1. Eighty-six (86) out of the 104 respondents representing 82.7 percent identified water sachet plastics as the most recycled solid waste in Accra metropolis and therefore the category of solid waste that is mostly recycled in the area is plastic. This was confirmed by two key informants who also identified plastic waste as the most recycled category of solid waste in the area;
2. 88 percent stated that the main rationale for solid waste recycling in the Accra Metropolis was the promotion of environmental sanitation and employment creation. An NGO expert confirmed this in his interview that the main reason for solid waste recycling was to promote environmental sanitation;
3. With regards to the extent of government participation, respondents indicated that the government provide various forms of assistance to recycling enterprises but the main forms of assistance were tax rebates, allowing recycling enterprises to import machines without paying import duties, and the use of district cleansing officers to dialogue with inhabitants of sub-metros to reserve their accumulated solid waste for recycling companies which all together constituted over 50 percent (50.6%) of the views of the total responses. Most key informants interviewed, however, expressed that government assistance was in the form of technical advice offered by district cleansing officers to workers of recycling enterprises;

   With regard to ownership of recycling enterprises by the government, over 70 percent (70.2%) of the responses expressed that both the central and local

government have no ownership in existing recycling enterprises in Accra Metropolitan area. The key informants in support expressed that the central government partly owns only one recycling enterprise, while the local government does not own any recycling enterprise in the Accra Metropolis. Almost all the recycling enterprises are privately owned, and recycling and composting activities at households are virtually non- existence in the study area.

4. Several findings came under the socio-economic benefits of solid waste recycling. Respondents expressed the following:

a) Respondents were of the view that polythene bags, trashy bags, plastic bowls and rain coats were the most produced products from solid waste recycling since all together they represent over 50 percent (51%) of the total responses;

b) Many respondents expressed that recycling enterprises mostly provide soft loans, target achievement bonuses, and risk allowances as incentives to workers since all together over 50 percent (54.5%) of the responses indicated these incentives as the top three most provided incentives for workers. Most key informants who are waste management experts also confirmed target achievement bonus and provision of soft loans as the main incentives to employees of recycling companies;

c) The study also revealed that the socio-economic benefits mostly offered by recycling enterprises to communities in which they operate in Accra Metropolis were employment creation and the promotion of environmental sanitation since all together over 70 percent of the total responses (70.8%) indicated employment creation and environmental sanitation as the two main socio-economic benefits.

Most key informants confirmed that recycling enterprises offer employment to people in communities in which they operate in Accra Metropolitan area, but added that the enterprises also train people within their operating communities in compost making; and

d) It also came out from the analysis that over 60 percent (60.6%) of the total respondents were of the view that recycling enterprises pay taxes to the Accra Metropolitan Assembly and the state, meaning that the main socio-economic benefit Accra Metropolitan authorities and the state derive from recycling enterprises is tax revenue. The key informant also emphasized this benefit in their response.

5. These were findings on the environmental implications of solid waste recycling:

a. Over 50 percent (52.5%) of the responses indicated that each registered recycling enterprises in the Accra metropolis remove within the range of 5 to 10 tonnes of solid waste daily from the environment. However, the researcher advices that this finding should be used with caution since only 40 out of the 104 respondents expressed their views on the issue. A key informant was also of the view that AMA removes about 1200 tonnes of solid waste from the environment in the Accra Metropolis;

b. Over 60 percent (67.6%) of the respondents expressed that each recycling enterprise recycle a range of 5 to 10 tonnes of solid waste daily. However, the researcher is of the view that this finding should also be used with caution, since 37 out of 104 respondents expressed opinions on the issue. A key informant who is an expert in waste management indicated that recycling enterprises that use

water sachet plastics altogether recycle about 125 tonnes of water sachet plastics each day;

c. It also came out that the removal of water sachet plastics which prevent the chocking of gutters and the promotion of aesthetic environment could be the solid waste recycling activity that improves the quality of the environment because about 53.6% of the respondents supported this view. The key informants also confirmed that solid waste recycling leads to the removal of solid waste from the environment and thus preventing chocking of gutters, minimizes flooding, prevent land and water pollution but added that the removal of solid waste from the environment prevent the emission of gases such as ammonia, methane and sulphur dioxide that adversely affect environmental quality at certain concentrations; and

d. The analysis revealed that the two most serious adverse effects of solid waste recycling on the quality of the environment are contaminated water resulting from the washing of sachet plastics during the process of recycling seeping into lands and water bodies and polluting them, and secondly the excessive heat that is generated into the atmosphere as a result of the melting and purification of water sachet plastic waste by recycling machines during the recycling process. In all, over 50 percent of the total responses (50.8%) indicated these adverse effects as the most serious effect emanating from solid waste recycling that affect the quality of the environment. The key informants, however, cited the emissions of certain gases and leachates during aerobic composting as the most serious adverse effect of solid waste recycling. These gases are ammonia, methane, and carbon

dioxide that cause soil acidity and disturb ecosystems, respiratory problems, and eye and skin irritations in man.

Conclusions

The main objective of the study was to assess solid waste recycling as a means of improving environmental quality in the Accra Metropolitan area. It came out from the study that the Accra Metropolitan Assembly which is the public institution legally mandated to collect and dispose off all the solid waste on daily bases in the area is able to collect and dispose almost half (48%) of the amount of the daily generated solid waste. Recycling enterprises that make use of the generated solid waste, largely water sachet plastics and food waste, as raw materials are not able to clear all the solid waste left behind by the Metropolitan Assembly as established from the study. The reason is that these recycling enterprises are few in the area and the available ones are not able to make use of all the daily generated solid waste in for their recycling activities. It was also observed that most households do not engage in recycling activities either for profit generation or a means of treating their solid waste. It was established from the study that the central and local governments provide various forms of assistance for the recycling enterprises in order for them to be efficient; notwithstanding, almost all these enterprises are privately owned. It was also revealed that though recycling enterprises are not able to complement the efforts of the Metropolitan Assembly in clearing all solid waste on daily basis, their recycling activities have contributed towards the removal of over 120 tonnes daily of solid waste from the environment and this has improved environmental quality through the creation of aesthetic environment, minimising flooding, eliminating choking

of gutters, reducing pollution of land and water bodies as well as minimising the spread of communicable diseases.

The recycling processes are however characterized by adverse environmental problems such as the pollution of land and water bodies by contaminated water from recycling enterprises, excessive heat generated from the machines of recycling enterprises which affect the health of workers and the environment, as well as gases such as ammonia, methane, sulphur dioxide that affect the health of humans and other organisms since it adversely affect the quality of the environment. Based on the challenges and the problems associated and emanating from the recycling of solid waste the following recommendations have been made.

Recommendations

1) The current picture revealed by the study indicate that the amount of solid waste that is recycled most in Accra Metropolitan area, that is water sachet plastic, is just about 125 tonnes daily out of the 2500 tonnes of solid waste generated in the area, while for organic waste about 0.1 to 0.3 tonnes of the total generated solid waste is recycled daily. This provides clear evidence that recycling of water sachet plastics has contributed minimally to the reduction of solid waste in the area. This is due to the few recycling enterprises in the study area and the fact that almost all households are neither into recycling nor composting activities resulting in the low rate of recycling. This calls for a joint effort by both the central government and AMA to use both the print and electronic media to encourage households and individual entrepreneurs to invest in solid waste

recycling by creating the necessary awareness about the incentive package and the various forms of assistance that the government will provide for the entrepreneurs. This will attract many entrepreneurs into the recycling business and increase efficiency and the amount of solid waste removed daily. Besides, this will improve sanitation, create aesthetic environment and minimise flooding and choking of gutters.

2) Again, it came out from the analysis that though the government assists recycling enterprises in various forms its ownership of solid waste recycling enterprises is very minimal. Though, local governments are legally responsible for solid waste collection and disposal, the increasing difficulty to secure final solid waste disposal sites and their adverse health implications necessitate local government such as AMA to go beyond collecting and disposal of solid waste and establish compost plants and recycling enterprises in order to utilize the solid waste in making compost and other products for commercial purpose. This will reduce the burden of AMA constantly looking for plots of land as landfill or final dumping grounds which is not easy to come by and also create employment for people. This will also complement the efforts of recycling enterprises by reducing solid waste in the environment through their recycling activities.

3) Moreover, it came out from the analysis that solid waste recycling creates certain effects that adversely affect the quality of the environment, and the health of humans and organisms, if certain safety precautions are not taken. In the process of solid waste recycling, water used in washing the sachet plastics becomes contaminated and this pollutes land and water bodies. Also, during composting,

gases like methane, ammonia and carbon dioxide are emitted, and as well leachates from organic waste.

The researcher therefore recommend that the contaminated water be treated by the employed labour of recycling enterprises before allowing it to flow out of the work sites. This will prevent pollution of water bodies and land that can eventually affect man's health. The regular turning or stirring of the accumulated food waste encourages very low emissions of ammonia gas which in high concentrations cause respiratory problems, eye and nose irritations, soil acidity among others. The workers turning the organic waste must comply with safety practices such as wearing gloves; nose filters protective boots, and others.

4) Leachate from raw organics can be minimized when employed workers mix the organics into windrows containing a large proportion of actively composting organics. Also regular turning of windrows can also help minimize the quantity of leachate draining from the windrows. Nutrients can be recovered by using the leachate for the wetting of new organics or actively composting organics that require additional moisture.
5) When the responses of the 104 respondents on the categories of solid waste that are recycled in Accra Metropolitan area were analysed, 13.5 percent of the responses identified organic waste or food waste. This suggests that the rate and volume of organic waste recycled into compost might be low. This is due to the low participation of composting by households, local and central governments and the fact that there are few composting facilities in the study area. This calls for households, local and central governments as well as private entrepreneurs to

actively engage in the recycling of organic waste into compost. This can cause most of the generated organic waste to be converted into organic fertilizers or compost to save foreign exchange earnings since the organic ones are far less expensive to produce than the imported inorganic fertilizers. Again, using it on the land for the production of crops is more environmentally friendly than the inorganic ones.

Limitations of the Study

1. The researcher could not conduct a research into the recycling of metal scraps and paper in order to assess the benefits and its environmental effects. The reason was that recycling companies that recycle metal scraps were all located in the Tema Metropolitan area which fell outside the study area of the researcher. Also, no company in the Accra Metropolitan area was identified to recycle paper.
2. The researcher would have loved to include studies on the benefits of reuse of solid waste materials such as glass and plastic bottles and its health implications on man. However, the time- frame allocated for the studies limited the researcher into that area of studies.
3. The researcher in the original plan involved the assessment of waste-to- energy management option and its environmental implications. This aspect was, however, dropped due to limited fund and time constraint.

Areas for Further Studies

1. The researcher suggests that a research be conducted into the environmental implications and the socio-economic benefits of the recycling of paper and metal scrap.
2. The researcher is also suggesting a research into the reuse of solid waste such as glass and plastic bottles and its health implications on human.
3. The researcher would be delighted if a research is conducted into waste- to-energy option of solid waste management emphasizing on its benefits and environmental implications.

REFERENCES

Akordor, K. (2011). *The fate of our landfills*. Retrieved on 19th November, 2012 from kofiakordor.blogspot.com/2011/12/.

Ali, M. (2004) *Sustainable composting: Case studies and guideline for developing countries*. Water, Engineering and Development Centre, Loughborough University.

AMA (2012). *Submetros of Accra Metropolitan Assembly*. Retrieved on 15th August, 2012 from http://www.ama.gov.gh/ama/page/8027.

Ashworth, W., & Little, C. (2001). *Encyclopedia of Environmental Studies.* New York, USA: Facts on file Inc.

Asokan P., Saxena M., & Asokelar S. R. (2004). *Solid Wastes Generation in India and their recycling potential in Building Materials.* Regional Research Laboratory (CSIR): Habib Ganj. Nata-Bhopal. 462026, India.

Barrow, C. J. (1995). *Developing the Environment, Problems & Management.* Essex CM 20, 2JE, England: Longman House.

Benti, G. (2007). *Addis Ababa: Migration and the making of a multiethic Metropolis*. Trenton: Red Sea Press.

Berg, B. L. (2009). *Qualitative Research Methods for the Social Sciences*. (7th Edition).Boston, Massachussets: Allyn & Bacon.

Bizunesh, B. S. (2011*). Challenges and opportunities in Municipal Solid Waste Management: The case of Addis Ababa City, Central Ethiopia*: Haromanya University Ethiopia. Dept. of Rural Development and Agric. Extension.

Boadi, K. O. & Kuitunen, M. (2002). Urban Waste Pollution in the Korle lagoon, Accra, Ghana. *The Environmentalist* 22(4), 301-309.

Bogner, J., Abdelrafe A, Diaz, C., Faaji, A., Geo, Q., Hashinmolo, S. K, Mareckova, R., Pipatti, I., Zhang,I. (2007). Waste Management in Climate Change. *Mitigation Contribution of Working Group III to the Fourth Assessment Report of the Inter Government Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

Bryman, A. (2004). *Social Research Methods*. Oxford: Oxford University.

Charas D. (1998). *Environmental Science: A systems Approach to sustainable development*. New York: Wadsworth Publishing Company.

Coffie, F. M. (2010). *Landfill sites management challenges*. Kumasi, Ghana: College of Architect and planning, KNUST.

Collins, T. (2009). *Collins Dictionary*. England:Harper Collins Publishers.

Cooney, C. (1975). *Thermophilic Anaerobic Digestion of Solid Waste for fuel Gas Production.* Massachusetts, U.S.: John Wiley and Sons, Inc.

Cooper, A. R., & Reinhold, V. N. (1996). *Cooper's Comprehensive Environmental Desk.* New York: International Thompson Publishing Inc.

Crystal, D. (2000). *The Penguin Encyclopedia.* 80 Strand, London, England: Penguin Group Ltd.

Cunningham, W. P., & Saigo, B. W. (1997). *Environmental Science: A Global Concern.* (4th Ed.) London: WMC Brown Publishers.

Dickson, K.B., & Benneh, G. (1998). *A New Geography of Ghana*. England: Longman Group, UK Limited.

Eblen A. R. & Eblen R. W. (1994). *The Encyclopedia of the Environment.* New York: Houghton Mifflin Company.

Enger, E. D. & Smith, B. F. (2000). *Environmental Science: A study of Inter-Relationship* (7th edition) New York: Mc Graw-Hill Co. Inc.

Environmental Guidelines for Small-Scale Activities in Africa (2009). Retrieved on November 30th, 2012 from http://www.encafrica.org.

EPA & CHF (n.d.*). Guidelines for the acquisition of environmental permits for composting projects in Ghana.* Accra, Ghana: Author.

Eschooltoday & Business Ghana(2010). Retrieved on 21st December, 2012 from www.eschootoday.com/waste. recycling/ sources- of- waste. html.

European Commission (2010). Analysis of The Evolution of Waste Reduction and The Scope of Waste Prevention. *Final report*. Acardis.

European Commission (2011). *Guidelines on the preparation of food waste prevention programmes its part of the study on the evolution of (bio) waste generation/prevention*.[Brochure]

European Environmental Agency (2007). *The Road from landfilling to recycling*. Copenhagen: European Environmental Agency.

European Environmental Agency (2009).*Diverting Waste from Landfill. Effectiveness of Waste Management Policies in the European Union.* Copenhagen: Author.

European Environmental Agency (2012). "Environmental Quality(definition)*''.Glossary: Environmental Terminology and Discovery Service.* Copenhagen, Denmark.

Gakungu, N.K. (2011). *Solid Waste Management: A Case of Technical Institutions in Kenya* (unpublished). Nairobi, Kenya: University of Nairobi.

Ghana Statistical Service (2012). 2010 Population & Housing Census: *Summary Report Of Final Results*. Ghana: Sokoa Press Ltd.

Global Environment Centre Foundation (2006). *3Rs Technologies and Techniques in Japan.* Retrieved on 29th August, 2012 from http://gee.jp/gea/EN/publication/ectourism.

Hoomweg, D. & Laura, T., (1999). *Waste Solid Management in Asia: Working paper Serial Number 1.* East Asia and Pacific: Urban Development Sector Unit..

Hornby, A. S. (2006). *Oxford Advanced Learner's Dictionary of Current English.* (7th Ed). Oxford, England: Oxford University Press.

Idowu, O., Omirin, M., & Osagie, J .(2011). Outsourcing for sustainable waste disposals in Lagos metropolis: case study of Agege Local government, Lagos. *Journal of Sustainable Development.* 4(6), 116 – 131.

Islam M. S. (2010). *International Journal of the physical Sciences*. Melbourne, Australia: Dept. of Civil Engineering, Monash University.

Janicke, M. (1996). *Political Systems for Environmental Policy in National Environmental Policies. A Comparative Study of Capacity Building.* Kenya: United Nations University.

Johnson, D. L., Ambrose, S. H., Baselt T. J., Bowen, M., L.& Crummey, Isaacson, J., S. (1997) "Meanings of Environmental terms". *Journal of Environmental Quality.* 26:581-589. Retrieved from doi:10:2134/jeg 1997.004724500 2600030002x

Kellert, S. R. (1997). *Macmillan Encyclopedia of the Environment*. (Vol. 2). New York:

Ko, P. S., & Poon, C. S. (2009). Domestic Waste Management and Recovery in Hong Kong. *Journal of Material Cycles and Waste Management.* 11(2), 104 – 109.

kofiakordar.blog spot.com/2011/12/.

Kotoworola, O. (2007). Recovery and Recycling practices in Municipal Solid Waste Management in Lagos, Nigeria. *Elsevier Red Waste Management*. p. 1139 – 1143.

Lagos Waste Management Authority (2011). *Solid Waste Management Practices In Lagos*. Retrieved on 20th February, 2013 at http://www.lawma,gov.ng. Macmillan.

Magutu, D. O., & Onsongo, C. O. (2011). Operationalizing Municipal Solid Waste Management. *Integrated Solid Waste Management.* (vol II, P. 3 – 10). Rijeka, Croalia: Infotech.

Marbell, I. & Tsiboe, I. (2004*). A look at Urban Waste Disposal Problems in Accra, Ghana*: Rockslide University Centre.

McGinty (2002*). Community Capacity Building*. Townsville, Australia: School of Indigenous Australian Studies, James Cook University.

Metcalfe, S. (2011). *Guardian Provisional Network* retrieved on 2nd December, 2012 from guardian.co.uk.

Miller, T. (1997).*Environmental science: working with the earth* (6thed). New York, Wadsworth.

Mohammed, E. (2003). *Waste Management Programme*, Tokyo, Japan: UNIPO view document No. 3765.

Momodu, N.S, Dimuna, K. O., & Dimuna, J. E. (2011). Mitigating the Impact of solid waste in urban centres in Nigeria. *Journal of Human Ecology*.p. 125 – 138.

Nabegu, A. B. (2010). An Analysis Of Municipal Solid Waste In Kano Metropolis, Nigeria. *Journal of Human Ecology*. 31(2), 111 – 119.

Narayana, T. (2009). Municipal Solid Waste Management In India: from Waste Disposal to Recovery. *Waste Management*. 2(29), 1163 – 1166.

Nigatu, R., Rajan, S., & Bizunesh, B. S. (2011).*Challenges and Opportunities in Municipal Solid Waste Management: the case of Addis Ababa City, Central Ethiopia* .Addis Ababa, Ethiopia: Institute of Environment, Gender and Development, Hawassa University.

Ning, A. (2006*). Challenges of sustainable urban planning: the case of municipal solid waste management in U.S*. Georgia, U.S.: School of City and Regional Planning.

Ogwueleka, T. (2009), Municipal solid waste characteristics and management in Nigeria. *Iranian Journal of environmental health, science and engineering.* 6(3), 173 – 180.

Osei J. Osae S. K. Fianko, J. R., Adomako D., Laar C., Anim A. K., Ganyalo, S. Y., Nyarku, M, Nyarko, E. S. (2011). The Impact of Oblogo landfill site in Accra-Ghana on the surrounding Environment. *Journal of Environmental and Earth Sciences*. 3(6), 633-636.

Pattnik, R & Reddy, P. (2009).Assessment of Municipal Solid Waste Management in Puducherry, India. *Resource Conservation and Recycling*. 54(2012), 510 – 520.

Peterson, E. (2001,September 27th). 'Garbage Takes over Accra'. *Accra Mail,*p.2

Polit, D. F. & Beck, C.T. (2008). *Nursing Research: Generation and Assessing Evidence for Nursing Practice.* (8^{th}Ed). Lipponcott: Williams & Wilkins.

Raven, P. H., Berg, L. R., & Johnson, G. B. (1995). *Environment.* New York: Sounders College Publishing.

Remigious, M. V. (2010). An Overview of the Management Practices at Solid Waste Disposal Sites in African Cities and Towns. *Journal of Sustainable Development in Africa.* 12(7) 233 – 239.

Sarantakos, S. (2000). *Social research.* (2nded) , New York: Palgrave publishers.

Schubeler P., Wehrle K., & Christien, J. (1996). *Conceptual framework for Municipal solid Waste Management in Low- income countries*. Switzerland: UNDP/UNCHS (Habitat) World Bank / SDC collaborative programme.

Scott, R., W. (2001). *Institutions and Organizations.* (2nd edition). Thousand Oaks: Sage Publication.

Sharholy, M; Ahmad, K; Mahmood, G.; & Trevili, R; (2007). Municipal Solid Waste Management in India Cities. *A review waste management* (2008), 459-467

Tchobanoglous, G., Theisen, H. & Vigil, S. (1993). *Integrated Solid Waste Management Engineering Principles and Management Issues.* New York: McGraw-Hill Inc.

The League of Women Voters (1993). *The Garbage Primer*. New York: Lyons & Burford ,

Troschinetz, A. M., & Mihelcic, J. R. (2008). Sustainable Recycling of Municipal Solid Waste in Developing Countries. *Waste in developing countries.* 29(2009), 915 – 923.

Tyler, M. G. (1993). *Environmental Science: Sustaining the Earth.* (4th edition). Belmont, California: Wadsworth Publishing Company.

U.S. EPA (2010). *Municipal Solid Waste Generation, Recycling, and Disposal in the United States*.USA: Author.

UNEP (2005a). *Solid Waste Management.* (Vol I). Osaka, Japan: International Environmental Technology, Centre.

UNEP (2005b). *Solid Waste Management.* (vol II). Osaka, Japan: UNEP- Division of Technology, Industry and Economic International Environmental Technology Centre, Cal Recovery, Inc.

United Nations Conference on Environment and Development (2000). *Report*. New York: DESA

Waste Management Department, Accra Metropolitan Assembly (2013). Trend on Solid Waste Generation in Accra Metropolitan Area. *Report.* Retrieved on 16th August, 2012 from http://www.ama.gov.gh/ama/page/1527.

Weiss, I. R., Banilower, E. R., Mahon, K.C., & Smith, P.S. (2001). National Survey of Science and Mathematics Education. *Report of Year 2000.*Chapel Hill, Horizon Research, Inc.

Williams, P. T. (2005). *Waste treatment and Disposal.* (2nded). West Sussex, England: John Wiley & Sons.

Withgott, J. & Scott, B. (2008). *Environment: The Science Behind the Stories*. St. San Francsico, USA: Pearson Education Inc. 1301.

Yetunde, A. (2012). *Sustainably of municipal solid waste management in Nigeria: a case study of Lagos.* Holland: Department of thematic study, Linkoping University.

Yoshizawa S., Tanaka M., & Shekdar A.Y. (2004). *Global Trend in Waste generation in Recycling, Waste treatment and clean Technology.* Spain: TMS Mineral, Metals and Materials publishers, p. 1541-52(II).

Zerbeck O. (2003). *Urban Solid Waste Reduction in Developing Nations*. Retrieved on 30th August, 2012 from www.cce.mtu.edu.accesed.

Zhang, D., Keat, J.S. & Gersberg, R.M. (2009). A comparison of municipal solid waste management in Berlin and Singapore. *Waste management.* 30(2010) 291 – 233.

APPENDIX A

UNIVERSITY OF CAPE COAST

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

INTERVIEW GUIDE FOR RECYCLING COMPANIES

SECTION A: Demographies/Characteristics of respondent

1. Name of your organization
2. Gender of interviewee. Male/ female
3. Educational level
4. What is your rank in the organization? Senior/Intermediate/Junior staff.

SECTION B: Identification of solid wastes and the Rationale of Solid Waste Recycling.

5. In your opinion, how would you describe solid waste?
6. What solid waste(s) does your enterprise recycle?
7. Which categories of solid waste(s) do those mentioned in question (6) above belong?
8. Why does your enterprise recycle solid waste as raw material rather than virgin ones?

SECTION C: The Extent of Government Participation in Solid Waste Recycling.

9. Is your enterprise a private or state owned enterprise?
10. Does the government release funds or provide any form of assistance for your organization as a way of promoting recycling activities.
11. Mention any known recycling plant in Accra Metropolitan area owned fully or partly by the state?

12. How does your organization collaborative with other regulatory bodies in controlling the activities of recycling enterprise?

SECTION D: Socio-Economic Benefits of Solid Waste Recycling

13. What are some of the products derived from the recycling of solid waste?
14. What is your impression about the number of employees recruited by your enterprise?
15. What is your assessment of the level of profit generated by your enterprise?
16. Is the operation of your company economically viable?
17. What are some of the incentives offered by your enterprise to its employees?
18. What are the social and economic services that your enterprise offer to the community in which it's operate?
19. What are the social and economic services that your recycling enterprise offer to the state?

SECTION E: Recycling Rate and Environmental Implications.

20. Which amount of solid waste on the average do you obtain from the public on daily bases?
21. What amount of solid waste obtained in question (20) do you recycle within a day?
22. To what extent do the activities of your enterprise contribute towards the improvement of environmental quality?
23. To what extents do the activities of your enterprise threatens environmental quality?

APPENDIX B

UNIVERSITY OF CAPE COAST

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

Questionnaire for firms /enterprises using solid wastes as raw materials.

This research is focused on the use of solid waste such as plastics, metal scraps, organics, and wood waste as a means of improving environmental quality in Accra Metropolitan Area. This research is purely for academic purpose. You are assured of confidentiality and anonymity and the data will not be used for commercial purpose. The results of this study can be provided to you on request.

Section A: Socio- Demographic/Characteristics of Respondent

1. Name of Organisation……
2. (a) Sex of respondent. Male [ ] Female [ ] Tick
3. Rank of respondent in the Organization.

   Junior Staff [ ] Middle Level Staff [ ] Senior Staff [ ]

Section B: Type and Uses of solid waste

4) What solid waste does your organization utilize for production?.....

5) Which category of solid waste does the one stated in question (4) above fall?

Plastics [ ] Wood residue [ ] Metal Scrap [ ] organic [ ]

6) Why do you utilize solid waste as raw material rather than virgin ones?

They are less costly to utilize. [ ]

They ensure environmental cleanliness as they are utilized. [ ]

They are in abundance [ ]

7) State the product(s) that the solid waste identified in question (4) is used to produce…… …….……

8) How many tones /Kilograms/grams of solid waste identified in question (4) do you recycle for manufacturing purposes within a day? Tick your appropriate one

5 to 10 tones [ ]

11 to 15 tones [ ]

16 to 20 tones [ ]

Over 20 tones [ ]

Other [ ] please, specify …….

9) How many tones /kilograms /grams of the solid waste categorized in question (5) do you gather from public places into your firm within a day? Tick your appropriate one

5 to 10 tones [ ]

11 to 15 tones [ ]

16 to 20 tones [ ]

Over 20 tones [ ]

Other [ ] please specify ……..

Section C: Socio –Economic Benefits of Solid Waste Utilization

10) What is your impression about the number of employees recruited by your organization?

10 and less [ ] 11-49 [ ] 50 and over [ ] Tick the appropriate one

11) What is your assessment of the level of profit generated daily by your enterprise/ organization? Low [ ] moderate [ ] High [ ] tick

12) Taking into consideration the level of profit generated, is the operation of your organization economically viable?

Very viable [ ] viable [ ] Not viable [ ] Not very viable [ ] Tick your choice

b) Give reasons for your answer.

……

……

…… ……

13a) does your organization offer special incentives to employees

Yes [ ] No [ ] Tick

b) If Yes, please list them

……

……

……

14) Does your organization offer social services to the community you operate? Yes/No. Specify

b) Please give reasons for your answer

……

……

……

5) Does your organization offer special services to state institutions or government?

Yes [ ] No [ ] Tick

b) Please give reasons for your answer

……

……

……

Section D: environmental implications

16a) In your view, indicate whether the activities in your organization ensure the improvement of environmental quality

Yes [ ] No [ ]

b) Outline reasons why in your opinion, the activities in your organization contribute to the improvement of environmental quality.

……

……

17) How do you rate the extent to which your activities improve environmental quality ? Tick your appropriate choice

Very unsatisfactory [ ] Unsatisfactory [ ] Satisfactory [ ] Very satisfactory

18. Outline three way(s) by which activities of your organization threatens environmental quality in order of seriousness

1.……

2…….

APPENDIX C

UNIVERSITY OF CAPE COAST

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

Observation checklist for solid waste recycling enterprises

This checklist has been designed to help the researcher collect data in the form of identifying some tangible items associated with recycling of solid waste so as to confirm data collected by means of questionnaires, interview schedules and in-depth interviews.

Name of recycling enterprise: ……

The researcher indicated **P** for present and **A** for absent within the space provided for present and absent corresponding to items specified below.

ITEM	PRESENT	ABSENT
Type of solid waste recycled.		
Recycling machines/equipments/ composting chambers		
Products derived from recycling		
Instrument for measuring quantity of solid waste gathered daily		
Instrument for measuring quantity of solid waste recycled daily		
instrument for testing and identifying gases emitted		

APPENDIX D

UNIVERSITY OF CAPE COAST

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

In-depth Interview Guide for Regulatory Bodies and NGOs on Solid Waste Recycle

SECTION A: Demographies /Characteristics of Respondent

1. Name of your Organization
2. Gender of interviewee. Male/Female
3. Educational level
4. What is your rank in the Organization? Senior/Intermediate/Junior Staff.

SECTION B: **Identification and the Rationale of Solid Waste Recycling.**

5. In your opinion, how would you describe solid waste?
6. What solid waste (s) do recycling enterprises recycle?
7. Which categories of solid waste (s) do those mentioned in question (6) above belong?
8. Explain why recycling enterprises make use of solid wastes as raw materials instead of utilizing virgin raw materials.

SECTION C: The Extent of Government Participation in Solid Waste Recycling

9. Is your organization a private or state owned enterprise?
10. Does the government release funds or provide any form of assistance into your organization solely for recycling activities.

11. Mention any known recycling plant in Accra Metropolitan area owned fully or partly by the state?
12. How does your organization collaborate with other regulatory bodies in controlling the activities of recycling enterprises?

SECTION D: Socio-Economic Benefits of Solid Waste Recycling

13. What are some of the products derived from the recycling of solid wastes?
14. How will you rate the number of employees recruited by recycling enterprises
15. What is your assessment of the level of profit generated by recycling enterprises?
16. Is the operation of recycling companies economically viable?
17. What are some of the incentives offered by recycling enterprises to their employees
18. What are the social and economic services that recycling enterprises offer to the community in which they operate.
19. What are the social and economic service that recycling enterprises offer to the state?

SECTION E: Recycling Rate and Environmental Implications.

20. In your estimation, what is the average amount of solid wastes generated daily in Accra Metropolitan area?
21. What amount of the daily generated solid wastes goes into recycling?
22. To what extent do the activities of recycling enterprises contribute towards the improvement of environmental quality?
23. To what extents do the activities of recycling enterprises threatens environmental quality?

APPENDIX E

UNIVERSITY OF CAPE COAST

CAPE COAST, GHANA

DEPARTMENT OF GEOGRAPHY & REGIONAL PLANNING

Our Ref: **GRP/S.4**

Your Ref:

UNIVERSITY POST OFFICE
CAPE COAST, GHANA
WEST AFRICA

20th December, 2012

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

LETTER OF INTRODUCTION

Dear Sir/Madam,

The holder of this letter, Mr. Samuel Donkoh is an M.Phil student of the Department of Geography and Regional Planning, Faculty of Social Sciences in the University of Cape Coast. His research topic is:

Assessment of solid waste utilisation as a means of improving environmental quality in Accra Metropolitan Area.

I shall be very grateful if you would offer him any facility and help at your disposal to enable his access any information that would be useful for his work.

By this letter we have officially asked the holder to approach you with the assurance that you would provide any help you can.

Thank you.

for

Dr. K. Barima Antwi
Head

APPENDIX F

24. ***Table 11: Analysis of observation of specific items present in registered recycling enterprises in Accra Metropolitan area***

Item / Recycling enterprise	Solid waste	Recycling equipment	Recycled products	Solid waste measuring Instrument	Instruments for measuring recycled quantity	Gas testing equipment	Total items present	Total items Absent
ZCF	Present	Present	Present	Present	Present	Absent	5	1
ACF	Present	Present	Present	Absent	Absent	Absent	2	4
BNARI	Present	Present	Present	Present	Present	Present	6	-
TOP	Present	Present	Present	Present	Present	Present	5	1
ATC	Present	Present	Present	Present	Present	Absent	5	1
DTC	Present	Present	Present	Present	Present	Absent	5	1
ENV	Present	Present	Present	Present	Present	Absent	5	1
BP	Present	Present	Present	Present	Present	Absent	5	1
AGY	Present	Present	Present	Absent	Absent	Absent	3	3

Source: Field data (2013)

APPENDIX G

The 3Rs technologies and techniques of solid waste utilization in Japan.

Category of 3Rs Technologies			
Major Division	Division of Technologies		Remarks
<u>Reduce</u>	1	Resource saving	Resource saving design Resource saving production process. Development of materials contributing to resource saving
	2	Extension of durable periods of products	Development of long-life products and parts. Development of repair and maintenance technologies
	3	Reduction of wastes	Development of reduction technologies for wastes e.g. reduction of fly's ash volume by melting
Reuse	4	Easy dismantlement of products	Design for easy dismantlement of products Enhancement of dismantlement technologies
	5	Diagnosing life cycle of products	Enhancement of inspection technologies for used products and parts. Development of evaluation of product's life expectancy
	6	Other reuse technologies	Management of usage records of products Enhancement of functional recovery of

			products Segregation of used parts Development of materials with less blemish, blot and wear
	7	Intermediate treatment - shredding technology -	
<u>Recycle</u>	8	Recovery technology -Resource recovery (except fuel recovery)	Recovery by extraction (Recovery of raw materials such as iron, aluminium, plastic, glass, etc) Recovery by conversion (Recovery of fixed carbon, compost, fodder, etc which are converted from used products or by-products)
	9	Recovery technology - Fuel recovery -	
	10	Recovery technology -Thermal energy recovery -	Utilization of heat produced by incineration
	11	Other recycle technologies	
Appropriate Disposal Technologies			Waste detoxification disposal technologies .Reduction of exhausted hazardous substances, Ensuring safety for waste disposal

Common fundamental Technologies	Inverse manufacturing Life cycle assessment (LCA Record management

Source: Global Environment Centre Foundation, 2006

APPENDIX H

Transcript of Interviews

IN-DEPTH INTERVIEW WITH

PRINCIPAL PROGRAMME OFFICER, EPA

Q. Name of Organisation:

A. Environment Protection Agency (EPA)

Q. Gender of Interviewee: Male/Female

A. Female

Q. Educational Level:

A. Tertiary

Q. What is your rank in the organisation?

B. Senior staff member

Q. In your opinion, how would you describe solid waste?

A. This refers to municipal solid waste, household waste, market waste, and some wastes from institutions some of which are biodegradable whiles others are non-degradable. Biodegradable ones are the solid wastes that decompose by the bacteria in them, whiles non-degradable ones cannot decompose naturally.

Q. What solid waste(s) do recycling enterprises recycle?

A. sachets, broken plastic buckets, food wastes

Q. Which categories of solid waste do those mentioned in question (6) above belong?

A. Water sachet plastic mostly recycled in Accra Metropolitan area belongs to the plastic waste category, while food waste belongs to the organic waste category.

Q. Explain why recycling enterprises make use of solid wastes as raw materials

A. To promote environmental cleanliness through the removal of the solid wastes

Q. Is your organisation private or state owned enterprise

A. State-owned

Q. Does the government release funds in the form of loans/grants/subsidies into your organisation solely for recycling activities

A. No funds available for that

Q. Mention any known recycling plant in Accra Metropolitan Areas owned fully or partly by the state?

A. No known example

Q. How does your organisation collaborate will other regulatory bodies in controlling the activities of recycling enterprise?

A. First of all, we jointly apply EPA, Act 490 (1994) and L1 462, 1999. In addition, we adopt other strategies such as co-ordinations, dialogue through discussions, persuasions, and above all organising seminars to equip ourselves with the requisite knowledge and skills for guiding the activities of recycling enterprises

Q. What are some products derived from the recycling of solid waste?

A. They manufacture pellets, plastic wares such as plastic dustbins, plastic chairs, tables, etc.

Q. To what extent are you impressed about the number of employees recruited by recycling enterprises?

A. Moderate. There are both casual and permanent workers in all recycling enterprises

Q. What is the level of profit generated by recycling enterprises?

A. Moderate. The level of profit is generated from the sale of the products in which the rate of purchase is moderately fast at times.

Q. Is the operation of recycling enterprise economically viable?

A. Viable. The reason is that the solid waste that is used as raw materials is always available in our society and also cheap to obtain. Demand for products is always on the increase.

Q. What are some of the incentives offered by recycling enterprise to their employees?

A. They arrange with state institutions such as EPA to offer technical advice to employees so they can work within acceptable environmental standards. Also, some of them grant loans and scholarships to the wards of workers.

Q. What are the social and economic services that recycling enterprises offer to the community in which they operate?

A. They offer employment to people either as permanent or casual workers.

Q. What are the social and economic services that recycling enterprises offer to the state?

A. Solid waste recycling generate tax revenue and offer employment.

Q. In your estimation, what is the average amount of solid wastes generated daily in Accra Metropolitan area?

A. The generated amount is about 2000 tonnes daily

Q. What amount of the daily generated solid wastes goes into recycling?

A. No idea

Q. To what extent do the activities of recycling enterprises?

A. The removal of various forms of solid wastes such as plastic wastes, organic waste, etc. from the environment keeps the environment clean, reduce solid wastes and other toxic substances on the earth's surface and thereby improve environmental quality.

Q. In your judgement, explain how the activities of recycling enterprises in Accra Metropolitan area pose threats to the environment?

A. The aerobic decomposition of organic waste during the making of compost involves the emission of poisonous gases like ammonia and sulphur dioxide pose threats to the quality of the environment.

IN-DEPTH INTERVIEW WITH DIRECTOR IN CHARGE OF SOLID WASTE (AMA)

Q. Name of your organisation

A. Waste Management Department, AMA

Q. Gender of Interviewee. Male/Female:

A. Male

Q. Educational Level

A. Diploma (Tertiary)

Q. What is your rank in the organisation? Senior/Intermediate/Junior

A. Senior Staff member

Q. In your opinion how would you describe solid waste?

A. Solid waste is any waste in the solid form

Q. What solid waste (s) do recycling enterprises recycle?

A. Water sachet plastics

Q. Which categories of solid waste(s) do those mentioned in question (6) above belong?

A. Plastics

Q. Explain why recycling enterprises make use of solid wastes as raw materials instead of utilizing raw materials

A. Solid waste recycling removes solid waste from the environment and promotes environmental sanitation.

Q. Is your organisation a private or state owned enterprise?

A. State owned

Q. Does the government release funds in the form of loans/grants/subsidies into your organisation solely for recycling activities?

A. Not at all

Q. Mention any known recycling plant in Accra Metropolitan area owned fully or partially by the state

A. None

Q. How does your organisation collaborate with other regulatory bodies in controlling the activities of recycling enterprises?

A. Through workshops and seminar waste management workers are equipped with knowledge and skills and are sensitized and made responsible in dealing with the solid waste menace.

Q. What are some of the products derived from the recycling of solid wastes?

A. Plastic bucket, plastic chairs and pellet for further production.

Q. To what extent are you impressed about the number of employees recruited by recycling enterprises?

A. Employed recruitment is high and many people are into recycling business since for each recycling enterprise apart from the permanent workers more people are contracted to collect solid waste for the enterprises causing the number of people to be high.

Q. What is your assessment of the level of profit generated by recycling enterprises?

A. The profit level is quite high. Apart from the recycling companies who make enough profit from the sale of their products, the casual workers also make profit from the sale of bags of plastic wastes and organic wastes.

Q. Is the operation of recycling companies economically viable?

A. Very viable since most of the companies produce household utensils, compost etc. offer employment to people in communities and easily obtain cheap source of raw materials.

Q. What are some of the incentives offered by recycling enterprises to their employees?

A. They offer bonuses if they are able to exceed the target of production. In addition some of them offer scholarships to the wards of their employees , soft loans, IOU, T & T etc.

Q. What are the social and economic benefits that recycling enterprises offer to the community in which they operate?

A. Employment to people and producing household wares

Q. What are the social and economic benefits that recycling enterprises offer to the state?

A. Payment of tax revenue and employment

Q. In your estimation what is the average amount of solid wastes generated daily in Accra Metropolitan area?

A. 2500 tonnes per day. However, about 1200 tonnes of the generated solid waste is gathered from the environment by AMA and recycling enterprises

Q. What amount of the daily generated solid wastes/goes into recycling?

A. It is important to note that plastic waste constitute 6% of the weight of solid waste and 20% of the volume of solid waste generated daily. However the plastic component of the solid waste recycled daily constitute 5% of the total mass of solid waste generated daily and which is about 125 tonnes.

Q. To what extent do the activities of recycling enterprises contribute towards the improvement of environmental equality?

A. It results in the removal of various types of solid wastes from the environment, and by so doing reduce sachets and other solid wastes from the environment.

Q. To what extent does the activities of recycling enterprises threatens environmental quality.

A. Gases are emitted during the process of aerobic compositing and some of these gases are poisonous such as ammonia, sulphur dioxide, etc. water used in the washing of sachet becomes contaminated and when poured on the soil degrades it.

IN-DEPTH INTERVIEW WITH SENIOR ENVIRONMENTAL AND SAFETY COMPLIANCE OFFICER, GLOBAL COMMUNITIES.

Q. Name of your organisation

A. Global Communities (formerly Community Housing Foundation)

Q. Gender of interviewee. Male/Female:

A. Male

Q. Educational level

A. Masters degree (Tertiary)

Q. What is your rank in the organisation?

A. Senior Staff member

Q. In your opinion, how would you describe solid waste?

A. Solid waste is described as waste generated from household, streets, non-hazardous solid waste from industries, institutions etc and excludes all liquid waste as well as semi-solid wastes such as sludge and human excreta

Q. What solid waste(s) do recycling enterprise recycle?

A. Water sachets, market waste and food waste, fridges, engines etc. sheet etc

Q. Which categories of solid wastes do you put those mentioned in question (6) above?

A. Sachet belongs to plastics; market or food waste belongs to organic, condemned fridges, engines belong to metal scraps

Q. Explain why recycling enterprises make use of solid wastes as raw materials instead of utilizing virgin raw materials

A. Basically, the rationale of solid recycling is to remove filth including all manner of solid wastes from the environment in order to keep the environment clean.

Q. Is your organisation a private or state owned enterprise?

A. It is a privately-owned enterprise. However, it is not just a privately owned but a non-governmental organisation (NGO). This means that unlike ordinary private enterprise that are basically in for profit, our NGO render services to the society not with the intention of making profit.

Q. Does the government release funds or provides any form of assistance into your organisation solely for recycling activities?

A. Government assist recycling enterprises by using district cleansing officers to offer technical advice to recycling workers on how to safely handle solid waste.

Q. Mention any known recycling plant in Accra Metropolitan area owned fully or partly by the state.

A. The government offers various assistance, but partly owns only one recycling enterprise.

Q. How does your organisation collaborate with other regulatory bodies in controlling the activities on recycling enterprises?

A. By organising joint seminars, discussions, conferences and for a to equip ourselves with the requisite knowledge and skills so as to offer technical and consultancy services to recycling companies and guide them to operate within the required environmental laws.

Q. What are some of the products derived from the recycling of solid wastes?

A. Compost, plastic wares, such as bowls, dustbins, buckets etc.

Q. What is your impression about the number of employees recruited by recycling enterprises?

A. High. Apart from the permanent workers, casual workers supply composing facilities with market and food wastes whiles others supply plastic recycling enterprises with bags of water sachets waste, casual workers do so in exchange of money.

Q. Is the operation of recycling companies economically viable?

A. It is very viable as long as they offer employment, provide products to consumers due to high demand and continuously obtain cheap and abundant source of raw material.

Q. What are some of the incentives offered by recycling enterprises to their employees?

A. They offer bonuses to their employees when they exceed estimated production level, offer them in-service training on business and management and skills in recycling activities for effective work as well as supply employees with some of the companies products from time to time.

Q. What are the social and economic benefits that recycling enterprises offer to the community in which they operate?

A. Recycling enterprises offer employment and recycling products such as compost to close community members.

Q. What are the social and economic benefits that recycling enterprises offer to the state?

A. Contribute revenue to the government through the payment of taxes

Q. In your estimation, what is the average amount of solid wastes generated daily in Accra Metropolitan area?

A. About 2,500 tonnes

Q. What amount of the daily generated solid wastes goes into recycling?

A. No idea.

Q. To what extent do the activities of recycling enterprises contribute towards the improvement of environmental quality?

A. Firstly, they provide aesthetic view. Removal of sachet plastics, metal scraps, organics and forms of solid wastes makes the environment clean attracts tourists and promotes foreign investment. In addition, they prevent land degradation leaving sachet plastics, metals scraps, organics etc on the environment has the potential of turning into toxic substances that enter the land or water and contaminate them. Also the removal of solid waste prevents chocking of gutters and hence flooding and prevent the emission of some poisonous gases from some solid waste substances when left on the ground.

Q. In your judgement, to what extent do the activities of recycling enterprises pose a threat to the environment?

A. Gathered sachets, that are brought into recycling enterprises are contaminated with other unwanted materials such as dry cells, etc. Water used to wash the sachets becomes dirty and toxic and when thrown into the land or into water bodies, introduce toxic substances into land and water which affect plant growth and kill aquatic animals respectively. Also, in the process of aerobic composting, poisonous

gases such as ammonia and sulphur dioxide gases are released and are injuries to humans respiratory systems.

INTERVIEW SCHEDULE WITH MANAGING DIRECTOR AT ZEKORA COMPOSTING FACILITY

Q. Name of your organisation

A. Ga-Mashie Aerobic Composting facility or Zekora Composting facility.

Q. Gender of Interviewee:

A. Female

Q. Educational level

A. Secondary

Q. What is your rank in the organisation?

A. Senior Staff member

Q. In your opinion how would you describe solid wastes?

A.

Q. What solid(s) waste does your organisation utilize for production?

A. Food leftovers and sawdust

Q. What is the categories of solid waste(s)used by your organization in production?

A. Food waste belongs to the category of organics, while sawdust belong to wood waste category

Q. Explain why your organisation utilizes solid wastes as raw materials instead of utilizing virgin ones?

A. Solid wastes utilization promotes environmental cleanliness. The mixing of the sawdust with the food waste produces carbohydrates in the decomposing waste and helps in speeding up the manuring process. In addition the use of organic waste also reduce the cost of production.

Q. Is your organisation a private or state owned enterprise?

A. Is privately owned

Q. Does the government release funds or provide any form of assistance into your organisation solely for recycling activities?

A. AMA is pleased with our work and offer technical advice on how to handle solid waste such that it does not affect us and the environment.

Q. Mention any known recycling plant in Accra Metropolitan area owned fully or partially by the state.

A. BNARI

Q. What are some of the products derived from the recycling of solid wastes?

A. We obtain a type of organic fertilizer called compost from the recycling of food waste.

Q. What is your impression about the number of employees recruited by our organisation?

A. The number is low since the employees are only six

Q. What is your assessment of the level of profit generated daily by your

enterprise?

A. Moderate

Q. Taking into consideration the level of profit generated, is the operation of your organisation economically viable? It is viable because

A. I t is viable because compost for farming yields bumper harvest and encourage users to consistently purchase compose for farming.

Q. What are some of the incentives offered by recycling enterprises to their employees?

A. The incentives offered by our enterprise to employees are registering employees for NHIS, providing money for employees' medical care and offering free soap or dettol for bathing.

Q. What are the social and economic benefits that your enterprise offers to the community in which it operates?

A. We offer employment to the people, remove organic wastes from the environment and provide compost to farmers for farming.

Q. What are the social and economic benefits that your enterprise offer to the state?

A. Contribute towards the reduction of unemployment as well as improve agriculture by ensuring food security. Food security also improves the health status of the citizens.

Q. How many tonnes/kilograms of solid wastes utilized by your enterprise do you gather from public places into your company daily?

A. The organic waste are put into chambers. Each tonnes hold 8tonnes of solid wastes when filled to full capacity using a period of one week. Since the chambers are eleven our enterprise can hold a total capacity of 88 tonnes food/ waste market waste using a period of one week. On

daily basis, we can hold about 12.3 tonnes of organic waste at our aerobic composting facility.

Q. How many tonnes/kilograms of organic waste is recycled into compost daily?

A. The recycling of food wastes into compost is natural which is through the process of decomposition by bacteria facilitated by the presence of oxygen that is aerobic. The maturation of the compost takes at least two months and after two months 14300kg that is 14.3 tonnes of compost is realized out of the 88 tonnes of organic wastes. This worked out on daily basis meant that 255.4kg of compost or 0.3 tonnes of compost was produced daily.

Q. In your view, indicate whether the activities in your organisation ensure the improvement of environment quality

A. Removes solid wastes such as sawdust and large food waste from hotels, restaurants, chop bars, markets, household and free such places of the stench and negative health hazards.

Q. How do you rate the extent to which your activities improve environmental quality?

A. Very satisfactorily because we are able to remove 88tonnes of food wastes every week and on daily basis remove 12.3 tonnes of organic wastes from the environmental making it healthy and safe.

Q. Outline three ways by which activities of your organisation threatens environmental quality in order to seriousness.

A. Gases such as ammonia, carbon dioxide and methane gases are emitted during aerobic composting and these cause global warming. Leachate or contaminated liquid also flow out of the organic wastes in the process of compositing and this leachate contain toxic substances like

nitrate, cyanide and sulphuric acid which pollute water bodies and land into which they come into contact.

INTERVIEW SCHEDULE ON SOLID WASTE RECYCLING WITH WITH SENIOR WORKER AT AVENOR COMPOSTING FACILITY

Q. Name of organisation

A. Avenor Aerobic Composting Facility

Q. Gender of Interviewee

A. Male

Q. Rank in the Organisation

A. Senior Staff member

Q. What solid waste do you recycle?

A. Vegetable waste, food waste

Q. Which category of solid waste does the one stated in question (4) above fall?

A. Organic

Q. Why do you utilize solid waste as raw materials rather than virgin one?

A. They are less costly to utilize and they bring about environmental cleanliness as they are utilized

Q. Is your organisation private or state owned enterprise?

A. A private owned enterprise

Q. Does the government release funds in the form of loans/grants/subsidies into your organisation solely for recycling activities?

A. No money is released in any form for recycling

Q. Mention any known recycling plant in Accra Metropolitan area partly or fully owned by the state?

A. To the best of my knowledge, the government owns only one recycling enterprise.

Q. What are some of the products derived from the recycling of the solid wastes you utilized?

A. Compost or organic fertilizer.

Q. What is your impression about the number of employees recruited by your organisation?

A. Low, since we are only four in number.

Q. What is your assessment of the level of profit generated daily by your enterprise?

A. It is high. However, sales are not on daily basis, but annual or seasonal.

Q. Is the operation of your organisation economically viable?

A. It is viable since less electricity is utilized; cost of operation quite low few workers are paid and enough profit is obtained or at least breakeven.

Q. What are some of the incentives offered by your enterprise to its employees?

A. They are offered detergents and a reliable income though not monthly.

Q. What are the social and economic benefits that your enterprise offer to the community in which it operates?

A. First of all, it offers employment, it provides compost for farmers and train people to acquire knowledge and skills in compost making.

Q. What are the social and economic benefits that recycling enterprise offer to the state?

A. It helps in the creation of jobs through training in compost making. This also contributes to the reduction of unemployment problem.

Q. How many tonnes/kilograms/grams of solid wastes is recycled by your enterprise daily?

A. The recycling of food waste into compost does not take a day. The process here is by bacterial decomposition which takes place aerobically that is in the presence of abundant air. The workers only facilitate the process by stirring every three days. After 8 – 10 weeks 4.8 tonnes of compost is formed, and this worked on daily basis will mean that about 86kg of organic waste is recycled into compost on daily basis.

Q. Explain how the activities of your enterprise contribute towards the improvement of environmental quality?

A. As we remove food and market wastes from the environment into our facility, the environment is kept clean.

Q. Qutline three ways by which recycling activities of your enterprise threatens environmental quality?

A. During the aerobic decomposition of food waste, greenhouse gases such as ammonia, carbon dioxide and methane gases are emitted which in large concentrations cause green house effects and global warming. However, when the

organic waste is stirred on daily bases, emission rate is very low and global warming and greenhouse effects are not experienced much.