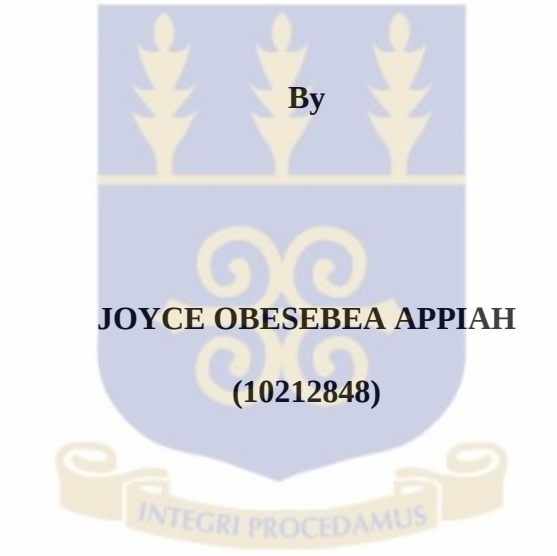
UNIVERSITY OF GHANA

TURNING HOUSEHOLD SOLID WASTES INTO RESOURCES FOR POVERTY ALLEVIATION: A CASE STUDY OF ABOKOBI IN THE GA EAST MUNICIPALITY

THESIS SUBMITTED TO THE INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH



By

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IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MA DEVELOPMENT STUDIES DEGREE

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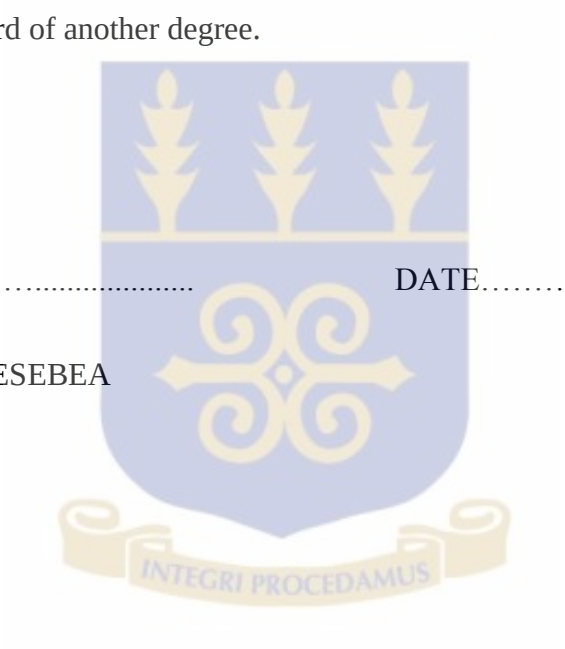
DECLARATION

I, Joyce Obesebea Appiah, hereby declare that except for references to other people's work which I have duly acknowledged, this thesis is the result of my own research carried out at the Institute of Statistical Social and Economic Research (ISSER), University of Ghana under the supervision of Professor Kwabena Asomanin Anaman.

I further affirm that this thesis has neither in whole nor in part been previously presented elsewhere for the award of another degree.



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ABSTRACT

The study was a randomly-sampling based survey of 165 respondents living in three suburbs of Abokobi – low-income, middle-income and high-income areas. It was undertaken to identify the types of solid wastes generated by householders, ascertain the solid waste management practices of households, assess the level knowledge of households with regards to the various methods for converting solid wastes into resources for their benefit, and assess the current practices of converting solid waste into resources. The study further assessed the acceptability of new waste disposal methods and established the factors influencing the levels of income currently earned through conversion of solid wastes into resources.

The results indicated that 12 different types of solid wastes were generated by householders with food and plastic wastes being the dominant ones. The most popular methods of disposal of solid wastes were dumping of such wastes into public containers and burning the wastes around the home; these two methods were especially favoured by people living in the low-income and middle-income suburbs. Waste collection services offered by companies was also a major disposal method used by slightly over one-third of households, especially those living in the high-income suburb. Respondents generally had a low level of knowledge concerning the methods available for converting solid wastes into resources. However, given the right information and conditions, more than 90% of the respondents were willing to accept the alternative methods of converting waste into a resource such as waste reduction, reuse, recycling and composting. It was established that older women aged over 50 earned more money from collecting household plastic wastes than other groups of people.

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DEDICATION

This thesis is dedicated to my parents, Mr Emmanuel Appiah Acheampong and Madam Gladys Agyakwa for their enormous sacrifices made towards my education and professional attainment.

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LIST OF ABBREVIATIONS

AMA	Accra Metropolitan Assembly
CBA	Cost Benefit Analysis
CBOs	Community- Based Organisations
CEWEP	Confederation of European Waste-to- Energy Plants
DESSAPs	District level Environmental Sanitation Strategies and Action Plans
EEA	European Environmental Agency
EHSD	Environmental Health and Sanitation Department
EPA	Environmental Protection Agency
EPN	Environmental Paper Network
ERDF	European Regional Development Fund
EU	European Union
ESICOME	Expanded Sanitary Inspection and Compliance Enforcement
GDP	Gross Domestic Product
GEMA	Ga East Municipal Assembly
GIM	Ghana Innovation Market Place
ITDG	International Technology Development Group
ISWA	International Solid waste Association
ISWM	Integrated Solid Waste Management

KMA	Kumasi Metropolitan Assembly
KNCPC	Kenya National Cleaner Production Centre
LCA	Life Cycle Analysis
MDG	Millennium Development Goal
MEST	Ministry of Environment, Science and Technology
MLGRD	Ministry of Local Government and Rural Development
MMDA	Metropolitan Municipal and District Assemblies
MPCU	Municipal Planning Coordinating Unit
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste management
NESP	National Environmental Sanitation Policy
NESPoCC	National Environmental Sanitation Policy Co-ordination Council
NYDEC	New York Department of Environmental conservation
OECD	Organisation for Economic Cooperation and Development
RCRA	Resource Conservation and Recovery Act
SEPA	Scotland Environmental Protection Agency
TESDP	Town and Environment Sanitation Development Plan
UNCED	United Nations Conference on Environment and Development

UNEP	United Nations Environmental Program
USA	United State of America
USAID	United State Agency for International Development
USEPA	United State Environmental Protection Agency
WHO	World Health Organisation
WIEGO	Women in Informal Employment Globalizing and Organizing
WMD	Waste Management Department
WtE	Waste to Energy

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The World Bank has warned of a fast rising and dangerous generation of waste worldwide. It asserts that the garbage humans produce and dispose is rising so fast that the growing urban population will be producing about three times waste as it produces now by 2050. It is estimated that, the 3.5 million tonnes of waste produced daily worldwide as at 2010 will rise to six million tonnes per day by the year 2025 (World Bank, 2013). Though a lot of advancement have been made, WHO (2013) argue that it is not likely for the World to meet the United Nations Millennium Development Goal (MDG) 7, Ensuring Environmental Sustainability's target C on sanitation, which aims at halving the proportion people without access to improved sanitation by the year 2015.

With the world's shift towards a consumer-oriented culture, where the world's economy's success rests largely on how many things people buy, the issues with waste seems like it will never end. This is because product acquisition and its resulting waste creation in some ways appear to be a natural act of life by humans. The pursuit of development is also accompanied by rise in the material living standards of people and changing trends in demand for goods and services.

These factors, as posited by Oteng–Ababio (2012) contributes to the proportionate increase in per capita waste generated and increasing levels of improperly disposed waste. With the growing global population, solid waste management is becoming a challenge mostly for developing countries which seem unable to control population growth and are facing very

high rural-to-urban migration and rapid urban growth. As noted by Dinye (2006), Chaplin (1999) confirms that the crucial challenge confronting many developing countries undergoing urbanisation is the issue of sanitation and waste management.

Coffie (2010), also reports that this problem poses a bigger challenge for Africa due to increasing population growth, rapid urbanization and the fact that the continent seems to have become the landfill sites for some advanced countries. USAID, (2009) as noted by Alhassan (2013) reports that all over Sub-Saharan Africa, solid waste generation in most countries exceeds the capacity of collection. The cost and difficulties of managing waste are also increasing continually. Shubeler (1996) also noted that municipal solid waste management (MSWM) is a major responsibility of governments normally taking up between 20 to 30% of municipal budget in developing countries. Despite this huge budget, many countries collect less than generated.

The reality of this problem cannot be lost on Ghana, particularly in its major cities which are wallowing in waste. Heaps of waste are found at many places with land fill sites continuously running out of space for new waste generated while other options are fast depleting. This poses serious consequences for the public service including pressure on budget of government, growing demand for space consumed by waste as in landfill sites and the environmental, health and other social problems associated with improper waste management.

There is thus the urgent need for efficient and alternative ways of generating and managing waste. The World Bank proposes that consuming fewer resources and technology can bring the high waste creation down leading to enormous environmental and socio-economic benefits (World Bank, 2013). Currently, some cities have taken the lead in the waste reduction agenda. These include San Francisco's ambitious goal of "zero waste" by 2020 and the Japanese city

of Kawasaki's current diversion of waste into energy that exceeds the city's current waste generation level (World Bank, 2013).

Proper waste management present great opportunities, not only to do away with the harmful consequences that comes with waste, but also to recover resources, gain social, economic and environmental benefits and to take a step on the road to a sustainable future. Decision makers, whose responsibility are to plan and make policies must be adequately informed to develop integrated waste-management strategies adapted to the needs of citizens (Guerrero *et al*., 2013). Making and applying informed decisions about waste management leads to waste providing economic value.

However, such waste management practices have not always been a high priority for local and national policy makers as well as planners, especially in the Global South. Rather, issues with more social and political urgency might take precedence and leave little budget for waste issues (Memon, 2010). Thus, in many cities around the world, functioning policy measures that are effective have been elusive and the resources invested in the sector has proven not to be sufficient (Konteh, 2009).

1.2 Problem Statement

The increasing global waste management problems are not different from the situation in Ghana. The problem is even critical to the country particularly in the urban areas including the municipalities and metropolises which are undergoing increasing levels of consumption as a result of economic, population and urban growth. Ghana is currently stressed from the impact of wastes.

Waste has become a dilemma for the Ghanaian economy and health institutions, as well as environmental agencies so much that on 31st October, 2014, the President of the Republic declared every first Saturday of the month as a National Sanitation Day to address the embarrassingly poor sanitation situation of the country (Daabu, 2014). The country is currently overwhelmed with so much waste that government and private agencies have not been able to address the problems of waste adequately, particularly, in the major cities in the country (Selby, 2010).

Though there have been series of efforts by successive governments to help curb the problem of waste over years, the situation has deteriorated. Solid waste presents a major challenge in Accra particularly among residents living within highly populated areas and low income communities. As at 2013, Accra was generating about 2,500 tonnes of solid waste daily (Arku, 2013). Solid waste management constitute a serious problem in Ghana. Most municipalities do not collect the total amount of waste generated and of the waste collected, just a percentage receives proper disposal. The insufficient collection and impropriate disposal of solid waste represent a source of pollution that poses risk to human health and the environment since the health status and productivity levels of the population are greatly influenced by the state of the environmental sanitation condition in which they live.

Tema Municipal Assembly (2010) suggests that the problem of waste management in Ghana is a combination of factors prominent among which are poor spatial planning, inadequate and inappropriate equipment, inadequate expertise and underdeveloped private sector. The focus on waste management has been the centralised bureaucratic and conventional collection, transporting and dumping of waste in light of the inadequate resources and the overwhelming

rate of waste generation to the neglect of other alternative means like pre-cycling, recovery of waste for reuse and recycling which could further lead to income generation particularly by households.

The speed of waste generation and management in the Ga East Municipality is a matter of great worry to the Assembly. The growing inflow of people into the municipality as a result of urbanisation has led to an alarming rate of waste generation. The assembly estimates about 385 tonnes of solid waste generated per month (Ga East Municipal Assembly, 2014). However, only about 261 tonnes (67%) are collected. The 33% that is left builds up presenting various forms of health and environmental hazards

The solid waste management situation at Abokobi, the study area, reflects the above-mentioned challenges alongside the health and environment problems. The Municipal Planning Coordinating Unit (MPCU) of the Ga East Municipal Assembly based at Abokobi estimated the population of the municipality, using the 2010 population and housing census data, to be about 450,200 as at 2013 with 51% males and 49% females, and growing at an inter-censal rate of about 4.2% mainly as a result of migration inflows.

The estimated population density of 1,214 persons per square kilometre (sq. km) is much higher than the national density of 79.3 persons per sq. km and the regional density of 895.5 persons per sq. km (Ga East Municipality Annual Report for 2013). With such an increase in the number of people in the municipality, there is great likelihood that has led the increased waste generation and disposal requiring informed research to solve the problems pertaining to waste management and the developmental problems associated with it.

The poor sanitary condition of the community led to the inauguration of the seven (7) year strategic Town and Environment Sanitation Development Plan (TESDP), purposively for setting out strategy for improving Abokobi's environmental conditions by gradually and incrementally reducing the poor environmental burden due to indiscriminate disposal and littering of refuse (GEMA, 2008). The only landfill site in the municipality which serves other parts of the Greater Accra region also frequently runs out of space for new waste intake with its location potentially threatening the health of the people who live around it.

Driven mainly by the health and environmental concerns associated with solid waste management in Ghana's urban areas, a lot has been documented on the practices, problems, and challenges that solid waste poses without much interest in the possible resources generation from waste (Monney, 2014).

However, solid waste generated, particularly, domestically by households is increasingly drawing attention worldwide. The waste is generated as a consequence of household activities such as cleaning, cooking, packaging and large usage of plastics and other materials. In this era where waste is seen as a resource, waste management should not pose as much problem as it poses for Ghana in view of the economic challenges facing the country. However, much research has not yet been carried out to identify the practices and strategies by households to turn the menace of waste to wealth generation.

Research into turning waste into resources for development is even more acute to Abokobi, the study area, due to increasing population and low socio economic standards of most of the people within the community and the very little information on the subject. It is past time the country's view of waste as a menace be diverted and explored, the potentials of waste as a

major resource for national development. As a lower-middle-income country striving to attain a high income status, the glaring potentials of waste in wealth creation cannot be over emphasised.

There is also the urgent need of studies into why the country and in particular the MMDAs have not yet tapped adequately into waste as resource for development by exploring and taking advantage of the potentials of waste. This will help promote a cleaner environment for healthy living and reduce the huge expenditure associated with sanitation and filth related health problems. This will also help the country gain from benefits of waste rather than investing in and treating waste as a menace. After all 'resources are not, they become' (Zimmermann, 1951 as cited by Tuokuu (2009), through proper human interventions.

1.3 Objectives of the Study

At the backdrop of the above background, the overall objective of the study is to assess how households are converting domestic solid waste into resources for poverty reduction using Abokobi as a case study.

The specific objectives of the study included the following:

1. To identify the types of solid wastes generated by householders in the study area.

2. To examine solid waste management practices by households.

3. To assess the level of knowledge of households with regards to the various methods for converting solid wastes into resources for their benefit.

4. To assess households practices of converting solid waste into resources.

5. To assess the acceptability of new strategies to use household solid waste as resources by households.

6. To establish the factors influencing the level of income received by householders for collecting wastes and converting them into resources to earn money.

1.4 Research Questions

Thus, in relieving poverty by securing the socio-economic benefits derived from effective domestic solid waste management, this research therefore sought to find answers to the following research questions

What are the types of solid waste generated by households in the study area?

What are the methods of disposal available to households and what factors influence the choice of these methods?

How knowledgeable are households in Abokobi with regards to turning household solid waste into resources?

To what extent will households accept new strategies for the use of their solid wastes as resources?

Are some households currently involved in practices of turning solid waste into resources to enhance poverty alleviation?

If some households are involved in turning solid waste into resource to earn money then what factors influence the levels of income that they earn from this enterprise?

1.5 Hypotheses of the Study

The following hypotheses have been formulated for testing to answer the proposed research questions.

1. The types of solid wastes generated by households are largely made up of organic material which are easily decomposable.

2. The methods available to households to dispose of their solid waste are traditional methods and modern methods.

2. The waste management practices of households in Abokobi are dependent on their knowledge of the different methods of waste management and their socio-economic characteristics.

3. Households with higher knowledge about waste management practices are more likely to accept new strategies of converting household waste into resources.

4. Some factors that influence the levels of income earned by households from converting waste into resource may include the gender of the respondent, his/her age and current personal income earned by that person.

1.6 Justification of the Study

There are a lot of challenges associated with improper waste disposal including health, economic and environmental deterioration in the study area though current trends in waste management have been seen to create economic benefits that ensure socio economic development. The expected outcomes of the study are to identify appropriate settings for community-based domestic solid waste management practices that produces socially-

desirable solutions to the intractable problem of solid waste. It is hoped that the findings of this study will help raise awareness on possible ways of reducing waste and generating income particularly at the household level. This awareness can help shape initiatives to possibly decrease the problem of waste in the Ga East Municipality. The findings of this study can also contribute significantly to the literature in the study area and establish an outline and means to promote the sharing, dissemination and use of lessons learned from this study. It will also provide policy makers with an opportunity for more informed, evidence–based planning, decision making and management of domestic solid waste and also serve as a source of reference for other research workers.

1.7 Limitation of the Study

The study is limited to Abokobi, the capital of Ga East Municipal Assembly, where the residents are predominantly Christians. Thus, the study represents a major view of Christian respondents. The study also sought to find out how willing household will accept new improved ways of domestic waste management but however failed to find out how much they are willing to accept to engage in these practice for economic incentives. This gap presents a platform for further study to access how much households are willing to accept to engage in such waste management practices like segregation for recycling and composting.

1.8 Organization of the Study Report

This thesis is organised as follows: The first Chapter is the introduction which covers the background to the study, research objective and questions, hypothesis of the study, justification of the study and limitations. The next chapter (Chapter 2) provides a summary of the theoretical and conceptual framework of the study, followed by a discussion of the methodology used for

the study as well as a profile of the study area which are reported in Chapter 3. The findings of the study are discussed in Chapter 4. Chapter 5 presents the conclusions and recommendations. A list of references is reported at the end of the paper followed by appendices.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Waste is an important environmental, social and economic issue worldwide. Increasing consumption and rapid economic growth in many countries lead to the generation of large amounts of wastes with more effort required to properly dispose of these wastes. One of the underlying reasons waste generation is on the increase particularly in developing countries like Ghana is that, neither governments, industries, nor individuals have incentives to adapt to changing trends in solid waste management.

While waste was viewed as disposable in the past, today it is increasingly recognised as having potentials for resource generation. This is seen in waste management shift from disposal towards recycling and other recovery methods. Sound management of solid wastes can protect public health leading to a healthy human capital stock which is a prerequisite for development. It also benefits the environment while supporting and conserving natural resources. Pre-cycling, reuse, composting and recycling have become economically attractive options preferred over conventional waste management processes because of the enormous resource provision by wastes to support the developmental objective of poverty alleviation.

2.1 Solid Waste: Context and Conceptualisation

2.1.1 Defining Solid Waste

Like any social concept, the term solid waste has been defined to mean different things to different scholars and authors but with the varied definitions there are some commonalities in what basically constitute solid waste. According to Tchobanoglous, Theisen and Vigil (1993),

solid waste is any material that arises from human and animal activities that are normally discarded as useless or unwanted. The New York Department of Environmental Conservation (NYDEC) defines solid waste as any garbage, refuse, sludge from treatment facilities and other discarded materials resulting from the operations of industries, commercial entities, mining and agricultural activities as well as activities of people within communities. However, this does not include solid or dissolved materials in irrigation flows or domestic sewage (NYDEC, 2015).

In the view of Zerbock (2003), solid wastes includes non-hazardous industrial, commercial and domestic waste which forms part of household organic waste, waste from sweeping the streets, institutional and construction wastes. The Ghana Innovation Market Place (2009), popularly known as 'GIM`, notes that solid waste is neither wastewater discharges nor atmospheric emissions, as a result of domestic, institutional, industrial or commercial activities in an urban area.

The issue with solid waste emerged as a result of increases in population growth, leading to the rise of towns and cities where large numbers of people started to congregate in relatively small areas in pursuit of livelihoods (Shafiul and Mansoor, 2003). Due to this convergence, the volume of annual per capita waste generation increased whiles available resources such as land for waste dumping decreased. This led to the emergence of solid waste management as an essential and specialised sector for keeping cities healthy and in good conditions (Puopiel, 2010). The non-degradable nature of solid wastes generated by an increasingly dominant urban part of the population is also another factor. Rural dwellers produce wastes which are largely biodegradable and they pose a lesser challenge than urban dwellers in terms of the proper disposal of solid wastes.

2.2 Sources and Types of Solid Waste

There are various classifications of solid waste but one of the commonest classifications is by the sources and generation facilities, activities, or locations (Tchobanoglous *et al*., 1993). Table 2.1 summarizes the various sources and types of waste generated

Table 2.1 Sources and types of solid wastes

Source	Typical waste generators	Types of solid wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (manufacturing, etc.)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay, tailings.
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).

Source: Tchobanoglous *et a*l. (1993)

The various types of solid waste have further been elaborated into details by Tchobanoglous *et al.* (1993) which include food waste (all animal, plant or vegetable waste resulting from the usage, preparation, cooking, and eating of foods (also called garbage) which brings out offensive odours when decomposed); rubbish (made up of combustibles and non- combustible solid wastes of households, institutions and commercial activities but does not include food wastes or other highly putrescible materials); ashes and residues (materials remaining from the burning of coal, coke, wood and other combustible wastes; and special waste (which includes roadside litter, dead animals and abandoned vehicles and street sweepings,).

The Centre for Environment and Development (2003) has also classified types of solid waste based on origin, characteristics and risk. In terms of origin, solid waste was categorized as food waste, rubbish, ashes and residues, demolition and construction waste and waste from agriculture. Based on characteristics, solid waste was categorized as biodegradable and non-biodegradable; and based on the risk potential, it was categorized as hazardous and non-hazardous waste. The Centre also enumerated sources of solid waste as from residential, commercials institutions, eateries, slaughter houses and others. This confirms the sources and types of solid waste outlined by Tchobanoglous *et al*. (1993) such as food waste, rubbish, ashes, construction demolition and agriculture waste. Solid waste sources also include domestic, commercial and industrial types.

2.3 Theoretical Concepts of Emerging Trends in Waste Management

The waste management theories used in this study is used to explain the emerging trends in waste management. In industrialised nations, waste management practices evolved in the 1970s focusing on reducing environmental impacts (Tanskanen, 2000). This was done by creating controlled landfill sites, putting up waste transfer stations or redirecting waste collection vehicle routes. The 1980s and early 1990s focused on new technological solutions for waste management while from the mid-1990s the focus shifted to resource recovery (Tanskanen, 2000). In this respect, recycling and composting methods are included in municipal solid waste management (MSWM) systems (Chang, 2015).

Changes in waste management policies in recent times have shifted waste management planning from reliance on landfill towards Integrated Solid Waste Management (ISWM) approaches (Tanskanen, 2000). New directives/legislations are being promulgated in the European Union (EU) and the United States of America (USA) on waste disposal methods that favours the environment. These include the January 1st 2003 increase in tax to 370 Swedish Kronor per tonne of land filled waste in Sweden (RVF 2003) and the 1993 United States' Resource Conservation and Recovery Act (RCRA) Subtitle D which requires landfills to be impermeably lined and equipped with leachate and gas collection equipment (Pacey, 1999).

These policies and their enforcement have helped the developed nations in implementing a solid waste management plan based on waste hierarchy, thus, prevention, materials recovery, incineration and landfill. Sakai *et al.* (1996) also showed evidence from the 1993 Government Action Plan on Waste and Recycling in Denmark set out to achieve targets of 54% recycling, 25% incineration and 21% landfill by the year 2000.

On the contrary, in many developing countries, poor enforcement or non-existence of proper waste management policies have resulted in the dependence on dumping in the open. Advancement in the field of constructing sanitary landfills in these regions have most often been supported by the World Bank and other bilateral donor agencies (Johannessen and Boyer, 1999).

To achieve proper waste management objectives and abide by such policies as well as models, emerging waste management trends have evolved. Such decision support models make use of methods and tools such as cost benefit analysis (CBA), life cycle analysis (LCA) and integrated waste management (Morissey and Browne, 2004). Waste management systems based on CBA usually convert the economic, social and environmental effects into monetary values (Berkhout and Howes, 1997). Here, economic values are readily obtained by the cost of building waste management facilities and the revenues generated from these facilities. Impacts on the environment and society are estimated by the cost of abating pollution from a waste treatment facility and or how much the public is willing to pay for an environmental improvement.

Those waste management practices based on the LCA of products involve the evaluation of the environmental aspects and potential impacts throughout a product's life from raw material acquisition, production, use and its final disposal. More recently, waste management systems are concerned with the whole life cycle of products (Brorson and Larson 1999; McDougall *et al*., 2001) aiming at making a thorough assessment of the systems environmental impact. Such method is critical for waste reduction as it affords the producers the opportunity to alternative production routes and waste reduction strategies (Berkhout and Howes, 1997). The LCA nevertheless, is a specific and technical environmental accounting process that is unable to

deal effectively with social issues. Petts (2000) observes that LCA though covers environmental and economic sustainability does not consider social aspects such as health effect predictions and for this reason, cannot be deemed as a sustainable waste management system.

In this study the proposed solid waste management concept is based on integrated waste Management system that brings together a range of management options, considering the local environment, while aiming at social, economic and environmental aspects of sustainability. The waste management system with the aims of sustainability, should function within the principles of Agenda 21 (established at the UNCED World Summit in Rio in 1992) and within its local manifestation (Local Agenda 21).

2.3.1 The circular economy concept

The growing cost of waste disposal and stress on the importance of reduce, reuse, recycle and recover have raised the value placed on waste. The concept of 'Circular Economy' also view waste as a resource for poverty alleviation. It sees the current take-make-dispose linear economy method as the major factor for the current waste explosion. Instead of throwing away things that are no more useful, the circular economy waste concept takes the resources in the unwanted products and manufacture new items from them (Vision 2020). Peralla (2011) posit about 80% of products that leave production companies get discarded within six months of their life cycle.

The European Commission embraced the slogan "Towards a Circular Economy: A Zero waste Program for Europe". The purpose for this was to encourage recycling and reuse of waste to

about 70% by the year 2030 and also reduce food waste volume by 30% (European Commission, 2015). They asserted that employing measures such reusing, repairing, refurbishing and recycling that adopts a circular economic approach would reduce the amount of waste to be disposed. They believe this could bring a net savings for EU of up to EUR 600 billion, raise productivity by 30% by the year 2030 which could increase EU's GDP by a percentage. There is further hope of this to promote up to about two million new employment opportunities (European Commission, 2015). For this enormous contribution of waste to development, a shift towards a circular economy for converting waste into resource is at the heart of their Resource Efficiency Agenda, established under their Europe 2020 Strategy for smart inclusive growth with aims of strategies that focus on what each person can do to turn waste into resources (European Commission, 2015).

For developing countries, turning waste into resources for poverty alleviation within the circular economy concept is even more compelling. Analysis by McKinsey, as cited by Perella (2014) estimates that, shifting towards a circular economy which aims to eradicate waste by turning it into resources could add one trillion United States dollars to the global economy by 2025and create 100,000 new jobs within five years. As developing countries are highly affected by problems dealing with waste, there is the urgent need to tap into the waste as resource agenda to promote development.

2.3.2 Zero waste theory

In recent years, waste manager's attention has further drifted to the concept of 'Zero waste'. The European Regional Development Fund accounts that, the term 'Zero Waste' first emerged in the 1970s and had many interpretations then as well as different views. The term zero waste,

is a theory of how to get the maximum efficiency from use of resources thereby minimizing waste through reuse for economic benefits (European Regional Development Fund, n.d.). It contends that, it is both solution and a directorial policy to the problem of waste. This also offers new ways in ordinary day to day activities that contribute to turning waste into resources rather than increasing the problem of waste (European Regional Development Fund, n.d).

Zero waste strategies have been used in most places around the world since its introduction. ERDF (n.d) recounts cities which have embraced zero waste practices. It asserts that, Canberra, Australia became the first city in the world to set a vision of no waste by 2010, followed by United States municipalities of Seattle, Del Notre County and Santa Cruz County. Many major international corporations like Hewlett Packard, Xerox and Honda Motors who have also embraced zero waste policies.

ERDF (n.d) recounts how a case study in Canberra, Australia which developed zero waste policies for a waste free society by 2010 has established markets and jobs through continual reuse of waste and community based recycling and composting. This helped the community to achieve a local economy that operates efficiently, sustains good jobs and provides measures for efficiency. The concept of zero waste promotes sustainable development by identifying pathways for better uses of waste that promote poverty alleviation.

The Scottish Government's Zero Waste Plan developed by Scotland Environmental Protection Agency (SEPA) also set out a policy where waste is treated as valuable resource and not a burden. This policy has reduced the amount of waste going to landfill sites from 16 million tonnes in 1994 to 4.5 million tonnes in 2010 while processing organic waste have promoted the production and high quality fertilizer (SEPA, 2014)

2.3.3 The waste hierarchy

The new European Waste Framework Directive (2008/98/EC) came into being on December 12, 2010 with the aim of turning EU member states into "recycling societies". This framework shifts the focus away from waste as a menace to being a valuable resource, providing prospects for sustainable development SEPA (2014). Such waste to resource oriented approach to waste management is briefed in a waste hierarchy.

The waste hierarchy scale is presented in Figure 2.1. On the scale, preventing waste through pre-cycling and efficient use of resources and raw materials is seen as the most desirable option. This is followed by re-using goods such as clothing, books, bottles and furniture. Recycling material such as paper, glass and plastics in to new product is the next desirable choice. If reuse or recycle cannot be done, then value recovering, often in the form of energy from the remaining waste is promoted. Practices such as landfill, is viewed as the least desired option.

Figure 2.1: The Waste Hierarchy Scale

Source: SEPA, 2014

2.4 Conventional Solid Waste Management

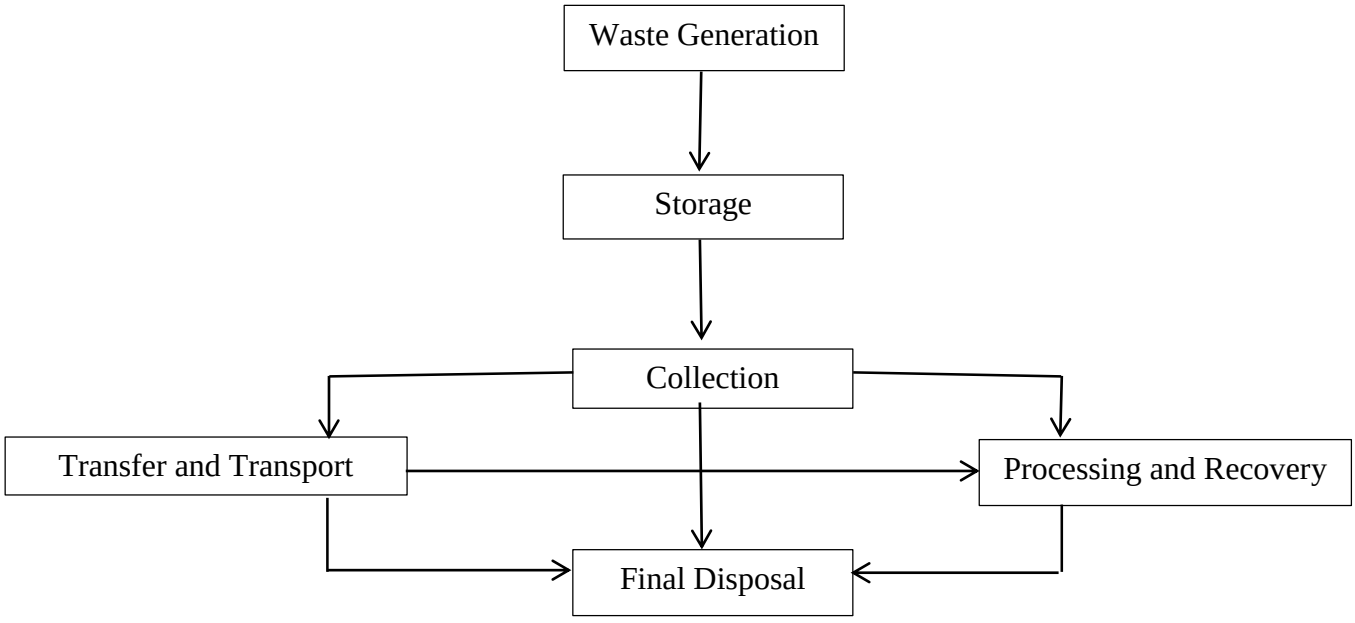
The concept of solid waste management has equally attracted different definitions just like the definition of solid waste as noted earlier. Solid waste management has been defined as "the administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of waste" (Kumah, 2007, p.2). On the other hand, Tchobanoglous *et al*. (1993) provided a more comprehensive definition of solid waste management. According to them, solid waste management is:

".....that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best

principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes" (p.7).

Tchobanoglous *et al.* (1993) suggest that if solid waste management is to be accomplished in an efficient and organised way, the basic aspects and linkages involved in the management process must be clearly identified and understood. They have therefore identified the following as the most efficient processes in solid waste management process: source separation, storage, collection, transportation and disposal of solid waste in an environmentally sustainable manner. This is illustrated in Figure 2.2.

Figure 2.2: Key Elements of Solid Waste Management



Source: Puopiel, 2010

2.5 Solid Waste Management Processes

The key elements in solid waste management include: waste generation, storage, collection, transfer and transport, processing and recovery and final disposal. This implies that when waste is produced it is first stored. Then it is collected and finally transported to landfill sites for disposal. Also, when waste is collected it can be transferred from small collection equipment like the tricycle to a bigger truck for final disposal. However, Puopiel, (2010) affirms that waste generated can be processed and recovered for materials to be reused. These elements gives further elaborations:

2.5.1 Waste generation

Waste generation encompasses those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal (Momoh and Oladebeye, 2010). According to the United Nations Environment Programme (UNEP) (2009), the total amount of municipal solid waste (MSW) produced yearly worldwide in the year 2006 reached 2.02 billion tonnes. This represented about 7 per cent annual increase since 2003. The estimation made from this was that waste generation globally would increase by about 37.3 percent between the years 2007 and 2011, equivalent to roughly 8 per cent increase per year (UNEP, 2009).

The conclusion drawn from a recent survey conducted by the World Watch Institute - an independent research organization dedicated to global environmental concerns is that given the propensity at which urbanization is rising in almost all major cities in the world, it will lead to a doubling of the volume of municipal solid waste generated annually by 2025. This indicates that the annual volume of municipal solid waste will increase from 1.3 billion tonnes

per year to 2.6 billion tonnes. PennWell Corporation (2014) affirms this will be a challenge to environmental and public health management in the world's cities.

2.5.2 Storage

Tchobanoglous *et al.* (1977) explain storage to mean where solid waste is stored before it is collected. This could be a skip or dustbins and not thrown away indiscriminately. They suggest that, storage is of primary importance because of the aesthetic consideration.

2.5.3 Collection

The element of collection includes not only the putting together of solid waste, but also the transportation of waste after collection to the location where the collection vehicle is emptied (Tchobanoglous and Kreith, 2002). According to Tchobanoglous and Kreith (2002), the most common type of residential collection services in the United States include “curb”, “setout-setback” and “backyard carry”. According to the USPS (2000), in the city of Thimphu in Bhutan the collection of solid waste from households, commercial set-ups is done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. In Ghana, the use of bins and containers placed at vantage points and later conveyed by trucks/tractors is common.

2.5.4 Transfer and transport

According to Tchobanoglous and Kreith (1994), the transfer and transport of solid waste involves two steps: (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (2) the subsequent transport of the wastes, usually over long distances to the final disposal site.

2.5.5 Processing and recovery

According to Tchobanoglous *et al.* (1977), the elements of processing and recovery include all the skill, tools, and facilities used to promote the efficiency of other functional elements and to recover materials that are useful from solid wastes. In the recovery, separation operations have been devised to recover valuable resources from the mixed solid wastes delivered to transfer stations or solid waste processing plants. It is thus considered that there are some valuable items and resources in the solid waste gathered and it is at the recovery stage that these items are removed. In Ghana, many people recover plastics, metals (steel and aluminium) among other materials which they sell for a living.

2.5.6 Disposal

Disposal is the final stage of solid waste management where it is dump at a landfill site or any other designated place.

2.6 Solid Waste Management Practices

The management of solid waste has evolved over time. It has gone through many transitions as technology continues to evolve. Even in recent times, new methods and approaches are emerging as best practices of managing solid waste. Earlier, some of the common practices used in managing the final disposal of solid waste were dumping in water, on land, gullies and mining pits; ploughing into the soil; reduction and incineration (Tchobanoglous *et al*., 1993). There were many hazards that were associated with these forms of practices and there was a paradigm shift to other best practices. However, in recent times, some of these harmful practices still exist in many urban areas and even in the rural areas in many developing

countries like Ghana. People still dump solid waste in open spaces, gutters, river bodies, pits etc. (Puopiel, 2010).

One of the common practices in modern Ghana is the burning of solid waste. The situation is not different from what exist in other African countries like Nigeria. In Nigeria, Momoh and Oladebeye (2010) found that some of the common practices of solid waste disposal include dumping of waste in drains, by roadside, in water bodies and places that are unauthorized dumping sites and burning of wastes on unapproved dumping sites . This shows how Africa and other developing nations are lagging behind in terms of best practices to solid waste management.

In the contemporary era, the methods of managing solid waste include source reduction, sanitary landfills, composting, recycling, and incineration (Denison and Ruston, 1990). These methods are discussed below:

2.6.1 Source reduction

Denison and Ruston (1990) viewed source reduction as any action that reduces the volume or toxicity of solid waste prior to its processing and disposal in incinerators or landfills. Tchobanoglous and Kreith (2002) also gave a similar explanation when he asserted that source reduction focussed on reducing the volume and/or toxicity of waste generated. Source reduction consist of the shift to reusable products and packaging, the most common practice being returnable bottles. The city of Thimphu in Bhutan have considered this as one of the key methods of reducing the problem of solid waste management (USPS, 2000). Some practices of possible reduction at the consumption level include reuse of containers and bags,

better habits towards purchasing of products (pre-cycling), and reducing the use of disposable products and packaging (USPS, 2000).

One of the cardinal reduction practices is source separation of waste and recovery (Puopiel, 2010). Some of the advanced countries that have striven to minimize their waste challenges started by adopting source separation method. According to Tsiboe and Marbel (2004), Austria, the Netherlands, and Denmark developed a waste management processes to efficiently resolve the waste disposal problem by essentially coaxing their citizens to separate their domestic solid waste into categories of paper, glass and plastic, this enables easy collection and consequently reuse. Source reduction has therefore been practiced by many advanced nations who have made greater achievements in solid waste management.

2.6.2Sanitary landfill

Sanitary land filling includes confining the waste, compacting it and covering with soil (Puopiel, 2010). The practice does not only prevent burning of garbage but also helps in reclamation of land for valuable use (Centre for Environment and Development, 2003). It must be noted that the placement of solid waste in landfills is the oldest and definitely the most prevalent form of ultimate waste disposal (Zerbock, 2003). According to Zerbock (2003), landfills are nothing more than controlled or open dumps. He convinces that, "the difference between landfills and dumps is the level of engineering, planning, and administration involved" p.7. Dumping in open space is associated with non-availability of technical measures, poor management and little or no operational measures like registration of users, control of the number of "tipping fronts" or compaction of waste (Zerbock, 2003).

Interestingly, “landfills are one form of waste management that nobody wants but everybody needs” (Tchobanoglous and Kreith, 2002, p.28) According to him, there are simply no combinations of waste management techniques that do not require landfilling to make them work. According to Tchobanoglous and Kreith (2002), some wastes can simply not be recycled. At some point a lot recyclable materials values can no longer be recovered.

In contrast to what the various authors have said about sanitary landfill as an option for waste management, they have overlooked the fact that land fill in itself has some disadvantages as it is costly to construct and maintain, can cause pollution of underground water through leaching, and non-availability of land particularly in urban centres. However, Puopiel, (2010) suggests an alternative which include recycling, composting and reuse

Ghana has basically relied on the use of landfill in the management of solid waste. Until July 2014, Accra was depending on only one landfill site, the Kpone landfill site, which receives an amount of 2,500 tonnes of waste a day. As a result of heaps of garbage, the foul smell coming from the dump site was described as unbearable. In July 2014, Nsumia Waste Disposal facility, located within the Nsawam Adoagyiri Municipality, off the Accra Nsawam road, was built and commissioned to serve as an alternative solid waste landfill site for the Accra metropolis and its surrounding areas. It was also to reduce the pressure that had mounted on existing landfill sites in the country that presents challenges to dumping waste any time the sites were full to capacity (The Chronicle, 2014).

2.6.3 Recycling

According to Momoh and Oladebeye (2010) recycling has been viewed as "a veritable tool in minimizing the amount of household solid wastes that enter the dump sites" (p.1). Recycling does not only help in the minimization of household solid waste, it has also been seen as one of the means that provides industries with raw materials. They assert it has been noticed to be the best, alternative method of household and other solid waste management practice. The United States Environmental Protection Agency (USEPA) (1999) has recommended recovery for recycling as one of the most effective waste management practice. USEPA confirms that, recycling converts materials that would otherwise become waste into valuable resources that yield economic, social and environmental returns since a substantial proportion of what is discarded —metals, glass, paper, wood, and plastic— is made up of valuable resources that can be reprocessed and used again as raw materials (USEPA, 1999).

Tchobanoglous and Kreith (2002) has also affirm that, recycling is the most positively thought of and doable of all the waste management strategies. Recycling, according to them will bring back raw materials to market by separating reusable products from the rest of the municipal waste stream. According to him, some of the benefits of recycling include the fact that it saves precious finite resources and lessens the need for mining of virgin materials which lowers the environmental impact for mining and processing. Findings by the Institute of Waste Management has shown that UK recycles only 11 per cent of its household waste, Italy and Spain only 3 per cent but other countries like the Netherlands recycle about 43 per cent, Denmark 29 per cent, and Austria 50 per cent (Tsiboe and Marbel, 2004). In recent times, Ghana has also been making some efforts to recycle some of its wastes even though the most

popular practice of all times has been dumping waste on landfill site. The most popular recycling plant in Ghana is the one established by Zoomlion Company at Kotoku in the Amasaman District.

2.6.4 Composting

UNEP (2009) has also defined composting as a 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. According to the UNEP (2009), composting is the practice that fits best within the limited resources available in global south but with few exceptions. Composting is especially suitable because of its adaptability to a broad range of situations. According to Zerbock (2003), a low-technology approach to waste reduction is composting. In developing countries, household and other solid waste is made up of over 50 per cent organic material which have composting potentials for resource generation (Zerbock 2003).

2.6.5 Incineration

The Centre for Environment and Development (2003) defines incineration as "a controlled combustion process for burning combustible waste to gases and reducing it to a residue of non-combustible ingredients" (p.9). Incinerators have the ability to minimize the volume of waste drastically, up to nine fold than any other method (Tchobanoglous and Kreith, 2002) and recover useful energy either in the form of steam or electricity. The main setback with incineration they recognised were the high cost of operation, relatively advanced technology

needed to operate them safely and economically as well as the tendency to pollute the environment through emissions of carbon dioxide.

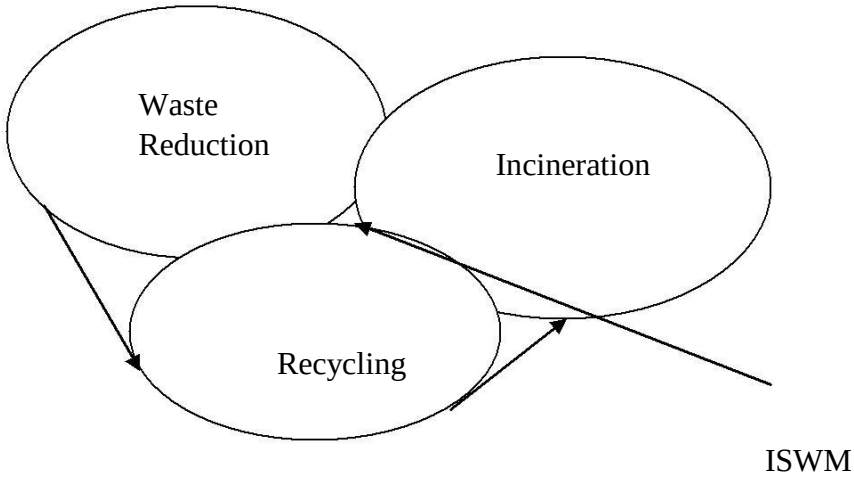
2.6.6 Integrated Solid Waste Management

An alternative method of managing solid waste effectively which is synonymous to waste reduction and recycling as mentioned earlier on is called integrated solid waste management (Puopiel, 2010). Although considerable efforts are being made by many governments and other entities in tackling the problems of waste, the problem still persist (UNEP, 2009). According to UNEP (2009), the World Bank estimates that in developing world, it is likely for municipalities to spend 20 to 50 percent of their available budget on solid waste collection and disposal, even though about 30 to 60 percent of all the urban solid wastes remain uncollected and less than 50 percent of the population is served. In the view of UNEP, if most of the waste could be diverted for material and resource recovery for utilization to generate revenue, it will lead to a huge reduction in the volumes of waste disposed finally. This therefore forms the premise for the Integrated Solid Waste Management (ISWM) system based on 3Rs (reduce, reuse and recycle) principle**.**

ISWM system has been pilot tested in a few locations (Wuxi, PR China; Pune, India and Maseru, Lesotho) and was welcomed by households and local authorities (Puopiel, 2010). It has been shown that with appropriate segregation and recycling practices, large amount of waste can be redirected from landfills and converted into resource (UNEP, 2009). Similarly, the USEPA (1999) has said that if a state, local government or households wants to plan for

and use the ISWM tool, a hierarchy of steps which are reduce, recycle, and incinerate/landfill needs to be followed. Figure 2.3 illustrates a model for ISWM.

Figure 2.3: Model of ISWM



Source: Puopiel (2010)

2.7 Problems of Managing Solid Waste

It is an undisputable fact that agencies and communities continue to face challenges in their waste management efforts due to the various challenges they face. According to Ogawa (1997), a typical solid waste management system in a developing country presents a number of problems. These include inadequate collection coverage and irregular services, open space dumping and burning of waste under inappropriate conditions. He categorized these challenges into social, economic, technical and institutional constraints. Also, he elaborated these constraints in relation to the sustainability of solid waste in developing countries.

2.7.1 Technical constraints

According to Ogawa (1997), technical constraints are basically inadequate human resources at both the national and local levels with low technical expertise necessary for solid waste

management planning and operation, especially in most developing countries. A lot of people responsible for solid waste management, especially lack training and technical know-how. (Puopiel, 2010).

2.7.2 Financial constraints

Ogawa (1997) noted that except in urban centres, solid waste management is given a very low priority in developing countries. For this reason, very little funds are allocated to the solid waste management sector by the governments, leading to low levels of public health and environmental service provision. This problem is critical particularly at the local government level where the local taxation system is inadequately developed. Though the inadequate financial system can be supported by user collection services, users in low income areas find it difficult to pay for such charges (Puopiel, 2010).

2.7.3 Institutional constraints

Ogawa (1997) further indicated that several agencies at the national level are usually involved in solid waste management. Ogawa however, showed that, most times, there are no clear roles or functions of the various national agencies defined in relation to solid waste management and also no single agency or committee designated to coordinate their projects and activities.

".....The lack of coordination among the relevant agencies often results in different agencies becoming the national counterpart to different external support agencies for different solid waste management collaborative projects without being aware of what other national agencies are doing. This leads to duplication of efforts, wasting of resources, and unsustainability of overall solid waste management programmes. The lack of effective legislation for solid waste management, which is a norm in most developing countries, is partially responsible for the

roles/functions of the relevant national agencies not being clearly defined and the lack of coordination among them" (Ogawa, 1997: p.2).

Zurbrugg (2009) also added that solid waste collection schemes of cities in the developing world generally serve only a limited part of the people living in urban centres. Those left with no waste collection services are usually the low-income population living in peri-urban areas. One of the main reasons he posits is the lack of financial resources to cope with the increasing amount of generated waste produced by the rapid urban population. Most times, low fees charged and non-availability of funds from a central municipal budget cannot finance adequate levels of service.

Zurbrugg further showed that, in addition to financial constraints that affect the availability or sustainability of a waste collection service; operational inefficiencies of solid waste services such as deficient management capacity of the institutions and inappropriate technologies also affect effective waste management.

2.8 Waste to Resource and Income Generation

The quantity and volume of solid waste generated in countries have tended to vary from country to country and even region to region within countries. Whiles all countries across the globe have been generating solid waste, the quantity of generation tend to be higher in developing countries than developed countries. However, the increased scarcity of resources has led to a gradual increase in the demand for recycled products (Rozenberg, 2013). In some two to three decades ago, solid waste was seen as a major challenge to governments but in recent times, the increase in technological advancement has made waste more of a resource than garbage for industrialised and developed countries.

2.8.1 Waste picking creating jobs and contributing to national development

Studies have shown that there are millions of people worldwide whose livelihoods depends on collecting, sorting, recycling, and selling materials that someone else has thrown away (WIEGO,2014). In many developing countries today, many of the urban poor gain their livelihood from recovering valuable items and materials from waste at landfill sites (UN-HABITAT, 2010). There is therefore the growing recognition that waste pickers contribute to the domestic economy, sustainable environment and the safety and health of the public. In 2012, WIEGO conducted a research in 10 cities in Africa, Asia and Latin America, to examine how informal livelihoods are changing. Waste pickers were studied in five cities involving 763 waste pickers (427 women and 336 men). Their findings show that waste pickers provide recyclable materials to formal enterprises and generate demand for service providers. 34% of waste pickers use municipal services as part of their work, generating revenue for city governments. Waste pickers provide jobs for themselves and others, creating opportunities where others may not exist (WIEGO, 2014). It was also found that waste pickers are environmental agents who pick up discarded material from public spaces, thereby contributing to cleanliness and helping to beautify the city. Their activities also contribute to public health, preventing the spread of diseases, even at personal risk (WIEGO, 2014).

2.8.2 Waste provides revenue

As noted by Chalmin and Gaillochet (2009) there are many economic benefits to national development that solid waste can give to a country if it streamlines its policies to recycle them. In a report assessing recycling's economic implications, it was found that the EU countries were able to generate an amount of EUR 32 billion in 2004 from recycling and this amount

increased by almost 100 per cent to a minimum of EUR 60 billion in 2008 (EEA, 2011). In the same vein, from 2000 to 2008, the recycling business growth in job creation increased from 7 per cent each year, to an overall increase of 45 per cent. Thus, recycling generated more jobs at higher income levels than other forms of waste management in the European countries (EEA, 2011).

The U.S. recycling industry is estimated to have earned US $236 billion in returns in 2007. This sector also employed over one million people, accounting for about 2 per cent of the country's GDP (EPN, 2009). However, even though the quantity of waste generated in the informal countries are high, they have not been able to fully take advantage of it to turn it into economic resources. It has been estimated that only about 1 per cent of the urban population in developing countries is engaged in waste collection for their livelihood (Medina, 2008).

2.8.3 Energy from waste

There has been renewed interest in investing in waste-management technologies for extracting energy from organic waste (Papageorgiou *et al*., 2009; Marshall and Farahbakhsh, 2013) as well as efficient gas from landfills (UNEP, 2011). It has been found that organic waste contain enormous energy that if properly extracted, it can help reduce much of the energy crisis many countries face. Many of the countries in the Organisation for Economic Cooperation and Development (OECD) has therefore taken advantage of emerging technologies and are extracting waste energy (WtE) instead of burning it to even cause greenhouse effect (UNEP, 2011). This paved way for the generation of energy, usually in the form of electricity, through waste to resource technologies (Rozenberg, 2013).

A number of thermal-based energy recovery processes have been reported, particularly in developed countries such as United States, and United Kingdom (ISWA, 2013). WtE in Europe already supplies a considerable amount of renewable energy (some 38 billion kilowatt-hours in 2006). By 2020, the amount is estimated to grow to as much as 98 billion kilowatt-hours, adequate to supply 22.9 million of the population with electricity and 12.1 million people with heat as well (CEWEP, 2009). By 2009, USA had 88 WtE plants serving about 30 million people and combusting about 26.3 million tonnes of municipal solid waste (Psomopoulos *et al*., 2009). The people who use WtE in the U.S. surprisingly have about 17.8 per cent higher recycling rate than the USEPA average, showing that energy from waste coexists with high recycling (Psomopoulos *et al*., 2009).

In Africa, one of the countries that made remarkable strides in managing its solid waste is Kenya. Available data showed that the nation generates 2400 tonnes of waste a daily of which 83% of it come from households (ITDG, 2004). The disaggregation of the volume of solid waste shows that 60% of the total waste generated in a day contains 60% organic waste, 20% plastic, 12% paper and 8% glass/metal and all other solid waste (Kasozi, 2009). Having recognized the volume and challenge of waste, the nation sought the involvement of private companies as actors and stakeholders in the management of organic waste. It also involved sub-national institution namely the Kenya National Cleaner Production Center (KNCPC) as well as other community based organizations (CBOs) (Kasozi, 2009). Recovery, reuse and recycling of solid waste are the major solid waste practices in Kenya.

Evidence has shown that Kenya has been able to recycle 20% of its overall plastic waste generated in the country. The Green Loop Company, Rainbow Plastic Limited and Skyplast Manufacturers located in Nairobi and 17 other companies nationwide are all engaged in some

degree of recycling and reuse of plastic waste (Karanja 2005; Bahri 2005). This initiative was made possible through the KNCPC Plastics Waste Management Strategy which was implemented in 2005. Through the activities of these companies, many people have gained employment in the plastic industry.

In terms of paper waste, Kenya is able to recycle 15% of its overall paper waste through the efforts of companies like Chandaria paper, which recycles 8% of waste paper and has created about 1100 jobs for people. Madhu paper also recycles about 7% of waste paper (Karanja, 2005). Pan Africa Paper alone, through its recycling efforts, is the leading marketer of paper in Kenya selling about 60% of recycled paper in the Kenyan market (Kasozi, 2009). Nairobi's Jua Kali Company also recycles about 60% of organic and glass waste and has a total of about 205 employees (Bahri, 2005; Karanja, 2005)

2.9 Solid Waste Management in Ghana

Over the years, solid waste disposal in Ghana has become a major challenge to metropolitan, municipal and district assemblies (MMDA). This is as a result of rapid urbanisation which has made it difficult for the assemblies to deal with the large quantities of solid waste generated every day. A common attitude among majority of Ghanaian with regard to waste management is the indiscriminate dumping of refuse which results in littering. A review of some statistics and findings with waste generation and waste management practices in Ghana using the top two Metropolitan Assemblies in Ghana; Accra Metropolitan Assemblies (AMA) and Kumasi Metropolitan Assemblies (KMA) as case studies are followed:

2.9.1 Solid waste generation

As of 2005, Mensah and Larbi (2005) using an estimated population of 22 million and an average daily waste generation per capita of 0.45 kg found that Ghana generates annually about 3.0 million tonnes of solid waste. In 2006, Boateng and Nkrumah (2006) added that solid waste generated daily in Accra alone was between 1500-1800 tonnes. Earlier in 2004, Anomanyo (2004) found that about 1800 tonnes of municipal solid wastes were generated per day in the Accra Metropolis and the average waste generated per capita per day was estimated at 0.5 tonnes. This large volume of waste generation was attributed to the rate of population growth in the Metropolis.

The major components of solid waste within the metropolis include food waste, yard waste, packaging materials, electronics and waste from textiles with organic waste being the major component. This constituted about 65 per cent (Puopiel, 2010). According to Anomanyo (2004), the high proportion of food and plant waste was due to the fact that Ghana's economy largely depended on agricultural products for export and domestic consumption. AMA estimated that per capita waste generation was at 0.45kg totalling 2000 tonnes of waste per day.

In Kumasi, the daily volume of waste generation as estimated by the Metropolitan Assembly as of 2009 was approximately between 1000-1500 tonnes (KMA, 2009). This was based on the projected population of 1,610,867. Ketibuah *et al*. (2010), mentioned that, in Kumasi, the bulk of households waste is found to be organic waste which includes food waste and pustrecible waste with an average of 55 per cent.

2.9.2 Solid waste collection

According to Tsiboe and Marbel (2004), there are basically three methods of household waste collection in Accra. These are as follows:

Waste Management Department (WMD) curbside collection by trucks directly outside each house. This method of collection according to them was provided weekly in areas of high income earners like Cantoments and Airport by compactor trucks. WMD collected from communal containers to which people must bring their own waste. This second method was visible in low-income areas including Nima . People who could not pay for the house to house collection service took their waste to any of these communal containers and from which the WMD collected the waste and disposed of it at the landfill site Tsiboe and Marbell (2004). There was also the door-to-door collection services in middle-income areas.

According to Anomanyo (2004), Accra's districts have been demarcated further into collection districts and allocated to waste collection companies in efforts to ensure effective waste collection. Fifteen (15) waste collection companies have been contracted. These include: Zoom Lion Company, Liberty Waste Service Company, and Daben Cleansing Construction Services Limited among others. The main types of vehicles used by AMA are compaction and skip trucks. The wastes are usually taken by road directly to the disposal sites. Transfer stations are non-existent (Puopiel, 2010).

According to Anomanyo (2004), solid waste collection in the city is carried out both on franchise and contract basis. With the franchise contract, a house-to-house collection was done in high income areas and the contractors charged the households some fees with weekly

collection frequency. Such communities were well-planned areas with access roads described as first and second class areas and include areas as Airport residential area and Cantonments. On contract bases, waste contractors are paid by AMA to perform both block and communal container collection. He added that despite the strategies put in place for the collection of waste in Accra, it is not able to collect the totality of waste generated and only about 65 to 75 per cent of waste generated daily was collected.

According to KMA (2006), there are two modes of waste collection in the Kumasi Metropolis. The first is the house-to-house and the second, communal collection. Aryetey Brother Company Limited, Waste Group Ghana Limited and Kumasi Waste Management Limited are contracted for solid waste collection. About 33 per cent of the population enjoys this service but payment for the service is irregular.

On a franchise basis, a monthly fee of GH¢1 to GH¢3 per house is charged. Additionally, the communal collections are awarded to Kumasi Waste Management Limited, Waste Group Ghana Limited, Meskword and Aryetey Brother Company Limited. The total quantities collected are weighed at the disposal site and payment was based on a rate of GH¢ 9 per tonne.

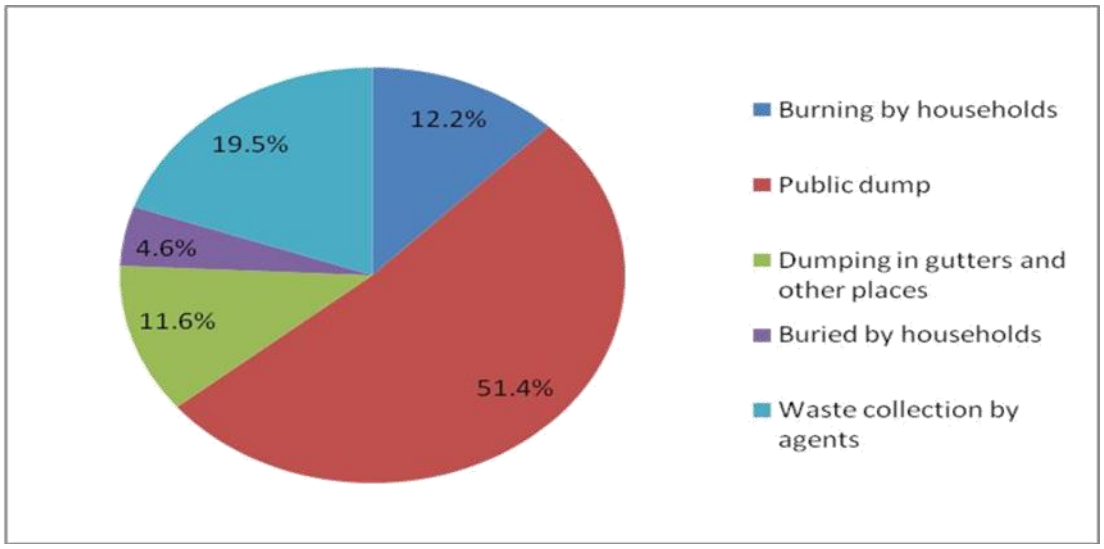
The above discussions show that there are two main modes of waste collection in AMA and KMA. These are door-to-door or house-to-house collection and communal collection which are carried out in the high class and low class residential areas respectively. Unlike the door-to- door collection which attracts some fee from households, the communal collection is carried out at no cost to the households in AMA. In the case of KMA, waste collection is charged per house. However, the door-to-door collection may not favour the poor or low income areas and therefore there is the likelihood of poor waste collection services in these

areas. So there is the tendency for residents to dump waste any how because of poor collection service (Puopiel, 2010).

2.9.3 Solid waste disposal

According to Anomanyo (2004), waste disposal from households in AMA take different forms. These disposal methods are illustrated in Figure 2.4. It can thus be ascertained that out of the about 1800 tonnes of waste generated, only 19.5 per cent was collected.

Figure 2.4: Waste Disposal of Households in AMA, 2004.



Source: Anomanyo (2004)

2.10 Waste Management Regulation and Policy in Ghana

According to the Ministry of Local Government and Rural Development (MLGRD) (2004), general waste management in Ghana is the responsibility of the MLGRD, which supervises

the decentralized MMDAs. However, the Ministry indicates that, regulatory authority is vested in the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science. The MMDAs are responsible for the collection and final disposal of solid waste through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Departments (EHSD). The policy framework guiding the management of solid waste as well as radioactive and hazardous waste includes the Local Government Act (1994), the Environmental Sanitation Policy of Ghana (1999), Act 462, the Environmental Protection Agency Act (1994), Act 490, the Pesticides Control and Management Act (1996), Act 528, the Environmental Assessment Regulations 1999, (LI 1652) and the Guidelines for the Development and Management of Landfills in Ghana. All these Acts and Regulations emanate from the National Environmental Action Plan (MLGRD, 2004).

Furthermore, the Ministry has published the National Environmental Sanitation Policy (NESP) since May 1999. From the National Sanitation Policy, MLGRD also developed a guideline document titled 'The Expanded Sanitary Inspection and Compliance Enforcement (ESICOME) Program guidelines.

The program guidelines which are implemented by the MMDA's, routinely looked at four broad areas namely; effective environmental health inspections (Sanitary Inspections), dissemination of sanitary information (Hygiene Education), pests/vector control and law enforcement. Each MMDAs have come out with waste management and environmental health plans to help solve the numerous sanitation problems. Generally, the National Environmental Sanitation Policy Co-ordination Council (NESPoCC) is responsible for coordinating the

policy and ensuring effective communication and cooperation between the many different agencies involved in environmental management in their respective Districts (MLGRD**,** 2004). The Ministry further indicates that in an effort to address the problem of waste management, Government has over the years put in place adequate national policies, and institutional frameworks as well as regulations. Due to this the Environmental Sanitation Policy (ESP) was formulated in 1999. This policy has currently been amended and strategic action plans developed for implementation according to the report. Various relevant legislations for the control of waste have also been enacted. They include the following.

Environmental Assessment Regulations, 1999 (LI 1652).

Criminal Code, 1960 (Act 29).

Water Resources Commission Act, 1996 (Act 522).

Pesticides Control and Management Act, 1996 (Act 528).

National Building Regulations, 1996 (LI 1630).

The Ministry also collaborated with the Ministry of Environment, Science and Technology (MEST), the Ministry of Health and EPA to prepare the following guidelines and standards for waste management:

National Environmental Quality Guidelines (1998)

Ghana Landfill Guidelines (2002)

Manual for the preparation of district waste management plans in Ghana (2002)

Handbook for the preparation of District level Environmental Sanitation Strategies and Action Plans (DESSAPs).

It is observed from the above that, despite the numerous sanitations regulations and policies that have been put in place by the MLGRD to deal with the solid waste menace in the country,

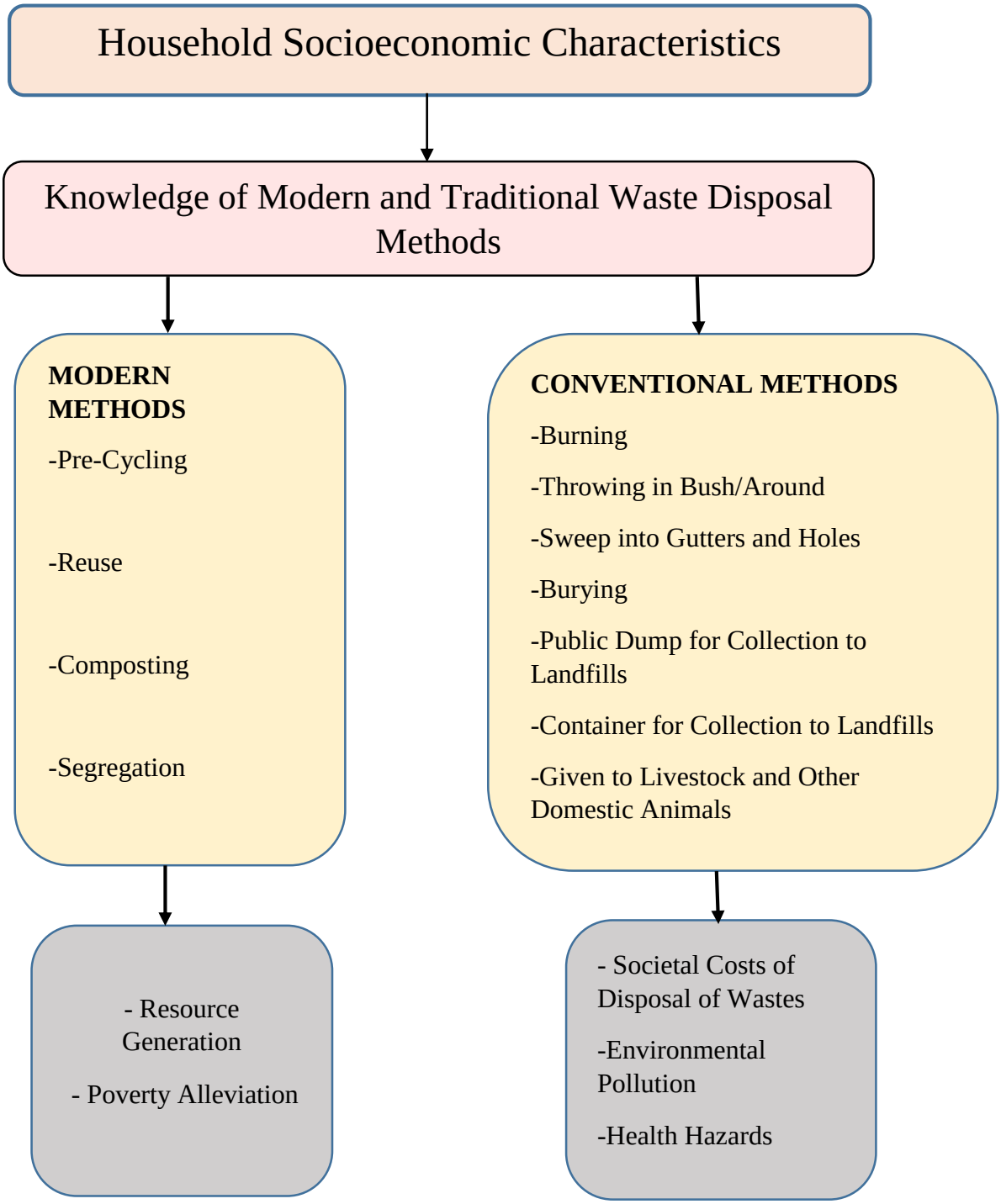
there has not been any improvement in the area of solid waste management. Rather it has moved from bad to worst and therefore has failed to achieve its goal of clearing filth in the country. Secondly, drawing from the views given by the Sanitation Country Profile Ghana and the National Report for Waste Management in Ghana, it can be said with certainty that MMDAs are the primary authorities to manage solid waste at the local level.

2.11 Conceptual Framework

The conceptual framework is informed by the Circular Economy Concept, the Zero Waste Theory and the Waste Hierarchy Concept which all promotes sustainable solid waste management practices from generation to disposal that promotes resource generation for poverty alleviation. Though there are other sources of solid waste generation, this study will focus on domestic solid waste management practices at Abokobi which can turn waste into resources for poverty alleviation.

The flow diagram shown as Figure 2.5 demonstrates the conceptual framework that informed the study. The socio-economic characteristics of households influence their knowledge of both old and modern waste disposal methods. Modern waste disposal methods such as pre-cycling, reuse, composting and segregation offer an avenue for people to convert waste into resource to earn additional income and reduce poverty. On the other hand, continuous use of the old methods imposes continuous costs to society and accelerates the pace of environmental pollution and degradation, and health hazards. Hence an understanding of factors influencing the choice and use of modern methods of disposal is important to advance socio-economic development. The contribution of this study is through the identification of the factors that can influence the choice of modern methods.

Figure 2.5: Conceptual Framework for this Study



Source: Author's construct, January 2015.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section presents the study design and the research methods that were employed for the achievement of the study objectives. It further presents the analytical tools used in the analysis of survey data.

3.1 Study Design

This research employed the case study approach. This choice was motivated by the fact that, a case study design facilitates the detailed and intensive analysis of a single case (Ahiadeke, 2008). In this case, the Ga East Municipal Assembly with emphasis on intensive study of Abokobi community was used. It was also cross sectional study of households using both quantitative methods and qualitative methods.

3.2 Study Population

The study population consists of all households in the Abokobi community. A representative sample of these households was randomly selected for the study.

3.3 Description of the Study Area

The Ga East Municipal Assembly (GEMA) is one of the 16 districts in the Greater Accra region. It was established in 2004 after the passing of the Legislative Instrument (LI) 2036. It was formally part of the Ga District Assembly. The district is located at the northern part of Greater Accra Region and covers a total land area of about 85sq km. There are about 52

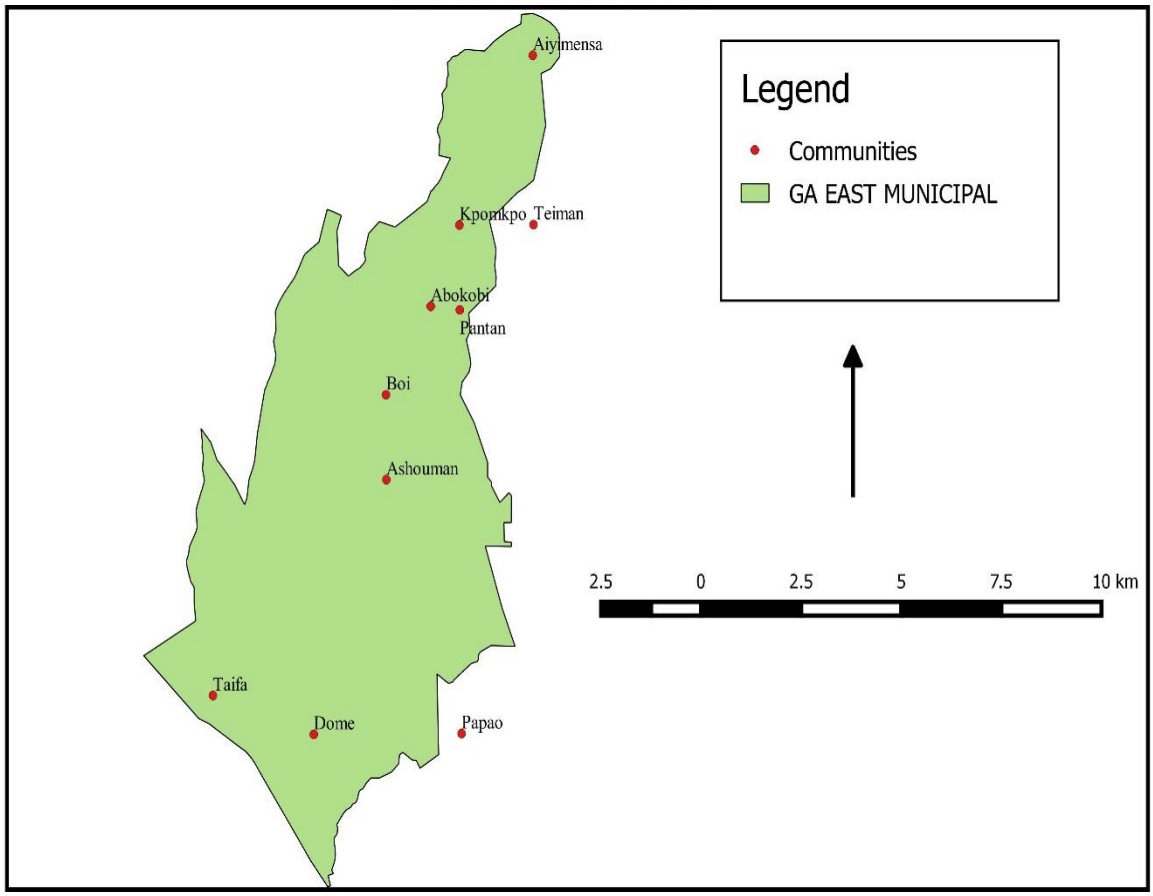
settlements in the district with Abokobi, a well-known Presbyterian Church community as its capital. Politically headed by the municipal chief executive, the municipality at the community level is ruled by traditional leaders and has two zonal councils, Abokobi and Dome Zonal councils. The GEMA has an estimated population as posited by the 2010 Ghana Population and Housing Census was about 198,220 with 51% males and 49% female and growing at an inter-censal rate of about 4.2% mainly as a result of migration inflows GEMA (2014).

Geographically, the municipality falls within the savannah agro–ecological zone and can generally, be termed as an urban municipality since 82% of the populace reside in the urban and peri-urban areas with only 18% inhabiting the rural areas. As basic social amenities are regarded as necessities, the municipality can boast of 17 health facilities with 14 being privately owned. The municipality also has 234 private and 67 public schools GEMA (2014) Farming is the major economic activity for majority of the economically-active population with about 55% found in the agricultural sector. The service, industrial and construction sectors are also vibrant in the municipality.

Development opportunities that the municipality is endowed with include agriculture, tourism and development of markets. However, the municipality is confronted with some challenges including inadequate sanitation facilities in homes, poor waste collection arrangements and management, bad roads conditions and drainage systems, inadequate security and market infrastructure. Encroachment on public lands, lack of adequate supply of water especially in urban and peri-urban areas also persists.

For Abokobi, which is the study focus, the problem of waste is even more acute, due to increasing population and low socio economic standards of most of the people within the community. This Christian community, which is aptly described as the Vatican City of Ghana suffocates under waste (Development Ghana, 2013). The poor sanitary condition of the community led to the inauguration of a seven (7) year strategic Town and Environment Sanitation Development Plan (TESDP), purposively for setting out strategy for improving Abokobi's sanitation conditions by gradually reducing the poor environmental burden due to indiscriminate disposal and littering of refuse (Ga East Municipa1 Assembly, 2008).

Figure 3.1: Map of Ga East Municipality



Source: GEMA (2014)

3.4 Sampling

3.4.1. Sampling Size Determination and Sampling Procedure

The population of Abokobi and Adjako according to the 2010 Population and Housing Census was 1,652 and 455 respectively resulting in a total of 2,107. Using the municipality's mean household size of 3.9, the study area has 540 households. To obtain an optimal sample size for the study, Yamane's formula was adopted (Yamane, 1973). The required minimum sample size was estimated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where

n = required minimum sample size

N = Number of households in the study area (540)

e = margin of error (10%)

By substitution, $n = \frac{540}{1+540(0.1)^2}$ = $n = \frac{540}{1+5.4}$ resulting in a minimum sample size of 84 households. This minimum number of households was increased to 165, representing 30% of the households in the community for the study. The community was divided into three income suburbs based on the Ghana Statistical Service's Census Enumeration Areas for Abokobi. Based on the total number of households in each cluster, the 165 households were proportionately distributed. Systematic sampling method was used in the selection of the households. To do this, the total number of households in each suburb was divided by the

expected sample size to obtain the sampling fraction. The sampling fraction then served as the sampling interval for selecting the n^{th} household on the sampling frame.

Table 3.1: Income-based geographical cluster (suburb), population and sample size

Income-based geographical cluster (suburb)	Income Level Designation	Number of households in geographical cluster	Proportion of share (%)	Number of households Selected
Adjako Area	Low	111	21	34
Presbyterian Church Area	Middle	239	44	73
Estate Area	High	190	35	58
Total		540	100	I65

3.5 Data Types/Data Collection

The study obtained primary data to answer the research questions. Primary data was gathered from households in the study area while secondary data was collected from institutions and organisations involved in waste management activities in the municipality.

For the primary data, a household questionnaire was administered to household heads or knowledgeable members of households in face-to-face interviews. The questionnaire was semi-structured with both closed-ended and open-ended questions to offer respondents the opportunity to express themselves on issues and give reasons for their answers.

The questionnaire consisted of eight (8) sections. The first and second (sections A&B) requested data and information on the type of waste generated and disposal methods. Section

C explored knowledge on modern waste management practices of turning waste into resources while Section D dealt with households using user-pay waste collection. Section E requested information on households using community waste collection services such as community waste bins and this section is followed by another section (Section F) dealing current practices of households that convert solid waste into resources. Section G explored the possibility of acceptance by households of new methods for converting solid wastes into resources. The final section, Section H dealt with the socio-economic characteristics of households.

Key informant interviews were also conducted with identified key informants in the Municipality including the head of the environmental health department of the municipality. Waste experts from waste collection agencies like Zoom Alliance Ghana and Asadu Waste were also interviewed on the prospects and challenges of domestic waste management practices that can convert solid waste into resource for poverty alleviation in the study area.

3.6 Data Management

All filled questionnaire were checked for consistencies and errors to ensure that data was cleaned. Quantitative data was captured in Epidata 3.1 software and exported to STATA, Statistical Package for Social Sciences (SPSS) and Time Series Processor (TSP) software for cleaning and analysis using both quantitative and qualitative means. In all, three statistical software were used for the analysis. The key informant interviews were also analysed quantitatively. Qualitative data that emerged from observed instances and in interviews with key informants were also studied to observe patterns to make comprehensive statements.

3.6.1 Ethical Considerations

The respondents were assured of confidentiality of their responses and that results of the study would be reported in aggregate forms without identifying any particular person. Further consent was sought from the Ga East Municipal Assembly before the commencement of the study.

3.7: Description of the Statistical Analytic Tools Used in this Study

3.7.1: Introduction

The survey data were subjected to statistical analysis to test various hypotheses derived from the objectives of the study. The three main statistical analytic tools used were as follows: (1) simple descriptive statistical analysis based on the derivation of the mean and standard deviation and frequency analysis of important variables, the so-called univariate analysis, (2) analysis of variance statistical test to determine statistically significant differences among the means of three or more groups of variables under question and (3) multiple regression analysis.

3.7.2: Analysis of variance test

The Analysis of Variance (ANOVA) was used to determine whether there were statistically significant differences in the mean values of variates for more than two groups. With only two samples or sub-groups of individuals, the Student t-test can be used to compare the mean values of variable to ascertain whether there are statistically significant differences in the means of the two groups. But with more than two groups, the Student t-test is not appropriate and the ANOVA test is the one commonly used.

For example, in this study there are three income subgroups which are derived based on the designated geographical clusters at Abokobi. These are (1) low-income subgroup, (2) middle-income subgroup and (3) high-income subgroup. An important objective of this study is to determine whether current waste management practices and awareness of modern waste management practices vary significantly among these three income subgroups.

The one-way ANOVA is employed in this study and it involves a test that checks whether the means of the three subgroups are equal, for example, whether the degree of usage of particular waste management practice is equal for all three subgroups of respondents.

The one-way ANOVA test compares the means between different subgroups and ascertains whether any one of those means are statistically significant different from each other. The null hypothesis is as follows:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_k$$

where μ = group mean and k = number of groups.

If the one-way ANOVA test is statistically significant then we accept the alternative hypothesis that there are at least two group means which are statistically significantly different from each other. Statistical significance is derived based on the F value or the F ratio. The F ratio is the ration of the between-group variability (numerator) divided by the within-group variability (denominator). In this study, two levels of probability of significance are used. These are the one percent (1%) and five percent (5%) levels.

3.7.3: Standard multiple regression analysis

Standard multiple regression analysis is employed to show the dependence between a dependent variable and a number of independent variables. The ordinary least squares method (OLS) is the most common method to undertake multiple regression analysis. The basic assumption is that the variation in the dependent variable can be explained by the variation in the independent variables (Anaman, 2014, p. 102).

3.7.4: Tobit multiple regression analysis

A Tobit regression analysis was conducted using the same model as the standard multiple regression analysis. This analysis was done due to the many zeros for the dependent variable, income from wastes as over seven in 10 respondents did not undertake any waste-to-resource conversion activities. The Tobit model is a statistical tool first suggested by Professor James Tobin in 1958 to describe the relationship between a non-negative dependent variable (which has many zero values and some positive values due to the fact that variable is often not observed but is latent) and several independent variables. The term Tobit was derived from Tobin's name by truncating and adding -it by analogy with the probit model (Tobin, 1958; Gujarati, 2003, pp. 618-619).

3.8. Specific Analysis Conducted in the Study

3.8.1 Analysis of the relationship between type of solid wastes generated by households and their socio-economic status

To address the first objective of the study, the types of solid wastes generated by the households in each suburb were obtained. Respondents were given a Likert-type scoring table with a range of 0 to 5 to identify in terms of level of importance the type of solid waste that

their household generated in terms of volume by a list of different types of waste. A score of 5 represented extremely important, 4 represented very important, 3 indicated modestly important, 2 represented less important, 1 represented not important and 0 means the household did not generate that particular kind of waste. The respondents' scores were averaged to determine the average level of importance. The mean score, standard deviation and the coefficients of variation of the mean scores were derived to establish the significant differences among the three suburbs. The F test was used to analyse the significant differences among the mean of various variables for the three income suburbs. Based on the literature review, the selected variables which could influence the type of waste generated by household included income, type of residence and household size. These variables were used as the basis of analysis of variance test to determine significant differences among the means for the suburbs.

3.8.2 Analysis of waste disposal practices by households

To address objective 2, binary questions were asked on different waste disposal methods to assess how households generally dispose of solid waste. Further questions were asked on specific disposal methods used for specific waste products. Household's income statuses by subgroups as well as other socioeconomic factors were cross tabulated with the kind of waste generated to assess relationships. Similar to the previous section, respondents were given a Likert-type scoring table with a range of 0 to 5 to identify in terms of level of importance the type of disposal method use by the household for each kind of solid waste that the household generated. A score of 5 represented extremely important, 4 represented very important, 3 indicated modestly important, 2 represented less important, 1 represented not important and 0 means the household did not use that type of method to dispose of the particular kind of waste.

Respondents' scores were averaged to determine the average level of importance. The mean score, standard deviation and the coefficients of variation of the mean scores were derived to establish the significant differences among the three suburbs. The F test was used to analyse the significant differences among the mean of various variables for the three income suburbs.

3.8.3 Analysis of the relationship between waste management practices of households, their level of knowledge of the different methods of waste management and their socio-economic characteristics.

To address objective 3 and four (4) binary questions (yes/no) were asked to assess household's knowledge on various waste management practices available. From this data, index was constructed using principal component analysis (PCA) to generate a variable for knowledge. The index scores were divided into three equal groups (low, medium or high) to represent the level of knowledge about waste management practices. Bivariate analysis was performed to assess relationships between waste management practices and household socio-economic characteristics.

3.8.4 Analysis of the relationship between level of knowledge about waste management practices and the acceptability of new strategies of converting household waste into resources

To address objective 5, acceptability of new methods of disposal such as waste reduction, reuse, and segregation from source for composting and recycling, and composting that could lead to resource generation by households were assessed. Households were asked to identify any specific methods they currently use to turn household solid waste into resource and how much they earn from it on monthly basis.Households were given a score table of a range of 5 to 1 to identify in terms of level of acceptability of waste management practices of turning

waste into resources for poverty alleviation where 5 means very willing, 4 means willing, 3 means slightly willing, 2 means unwilling and 1 means very unwilling. This was further cross tabulated among subgroups to assess their level of acceptability.

3.8.5: Analysis of factors influencing the levels of income received by householders for converting waste into resource

In order to address objective 6, a standard multiple regression analysis was undertaken to ascertain the factors influencing the level of income received by respondents from converting solid waste into resource to earn additional money. The multiple regression model used in this study is based on the dependent variable being the income earned by respondent over a particular period of time (one month) from selling collected household plastics (INCOMEPW).

The independent variables that were deemed to influence income earned from selling collected household plastic waste were (1) educational attainment of the respondent (EDU), (2) personal income of respondent (PINCOME), (3) whether the respondent was a female heading the household or not (FHH), and (4) whether the respondent was a woman aged over 50 years (AGEOLDWOMAN). Appendix 4 shows the programme used to undertake the standard multiple regression based on SPSS syntax command statements.

Algebraically, the model equation is postulated as follows:

$$\mathbf{INCOMEPW_i = Co + C_1\,EDU_i + C_2\,PINCOME_i + C_3\,FHH_i + C_4\,AGEOLDWOMAN_i + U_i}$$

Where U_i is the equation error term which is initially assumed to be normally distributed with zero mean and constant variance. These assumptions about the equation error term of the model are explicitly tested for in the analysis in the standard multiple regression using SPSS software (see Appendix 4).

As indicated earlier, the Tobit model is a much more accurate and better than the standard multiple regression analysis when the dependent variable takes on many zero values. Given that only 32 of the 132 respondents who chose to provide answers dealing with income raised from selling household plastic waste, the Tobit regression analysis was also undertaken due to the largely truncated nature of the data. Appendix 5 presents the programme used to undertake the Tobit multiple regression analysis using TSP syntax command statements. Appendix 5 also provides syntax statements that were used to undertake the standard multiple regression analysis that was done earlier with SPSS.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.1 Summary Socio-economic Descriptive Statistics of Respondents

Table 4.1 presents a summary of the descriptive statistics of the 165 respondents interviewed based on income subgroups and personal and household characteristics. Of the 165 respondents interviewed, 44.2% (73) resided in the Presbyterian Church area (the middle-income suburb), 35.5% (58) resided in the Estate area (the high-income suburb) while 20.6% (34) lived in the Adjako area (low-income suburb).

Females constituted the majority of the 165 respondents; thus males were 30.3% of the group. Adjako had a much higher proportion of females (88.0%) while Estate had equal proportions of males and females. The mean age of respondents was 40 years. The standard deviation (SD) of the mean age was 14.0 years. Respondents in the middle-income suburb had the highest mean age of 43 years (SD=15.0) with Estate recording the lowest of 36 years (SD=13.0) (refer to Table 4.1).

With respect to marital status, the majority of the 165 respondents (59.39%) were married with a higher proportion (67.65%) from the low-income suburb. About 19.0% of the respondents were single with Estate having the highest proportion of singles (25.86%). The high-income suburb had a higher proportion of divorced respondents (13.79%). However, there was no significant difference in marital status of respondents among the three different suburbs based on the p value reported in Table 4.1. Christians constituted the overwhelming majority of the respondents (97.58%). The remaining 2.42% of respondents were Muslims. This strong Christian presence could be attributed to the fact that the area was a major centre

of the Swiss-German Basel Missionaries who introduced Christianity to the area in the 19th Century. With regards to ethnicity, Ga/Adangbes were the biggest ethnic group representing about 38.18% of respondents. Akans were the second largest ethnic group in the area (29.7%), followed by Ewes (24.34%) and all other ethnic groups (7.90%).

The largest group of respondents based on educational attainment was the group that had had tertiary educational qualifications (30.49%). This was followed by the group that had completed junior high school (21.34%), those who completed senior high school and primary school (11.59% each) and those who had no formal education (10.98%). The very low p value (0.001) reported for the educational attainment suggested the strong statistical significance with respect to levels of education and income.

In terms of their main occupational activities, the biggest group (46.67%) were those who were self-employed or owned their own businesses. For those living in the middle-income suburb, the majority of them (58.90%) were self-employed. About 20.0% of the respondents were public sector employees. About one-third (32.76%) of the respondents from the high-income suburb were public sector employees. About 13.0% of all respondents were unemployed. However, in the low-income suburb, almost one quarter (23.53%) were unemployed and in the high-income suburb only 5.17% were unemployed. The figures related to employment showed a significant difference in the main occupational activities in the three suburbs (p value of 0.016).

The mean household size for all the responding households was 3.47 which was close to the 2010 Population Census figure of 3.7 (Ghana Statistical Service, 2013). There was a significant difference in household sizes among the suburbs (p value of 0.01). The lowest mean household size was recorded in the high-income suburb. However, the highest mean

household size was found in the middle-income suburb rather than the low-income suburb. The majority (62.80%) of respondents resided in compound houses with much higher proportions (76.4%) in the low-income suburb and the middle-income (79.17%) suburb. About 18.0% of all respondents resided in separate houses or bungalows; however about 28% of respondents in the high-income suburb resided in separate houses or bungalows. There was a significant difference in income levels among the suburbs (*p value of 0.000*). This information strengthened the case for the study using the geographically-based clusters which were largely income-based. The mean monthly household income was 984.34 Ghana cedis (GHC). The average income for the high-income suburb was as expected the highest being GHC 1,288.37. This was followed as expected by the middle-income suburb of GHC871.68. The mean monthly income of the low-income suburb was GHC707.78 (refer to Table 4.1).

Table 4.1: Descriptive statistics of the respondents by income subgroups based on percentages of respondents for various subgroups and personal and household characteristics where applicable.

Variables	Income levels			Total (n=165)	*p-value*
	Low (n=34)	Middle (n=73)	High (n=58)		
Gender (%)					
Female	88.24	76.70	50.00	69.70	0.000***
Male	11.76	23.29	50.00	30.30	
Mean Age (years)	37.00	43.00	36.00	40.00	0.017**
Standard Deviation	(11.0	(15.0)	(13.0)	(14.0)	
Marital Status (%)					
Single	11.76	16.44	25.86	18.79	0.419
Married	67.65	57.53	56.90	59.39	
Divorced	11.76	10.96	13.79	12.12	
Widowed	5.88	10.96	1.72	6.67	
Cohabitation	2.94	4.11	1.72	3.03	
Religious Affiliation (%)					
Christian	100	98.63	94.83	97.58	0.219
Muslim	0.00	1.37	5.17	2.42	
Ethnic Groups (%)					
Ga/Adangbe	23.53	57.53	22.41	38.18	0.004***
Akan	26.47	24.66	37.93	29.70	
Ewe	35.29	13.7	31.03	24.24	
Other groups	14.70	4.11	8.61	7.90	
Educational Level Completed (%)					
No school	23.53	12.33	1.75	10.98	0.000***
Primary	11.76	12.33	10.53	11.59	
Junior high school	20.59	27.4	14.04	21.34	
Senior High school	17.65	6.85	14.04	11.59	
Technical/Voc. School	2.94	8.22	0.00	4.27	
Tertiary	14.71	15.07	59.65	30.49	
Not stated	8.82	17.81	0.00	9.76	

Table 4.1 continued

Main Occupational Activity %)					
Public sector employee	14.71	10.96	32.76	19.39	0.016**
Private sector employee	11.76	5.48	13.79	9.70	
Self-employed	44.12	58.90	32.76	46.67	
Artisan	2.94	4.11	6.90	4.85	
Unemployed	23.53	13.7	5.17	12.73	
Household size (number) (SD ±)	3.38 (1.54)	3.89 (1.78)	3.00 (1.57)	3.47 (1.68)	0.010***
Type of Occupancy (%)					
Separate House/Bungalow	8.82	13.89	27.59	17.68	0.000***
Semi-detached	11.76	5.56	17.24	10.98	
Compound house	76.47	79.17	34.48	62.8	
Other	2.94	1.39	20.69	8.54	
Mean monthly Income (Ghana cedis) (standard deviation)	707.78 (501.32)	871.68 (709.32)	1288.37 (838.34)	984.38 (754.94)	0.000***

Notes on Table 4.1

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (***) denotes statistical significance at the 1% level.

(3) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

4.2 Analysis of the Relationship between Type of Solid Wastes Generated by Households and their Socioeconomic Status

The study identified 12 major types of waste generated by households. These are (1) food waste, (2) plastic, (3) paper, (4) aluminium can, (5) bottle, (6) wood, (7) metal, (8) glass, (9) textile, (10) leather, (11) diapers and (12) special waste consisting of electronics, batteries and tyres and other organic wastes. Table 4.2 shows the degree of importance attached to the generation of various types of waste by households in the survey area based on the Likert-type scale quantification of the order of importance. For all the 165 respondents, the most important source of waste was plastic with an average score of 3.70 out of the maximum score of 5.0 and the lowest score of 0.0. The next most important type of waste after plastic was food waste followed by paper, bottle, aluminium, diapers, textile, metal and wood in order of importance. Glass was the least important of waste generated (score of 0.24). The second and third least important types of waste were leather (0.25) and special waste (0.32). It is clear that the most important sources of wastes generated by households were largely biodegradable and/or recyclable offering a chance for converting the wastes into resources for improved livelihood of residents based on additional income that could be earned.

For comparison across the three income-based suburbs, plastic was the most important source of waste for all three suburbs. Food waste also remained the second most important source of waste in each of the three suburbs. In terms of the least important source of waste, there were variations across the three suburbs. For the high-income suburb, leather was the least important source of waste while the least important source of waste was glass for the middle-income suburb and metal for the low-income suburb.

Table 4.2: Importance of the types of wastes generated by households based on the scoring index of level of importance of particular waste.

Type of waste	% HH generating waste (n=165)	Income-based suburb			Total	P-value
		Low	Middle	High		
Food waste	98.2	3.21	3.70	3.45	3.51	0.425
Plastic	95.8	3.32	3.99	3.55	3.70	0.000***
Paper	87.9	1.62	1.56	1.60	1.59	0.665
Aluminium	46.7	0.82	0.88	0.59	0.76	0.003***
Bottle	50.0	1.15	0.79	0.93	0.92	0.013***
Wood	27.9	0.68	0.33	0.33	0.40	0.001***
Metal	20.6	0.12	0.21	0.97	0.45	0.000***
Glass	13.9	0.21	0.10	0.43	0.24	0.000***
Textile	35.2	0.56	0.44	0.67	0.55	0.002***
Leather	19.4	0.35	0.14	0.33	0.25	0.000***
Diapers	21.2	0.62	0.73	0.57	0.65	0.710
Special waste	24.9	0.38	0.32	0.29	0.32	0.016**

Notes on Table 4.2

(1) A score of 5 indicates extremely important", 4 is "very important", 3 is "modestly important", 2 is "less important" and 1 "not important" and0"means does not generate that type of waste"

(2) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(3) The triple asterisk (***) denotes statistical significance at the 1% level.

(4) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

4.3 Analysis of Waste Disposal Practices by Households

With respect to waste disposal methods, the largest subgroup of households (38.18%) dumped their wastes in public containers for collection. This proportion was significantly higher among residents in the low-income suburb (50.0%) compared to only 20.0% among those in the high- income suburb (p value of 0.001). Another 38.18% also reported that they burned their waste around their homes. This behaviour was more common among respondents from the middle-income suburb ($p<0.01$). About 36.0% of households used companies which collected their waste from their houses. This method of disposal was significantly highest at the high-income suburb (70.69%, $p<0.01$).

Some 15.52% of the households gave their waste (organic food waste) to animals, which was highest (45.21%) for the middle-income suburb and lowest (15.52%) for the high income-suburb. None of the households responded yes to putting waste into gutters; however, 9.09% of the respondents buried wastes in the ground around their house while 5.45% responded yes to throwing waste in the bush. Throwing waste into the bush was most frequent for the high-income suburb because of the persistence of squatters and caretakers living in uncompleted buildings in the high-income suburb.

Analysis of the type of occupancy and type of method of waste disposal showed that dumping of waste at public dumps (containers) was highest (76.19%, $p<0.01$) among those residing in compound houses. Residents in compound houses also indicated highest scores for burning household solid waste around the house (66.67%, $p<0.01$) with semi-detached house residents recording the lowest (15.87%). Waste collection from households by companies was also highest (46.55%, $p<0.0$) among residents of compound houses.

Throwing waste in the bush was another method of household solid waste disposal that the study identified. About 77.78% of respondent who resided in compound houses responded yes to throwing waste in the bush. This was however lower (11.11%) within residence of bungalows and semi-detached houses. One respondent residing in a compound house responded yes to throwing waste around the neighbour's house, however, none responded yes to sweeping wastes into gutters and drains. Majority (73.08%) of respondents who resided in compound houses also responded that they gave part of their food waste to livestock. However, this was not a common practice among respondents who resided in the semi-detached and separate houses.

Burying of waste in the ground around respondents' houses was also another method of household solid waste disposal identified. Majority (60.00%) of respondents in compound houses admitted to this method of disposal. It was also a common practice by respondents who lived in separate houses or bungalows and semi-detached houses. This attitude of respondents residing in bungalows and semi-detached houses, which was a common feature of the high-income suburb might be attributed to the fact that some areas within the suburb were still under development with open vegetation as well as caretakers for houses. It was likely respondents who engaged in such methods of disposal might belong to the group of caretakers or squatters who have occupied uncompleted buildings in this suburb.

Table 4.3: Relationship between waste disposal practices of households, their income status and type of occupancy.

	Disposal Method							
Variable	Dumping the waste at the public dump Container	Burning garbage around your house	Collected	Throwing the wastes in the bush	Throwing the wastes around your neighbour hood	Sweep or put solid wastes in the gutters and drains	Burying the wastes in the ground around your house	Given to livestock
Income suburb (%)								
Low	50.00	26.47	26.4	2.94	2.94	0.00	0.00	29.41
Middle	46.58	54.79	12.33	5.48	0.00	0.00	17.81	45.21
High	20.69	24.14	70.69	6.90	0.00	0.00	3.45	15.52
Total	38.18	38.18	35.76	5.45	0.61	0.00	9.09	15.52
p-value	0.003***	0.000***	0.000***	0.722	0.144	-	0.002***	0.001***
Type of occupancy								
Separate/bungalow	12.70	17.46	20.69	11.11	0	0	20.00	9.62
Semi-detached	9.52	15.87	10.34	11.11	0	0	20.00	9.62
Compound house	76.19	66.67	46.55	77.78	100	0	60.00	73.08
Other	1.59	0.00	22.41	0.00	0.00	0	0.00	7.69
Total	100	100	100	100	100	0	100	100
p-value	0.016**	0.011**	0.000***	0.709	0.897	-	0.439	0.233

Notes on Table 4.3

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (***) denotes statistical significance at the 1% level.

(3) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

4.4.1 Old Methods of Waste Disposal used for Specific Waste Products

Households generate different forms of wastes and since they have different chemical properties, the methods of waste disposal are also different, though there are some commonalities among some of the wastes. The varied methods used for managing wastes can broadly be categorized into old (traditional) and modern methods. The old or traditional methods are those that do not generate any direct benefits to householders from wastes but focus on getting rid of the wastes. On the other hand, the modern methods try to make use of the waste to serve other purposes for human livelihood including generation of additional income for the producers of the wastes. This section presents the results of the analysis dealing with the old methods of managing solid wastes. The next section presents results of the analysis dealing with the modern methods of managing solid wastes.

The results presented in Table 4.4.1 show that for food waste, only 8.82% of the respondents indicated that they did not generate such kind of waste. The results across the different income suburbs show that households usually use three methods for disposing food waste. These methods are (1) dumping waste into public container (29.63%), (2) using companies to collect the waste from their homes (21.60%), and (3) giving the waste to livestock and domestic animals such as dogs (27.16%). Within the low-income suburb, half of them (50.00%) dispose their food waste by dumping them into public containers. A few others (14.71%) burned the wastes, gave the wastes to livestock and other domestic animals (14.71%) or had the wastes collected (1.76%). For the middle-income suburb, a relatively large proportion of respondents dispose their food waste by giving it to livestock (42.86%), dumping in a public container (28.57%), or burning it around house (18.57%). For those within the high-income suburb, half

of them used waste collection companies to collect their food waste which was included as part of the total wastes generated in the home.

For plastic waste, 4.17% of respondents indicated that they did not generate such kind of waste; a modest proportion of people in the high-income suburb (11.32%) and relatively smaller proportion in the middle-income suburb (4.17%) did not generate this type of waste. However, all the respondents in the low-income suburb generated plastic waste. A relatively large proportion of all respondents (38.40%) depended on the services of waste companies to collect them. The proportion of respondents that dumped plastic wastes into public container was 29.90% compared to 24.40% who burned the plastic waste.

For those within the low-income suburb, half of them (50.00%) dispose their plastic waste by dumping it in a public container. About one-third (33.3%) of respondents living in the low-income suburb burned their plastic wastes compared to one-sixth (16.67%) of these people who had these wastes collected by private companies from their homes. For those within the middle-income suburb, the most popular method they used for disposing plastic waste was dumping it in a public container (35.42%). Almost three out ten (29.17%) of these people living in the middle-income suburb burned the plastic waste while one-quarter of them (25.00%) had the plastic wastes collected from their homes by companies. For those living in the high-income suburb, majority of them (60.38%) used waste companies.

Concerning paper waste, 14.37% indicated that they did not generate such waste. Dumping into public waste containers (31.25%) was the most popular form of disposing of paper wastes followed by burning (27.50%) and collection by waste companies (23.75%). Whereas a large proportion of those living in the low-income suburb disposed paper waste by dumping it in a

public container (45.45%) or burning (27.27%), those residing in the middle-income suburb usually disposed their paper waste by burning (41.43%) and dumping it in a public container (31.43%). A large proportion of those living in the high-income suburb depended on waste collection companies (52.63%) to dispose their paper waste. Based on the analysis of variance test, the different methods used to dispose-off paper waste among the low, middle and high-income suburbs was significant *(p-value < 0.000).*

Concerning aluminium waste, more than half of the respondents (56%) indicated that they did not generate any aluminium waste. A large proportion of those who did not generate aluminium waste were those who lived in the high-income suburb (79.31%). Dumping of waste into public containers was the common method for disposing aluminium waste (25.61%) by the few who generated that type of waste. Within the low-income and middle-income suburbs, aluminium waste was usually disposed by dumping it into a public container. The few people who generated aluminium waste in the high-income suburb dumped this waste into a public container (15.52%).

For bottle waste, more than half of the respondents (52.12%) indicated that they did not generate such waste. For the remaining 47.88% who generated bottle waste, as high as 46.06% used old methods of disposal and none of the respondents indicated that they used any modern method of waste disposal. For the low-income suburb, the most common method of disposal of bottle waste was through dumping into public containers (44.12%). This method was also the most popular method for people living in the middle-income suburb and the high-income suburb.

Table 4.4.1: Old waste disposal methods used for specific wastes.

Income Group	Old Methods: Does not generate this kind of waste	Dumping waste in Public Container	Burning	Burying	Collected	Give to livestock	Other	p-value
Food Waste								
Low	8.82	50.00	14.71	0.00	11.76	14.71	0.00	
Middle	1.43	28.57	18.57	2.86	2.86	42.86	2.86	
High	5.17	18.97	5.17	3.45	50.00	15.52	1.72	0.000***
Total	4.32	29.63	12.96	2.47	21.60	27.16	1.85	
Plastic/Rubber								
Low	0.00	50.00	33.33	0.00	16.67	-	0.00	
Middle	4.17	35.42	29.17	4.17	25.00	-	2.08	
High	11.32	15.09	11.32	1.89	60.38	-	0.00	0.000***
Total	6.40	29.60	22.40	2.40	38.40	-	0.80	
Paper								
Low	12.12	45.45	27.27	0.00	15.15	-	0.00	
Middle	18.57	31.43	41.43	0.00	4.29	1.43	2.86	
High	10.53	22.81	10.53	1.75	52.63	-	1.75	0.000***
Total	14.37	31.25	27.50	0.63	23.75	0.63	1.88	
Aluminum								
Low	36.36	36.36	18.18	0.00	9.09	-	0.00	
Middle	47.95	28.77	10.96	2.74	8.22	-	1.37	
High	79.31	15.52	0.00	3.45	0.00	-	1.72	0.001***
Total	56.71	25.61	8.54	2.44	5.49	-	**1.22**	
Bottles								
Low	32.35	44.12	17.65	0.00	5.88	-	0.00	
Middle	52.05	21.92	9.59	1.37	13.70	-	1.37	0.011**
High	63.79	15.52	0.00	1.72	15.51	-	3.45	
Total	52.12	24.24	7.88	1.21	12.73	-	1.82	

Notes on Table 4.4.1

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (***) denotes statistical significance at the 1% level.

(3) The double asterisk (**) denotes statistical significance at the 5% level.
(4) The dash (-) denotes non-applicability of such method to that particular waste

Source: Field data, 2015

4.4.2 Modern Methods of Waste Disposal used for Specific Waste Products

There are basically three modern waste disposal methods that are commonly used. These are segregation for composting (for organic waste), reuse, and segregation for recycling. The analysis of the results shows that only 3 of the 165 respondents, representing 1.82% used a composting as modern method for disposal with respect to food waste with two people using the food waste for composting and the other one for recycling purpose. All these three people lived in the middle-income suburb.

With regard to rubber/plastic, 40 respondents indicated that they used a modern disposal method for this type of waste. For the method of reuse, all five respondents who indicated this method for this type of waste lived in the high-income suburb. However for the method of recycling, respondents across all three income-based suburbs used this modern method of disposal with about one-quarter (24.64%) of these people coming from the low-income suburb, 64.10% coming from the middle-income suburb and about one in ten (10.26%) coming from the high-income suburb.

The modern methods for waste disposal was used by only five people for paper waste with reuse and recycling being the two methods. The person living in the low-income suburb who used the modern method for paper waste used segregating for recycling. The three people, living in the middle-income suburb, and the one person living in the high-income suburb, who used the modern method for disposal of paper waste, used the reuse method. Finally, only one person who lived in the low-income suburb used a modern method for recycling aluminium waste; this method was reuse.

Table 4.4.2: Modern waste disposal methods used for specific waste.

Income Group	Modern Methods: Segregating for composting	Modern Methods: Reuse	Modern Methods: Segregating for Recycling	p-value
		Food Waste(n=3)		
Low	0.00	-	0.00	
Middle(n=3)	66.67	-	33.33	-
High	0.00	-	0.00	
		Plastic/Rubber (n=40)		
Low (n=10)	-	0.00	24.64	
Middle (n=25)	-	0.00	64.10	0.028**
High (n=5)	-	100	10.26	
		Paper (n=5)		
Low (n=1)	-	0.00	100	
Middle (n=3)	-	75.00	0.00	0.082*
High (n=1)	-	25.00	0.00	
		Aluminum (n=1)		
Low	-	100.00	-	
Middle	-	0.00	-	-
High	-	0.00	-	

Notes on Table 4.4.2

(1) The p value refers to the probability of committing a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The double asterisk (**) denotes statistical significance at the 5% level

(3) The triple asterisk (*) denotes statistical significance at the 10% level.

(4) The dash (-) denotes non-applicability of such method to that particular waste

Source: Field data, 2015.

4.5 Waste Management Practices of Households and their Level of Knowledge of the Different Modern Methods of Waste Management

Table 4.5 presents a summary of results concerning the knowledge of modern method of waste management by the respondents. Overall, four out 10 respondents had low knowledge about the modern methods of waste disposal. One in three respondents had high knowledge about the modern methods while the remaining 26.67% had moderate level of knowledge about the modern methods. It is clear that for the three income-based suburbs, the low-income suburb had the highest proportion (41.18%) of people with high knowledge on the modern methods of waste disposal followed by people living in the middle-income suburb (41.10%); the lowest proportion (18.97%) of people with high knowledge of modern waste disposal method lived in the high-income suburb (refer to Table 4.5).

Table 4.5: Knowledge of modern waste disposal methods.

	Income-based suburb				
Knowledge	Low	Middle	High	Total	p-value
Low	32.35	31.51	55.17	40.00	
Medium	26.47	27.40	26.67	26.67	0.03**
High	41.18	41.10	18.97	33.33	

Notes on Table 4.5

(1) The p value refers to the probability of committing a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015.

4.6 Knowledge of Modern Waste Management Methods among Different Socioeconomic Characteristics

The results of the analysis of the knowledge and awareness of the four modern methods of waste disposal in relation with various socioeconomic characteristics of respondents are reported in Table 4.6. The four modern methods of waste disposal are pre-cycling, reuse, composting and recycling. The three socioeconomic characteristics used for the discussion are income (suburb), household size and type of household dwelling tenancy.

For the income-based suburb, knowledge of the four modern methods of waste disposal was at its highest in the middle-income suburb. Based on the analysis of variance test, statistically significant difference in the proportions of people with knowledge about the modern methods of waste disposal could only be established for the pre-cycling and reuse methods for the variation among the three income-based suburbs.

With respect to household size, small-sized households appeared to have the highest knowledge about the four modern methods of waste disposal. However, the analysis of variance test revealed no statistically significant differences in the proportions of people expressing knowledge across household size for any of the four methods. For type of dwelling tenancy, there were clear statistically significant differences for all four modern methods of waste disposal.

Table 4.6: Awareness of alternative waste management practices across various socioeconomic characteristics measured through the proportions of respondents.

Variable	Waste management practices			
	Pre –cycling (n=70)	Reuse (n=100)	Composting (n=96)	Recycling (n=125)
Income-based suburb				
Low	24.29	24.00	22.92	17.60
Middle	51.43	50.00	47.92	48.00
High	24.29	26.00	29.17	34.40
P-value	0.043**	0.009***	0.162	0.136
Household size				
Small	51.43	47.00	50.00	48.80
Medium	32.86	28.00	28.13	30.40
Large	15.71	25.00	21.88	20.80
P-value	0.374	0.058	0.589	0.201
Type of household dwelling tenancy				
Separate house	22.86	16.00	17.71	21.60
Semi-detached	12.86	11.00	11.46	9.60
Compound house	64.29	73.00	69.79	66.40
Others	0.00	0.00	1.04	2.40
P value	0.005***	0.000***	0.000***	0.000***

Notes on Table 4.6

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (***) denotes statistical significance at the 1% level.

(3) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015.

4.7 Knowledge about Waste Management Practices and Willingness to Accept New Strategies of Converting Household Wastes into Resources

Four strategies were identified as effective in turning household waste into a resource. These strategies were (1) waste reduction, (2) reuse, (3) composting and (4) segregation. This section analyses the relationship between these strategies and other socio-economic characteristics such as income, knowledge and education

4.7.1 Willingness to Accept Waste Reduction

The analysis of the wiliness of the people to accept waste reduction as a strategy for converting waste into a resource by residents of the three income-based suburbs shows a non-statistically significant relationship. All the respondents across the three income localities indicated that they were much willing to accept waste reduction strategy to waste management. The results show that as high as 95.76% of the respondents across all the three income suburbs were willing to accept waste reduction strategy and only 4.24% were unwilling to accept. For instance, among the low-income suburb, as high as 94.12% of the respondents were willing to accept waste reduction strategy and only 5.88% were unwilling to accept waste reduction.

Similarly, for those within the middle-income suburb, as high as 95.89% were willing to accept waste reduction and only 4.11% were unwilling to accept. In the high-income suburb, as high as 96.56% were willing to accept and only 3.44% were unwilling to accept waste reduction as a strategy for converting waste into a resource. Similar results were obtained when knowledge and formal educational attainment were used as the socio-economic characteristics to assess the willingness to accept waste reduction (refer to Table 4.7.1).

Table 4.7.1: Extent of willingness to adopt waste reduction strategies based on the proportion of respondents for different socioeconomic characteristics.

Income Status	Extent of Willingness %					p-value
	Very unwilling	Unwilling	Slightly willing	Willing	Very willing	
Income						
Low	2.94	2.94	2.94	44.12	47.06	
Middle	1.37	2.74	6.85	41.10	47.95	0.841
High	1.72	1.72	8.62	53.45	34.48	
Knowledge						
Low	0.00	3.03	12.12	50.00	34.85	
Medium	2.27	2.27	2.27	36.36	56.82	0.168
High	3.64	1.82	3.64	49.09	41.82	
Education						
No School	5.56	5.56	11.11	38.89	38.89	
Primary	0.00	0.00	15.79	57.89	26.32	
JHS	2.86	2.86	2.86	40.00	51.43	0.859
SHS	5.26	0.00	5.26	42.11	47.37	
Tech/Voc	0.00	0.00	0.00	71.43	28.57	
Tertiary	0.00	4.00	6.00	48.00	42.00	
Not Stated	0.00	0.00	6.25	37.50	56.25	

Notes on Table 4.7.1

(1) The p value refers to the probability of committing a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

Source: Field data, 2015

4.7.2 Willingness to Accept Reuse

The relationship between the willingness to accept reuse as a strategy for converting waste into a resource and income groups was statistically significant at 5% ($p < 0.05$). As high as 94.12% of those within the low-income suburb were willing to accept reuse. In the same way, 93% of those within the middle-income suburb were also willing to accept as well as 98% of those within the high-income suburb. Thus, with regards to reuse as a strategy for converting waste into a resource, the level of willingness to accept is relatively high among high-income suburbs as compared to the middle and low income suburbs.

The analysis of the relationship between levels of knowledge and education were however not statistically significant (p-values > 0.05) as presented in Table 4.9 above. For instance, with regards to knowledge, 96.97% of those with low knowledge, 97.73% of those with middle knowledge and 90.91% of those with high knowledge about waste management were willing to accept to accept reuse as a strategy for converting waste into a resource but the difference was not statistically significant ($p > 0.05$). With regards to education, over 90% across all the educational categories were willing to accept reuse strategy to manage waste, but this was not statistically significant across the educational groups.

Table 4.7.2: Extent of willingness to adopt waste reuse strategies.

Income Status	Extent of Willingness %					p-value
	Very unwilling	Unwilling	Slightly willing	Willing	Very willing	
Income						
Low	2.94	2.94	2.94	26.47	64.71	
Middle	0.00	6.85	4.11	38.36	50.68	
High	1.72	0.00	5.17	62.07	31.03	0.014**
Total	1.21	3.64	4.24	44.24	46.67	
Knowledge						
Low	0.00	3.03	6.06	51.52	39.39	
Middle	0.00	2.27	4.55	31.82	61.36	
High	3.64	5.45	1.82	45.45	43.64	0.185
Total	1.21	3.64	4.24	44.24	46.67	
Education						
No School	5.56	5.56	5.56	27.78	55.56	
Primary	0.00	5.26	5.26	68.42	21.05	
JHS	0.00	2.86	2.86	31.43	62.86	
SHS	5.26	0.00	5.26	26.32	63.16	0.326
Tech/Voc	0.00	0.00	0.00	57.14	42.86	
Tertiary	0.00	4.00	6.00	56.00	34.00	
Not Stated	0.00	6.25	0.00	37.50	56.25	
Total	1.22	3.66	4.27	43.90	46.95	

Notes on Table 4.7.2

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015.

4.7.3 Willingness to accept composting

For composting, the willingness to accept it as a strategy for converting waste into a resource among the various income groups was statistically significant. 94.12% of those in low-income suburb, 90.41% of those within middle income, and 98.28% of those within high-income suburb were willing to accept composting. Thus, the willingness to accept composting was significantly high among those in the high-income suburb as compared to those in the low and middle-income suburbs (p-value = 0.041 < 0.05).

However, concerning knowledge, even though 95.45% of those with low knowledge, 93.18% of those with middle knowledge and 92.72% of those with high knowledge were willing to accept composting as a strategy for converting waste into a resource, the difference among the knowledge levels are not statistically significant (p-value = 0.204).

Similarly, the relationship between the various levels of educational attainment and willingness to accept composting as a strategy for converting waste into a resource was not statistically significant (p-value = 0.937> 0.05).

Table 4.7.3: Extent of willingness to accept waste composting strategies.

Income Status	Extent of Willingness %					p-value
	Very unwilling	Unwilling	Slightly willing	Willing	Very Willing	
			Income			
Low	2.94	2.94	0.00	41.18	52.94	
Middle	2.74	6.85	6.85	52.05	31.51	
High	0.00	1.72	13.79	60.34	24.14	0.041**
Total	1.82	4.24	7.88	52.73	33.33	
			Knowledge			
Low	0.00	4.55	15.15	51.52	28.79	
Middle	2.27	4.55	4.55	50.00	38.64	
High	3.64	3.64	1.82	56.36	34.55	
Total	1.82	4.24	7.88	52.73	33.33	0.204
			Education			
No School	5.56	5.56	11.11	44.44	33.33	
Primary	0.00	5.26	10.53	63.16	21.05	
JHS	2.86	2.86	5.71	45.71	42.86	
SHS	0.00	5.26	10.53	36.84	47.37	
Tech/Voc	0.00	0.00	0.00	71.43	28.57	
Tertiary	0.00	4.00	8.00	62.00	26.00	
Not Stated	6.25	6.25	6.25	43.75	37.50	0.937
Total	1.83	4.27	7.93	52.44	33.54	

Notes on Table 4.7.3

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

4.7.4 Willingness to accept segregation

The fourth alternative waste management strategy considered in this study is segregation. The results concerning the willing to accept segregation among the various income groups showed that there is a statistically significant relation between income suburbs and willingness to accept. The results show that 94.12% of those within the low-income suburb, 95.89% of those within the middle-income suburb and 98.28% of those within the high-income suburb were willing to accept segregation. Thus, a large proportion those within the high-income suburb are more willing to accept segregation than those within the low and middle-income suburbs and this difference is statistically significant ($p< 0.05$).

There was no statistically significant relationship between knowledge and willingness to accept segregation as a strategy for turning waste into a resource. The results show that 96.03% of those with low knowledge, 97.73% of those with middle and 94.54% of those with high knowledge were willing to accept segregation as a strategy of waste conversion.

With regards to education, the results show that there is no statistically significant relationship between education and the willingness to accept segregation as a waste conversion strategy. The chi-square test among the various levels of willingness among the various level of education produced a p-value = 0.622> 0.05. Therefore it can be concluded that education is not a significant variable in examining the willingness of people to accept segregation as a strategy for converting waste into a resource.

Table 4.7.4: Extent of willingness to accept waste segregation strategies.

Income Status	Extent of Willingness%					p-value
	Very unwilling	Unwilling	Slightly willing	Willing	Very willing	
Income						
Low	2.94	2.94	5.88	26.47	61.76	
Middle	0.00	4.11	6.85	39.73	49.32	
High	0.00	1.72	8.62	56.90	32.76	0.085*
Total	0.61	3.03	7.27	43.03	46.06	
Knowledge						
Low	0.00	3.03	12.12	42.42	42.42	
Middle	0.00	2.27	4.55	34.09	59.09	
High	1.82	3.64	3.64	50.91	40.00	0.294
Total	0.61	3.03	7.27	43.03	46.06	
Education						
No School	5.56	5.56	11.11	22.22	55.56	
Primary	0.00	5.26	10.53	42.11	42.11	
JHS	0.00	0.00	8.57	34.29	57.14	
SHS	0.00	0.00	10.53	36.84	52.63	
Tech/Voc	0.00	0.00	0.00	57.14	42.86	0.622
Tertiary	0.00	4.00	6.00	54.00	36.00	
Not Stated	0.00	6.25	0.00	50.00	43.75	
Total	0.61	3.05	7.32	42.68	46.34	

Notes on Table 4.7.4

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (*) denotes statistical significance at the 10% level.

Source: Field data, 2015

4.8. Expenditures Incurred in the Disposal of Wastes

Table 4.8 shows the information given by respondents on the availability of home-based private waste collection services and public/community waste dumps in their areas and the expenditures incurred to dispose their wastes through these two methods. When asked if there is a waste collection service in the community, 94.12% of those in the low-income suburb indicated that there was a waste collection service in their community. In the same way, majority (84.48%) of those in the high-income suburb noted that they had a waste collection service in their community but only about 37% of people living in the middle-income suburb indicated that there was a waste collection service in the community. The average monthly payment for home-based waste collection service was GHC20.08 with no statistically significant differences among the mean monthly payment across the three income-based suburbs.

For the community or public waste collection dump, slightly more than five in six of the respondents (84.24%) indicated that they were aware of the existence of such an entity within their community. There were no statistically significant differences among the mean figures for this variable across the three income-based suburbs. The mean monthly payment for the use of the public/community dump was GHC7.83 with middle-income suburb residents paying the highest average amount of GHC9.84 compared to the payments of GHC5.26 and GHC5.84 for the low-income and high-income suburbs respectively. There were statistically significant differences among the mean payments per month across the three different income-based suburbs for the use of public/community dump.

Table 4.8: Expenditure involved with disposal of household solid wastes for home-based private waste collection services and public/community waste dumps.

	Income-based suburb				
	Low	**Middle**	**High**	**Total**	**p-value**
Is there a waste collection service in this community					
Yes	94.12	36.99	84.48	108	0.000***
No	5.88	63.01	15.52	34.55	
Monthly payment for waste management services					
Monthly Payments (GHC)	20.71	10.26	21.23	20.08	0.310
Availability of public or community dump site/container					
Yes	88.24	87.67	77.59	84.24	
No	11.76	12.33	22.41	15.76	0.224
Mean Monthly payment for using community dump container					
Monthly Payment	5.26	9.84	5.68	7.83	0.000***

Notes on Table 4.8

(1) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis in the analysis of variance test to determine the statistical significance among the mean values of the various subgroups. The null hypothesis is that the means of the variables concerned are equal among all subgroups.

(2) The triple asterisk (***) denotes statistical significance at the 1% level.

(3) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

4.9 Factors Influencing the Level of Incomes Acquired through the Conversion of Wastes into Resource based on the Collection and Sales of Household Plastic Wastes

As shown in Table 4.4.2, plastic waste was the main type of solid waste that was collected and converted into a resource earning additional money for the respondents. The average income derived from selling household plastic wastes was GHC2.12 per month for all respondents who answered the relevant question (132). The range of income was from zero GHC to GHC40.0 per month. However, only 32 out of 132 actually earned income through selling household plastic wastes. For this group, the average monthly income was GHC 8.0 with the range from GHC0.5 to GHC40.0.

Table 4.9 reports the results of the standard multiple regression analysis of factors influencing the level of incomes received from selling of household plastics based on the model described in Chapter 3 of this report. The variance inflation factor of all the four independent variables was very low and this result showed the relative absence of the problem of multicollinearity. The overall power of the model was statistically significant at the 0.007 p-value level. As measured by the 0.104 R^2 and the 0.076 adjusted $R^2$the power of the model was modestly good for cross-section data model.

However, the model could not be deemed to be accurate given the many zeros for the dependent variable. This was confirmed by the very high heteroscedasticity that was detected in the model based on the Langrange Multiplier test. The model was also deemed unacceptable as it was not correctly specified based on the Ramsey Reset test. The null hypothesis that the model was adequately specified was rejected at the 0.000 p-value level. Further, the assumption of the normality of the error term was also rejected based on the Shapiro-Wilk test (see Table 4.9 for detailed results).

Table 4.9: Results of the standard multiple regression analysis of factors influencing the level of incomes received from the sales of household plastic wastes. Dependent variable is the amount of money earned by selling household plastic wastes (INCOMEPW)

Explanatory Variable	Parameter Estimate	Standardised Estimate	Student t value	Probability level of significance	Variance inflation factor
CONSTANT	3.176	0.000	2.933	0.004***	1.000
EDU	-0.468	-0.217	-1.811	0.072	2.034
PINCOME	0.002	0.151	1.304	0.195	1.900
FHH	-2.557	-0.216	-2.280	0.024**	1.271
AGEOLDWOMAN	4.619	0.298	3.253	0.001***	1.190

Notes on Table 4.13

(1) The sample size used for this analysis was 132.

(2) R^2 was 0.104 and adjusted R^2 was 0.076 and was statistically significant at the 0.007 level.

(3) Probability level of significance of model specification based on the Ramsey Reset test for the null hypothesis of correct model specification 0.000***

(4) Probability level of significance of the normality of the error term based on the Shapiro-Wilk test for the null hypothesis of normally distributed error term 0.000***

(5) Probability level of significance of the homoscedasticity of the error term based on the Langrange Multiplier test for the null hypothesis of homoscedasticity 0.000***

(4) The triple asterisk (***) denotes statistical significance at the 1% level.

(5) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

The results from Table 4.9 clearly showed that the standard multiple regression model estimated through the ordinary least squares (OLS) method was completely unsuitable based on the strong presence of three key econometric problems – inadequate specification of the model, non-normality of the error term and heteroscedasticity (non-constant variance of the error term). So the Tobit model was estimated and used for discussion in this study.

Table 4.10 reports the results of the Tobit multiple regression analysis of factors influencing the level of incomes received from selling of household plastics. The SIGMA parameter reflects the degree of appropriateness of the model and its very high significance suggests that the Tobit specification is the appropriate model for the analysis of the data dealing with incomes earned from selling household plastic wastes. With the confirmation of the acceptability of the Tobit model, the only statistically significant parameter is for the variable AGEOLDWOMAN. The parameters of the other three variables – EDU, PINCOME and FHH – are not statistically significant. It is concluded that women who are over 50 years were more likely to be collecting household plastic wastes to raise money to alleviate poverty or improve their living standards.

Table 4.10: Results of the Tobit multiple regression analysis of factors influencing the level of incomes received from the sales of household plastic wastes.

Dependent variable is the amount of money earned by selling household plastic wastes (INCOMEFROMPLASTICWASTE)

Explanatory Variable	Parameter Estimate	Student t value	Probability level of significance
CONSTANT	-5.017	-1.255	0.210
EDU	-1.652	-1.675	0.094
PINCOME	0.306	0.729	0.466
FHH	-5.024	-1.301	0.193
AGEOLDWOMAN	11.750	2.611	0.009***
SIGMA	13.559	6.935	0.000***

Notes on Table 4.14

(1) The sample size used for this analysis was 132. The number of lower censored observations was 100. The number of uncensored observations (positive observations that is incomes from wastes greater than zero) was 32. The fraction of uncensored observations (positive observations) was 0.242 (32/132).

(2) The p value refers to the probability of a Type 1 error by rejecting the null hypothesis based on the Student t test. The null hypothesis is that the parameter has a value of zero.

(3) The triple asterisk (***) denotes statistical significance at the 1% level.

(4) The double asterisk (**) denotes statistical significance at the 5% level.

Source: Field data, 2015

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The study sought to examine how households could convert domestic solid waste into resources for additional income and poverty reduction. The study was conducted in three suburbs namely Adjako Area (low-income suburb), Presbyterian Church Area (middle-income suburb and Estate Area (high-income suburb). A total of 165 households were randomly selected based on proportional representation using populations for the suburbs. The data were analysed based on various statistical tests such as simple statistical analysis, analysis of variance test to determine statistically significant differences among the means of various variables of interest. Multiple regression analysis was undertaken to establish the factors that influenced the level of income earned from selling household plastic waste. This chapter presents the summary of the main findings, conclusions and recommendations

5.1 Summary of Findings

The summary of findings is presented below sequentially based on the six declared objectives of the study which are outlined in Chapter 1.

5.1.1 Type of solid wastes generated by households

The study revealed that there were 12 types of waste generated by households in terms of volume. These were (1) food waste, (2) plastic, (3) paper, (4) aluminium can, (5) bottle, (6) wood, (7) metal, (8) glass, (9) textile, (10) leather, (11) diapers and (12) special waste

consisting of electronics, batteries and tyres and other organic wastes. Food waste and plastics were the most important types of waste generated by households.

5.1.2 Waste management practices of households

A large group of households (38.18%) dumped their wastes in public containers for collection. Another equally large group of households (38.18%) indicated that they burned waste around their homes or within the vicinity of their homes. The third most important source of disposal of household waste was through collection at homes by private or public waste management companies; this practice was declared by 35.76% of all respondents. Burying the waste around the home was the third most important disposal source used by 9.09% of respondents. Throwing the wastes into the bush and throwing the bush around the neighbourhood were the two other declared waste disposal methods and both methods were subscribed to relatively small proportions of respondents.

Dumping of waste into public containers was most popular with respondents from the low-income suburb with one in two of respondents in this suburb using this disposal method. In contrast, in the high-income suburb, collection of waste from the home was the choice of waste disposal by slightly over seven out of 10 (70.69%) of the respondents living in that area. For the middle-income suburb, burning waste around the home was the most popular method of disposal used by 54.79% of respondents followed closely by dumping into public containers used by 46.58% of respondents in this suburb.

In relation to the nature of dwelling of household, those respondents living in compound houses indicated that dumping of waste into public dumps (containers), burning waste around the house and collection of wastes at home by companies were the dominant waste disposal

practices. Burying of waste in the ground around the home was also a common practice among those living in separate houses or bungalows and semi-detached houses.

In terms of the specific types of waste, for food waste, a greater proportion of the households dispose it by dumping it in a public container (dominant in low-income suburb), give it to livestock (middle-income suburb) and use the services of waste collection companies (high-income suburb). For plastics, the major disposal practices were collection by waste collection companies, segregation for recycling, dumping into public containers and burning. For paper wastes, they were mostly dumped into public containers, burned or collected at home by waste collection companies. Aluminium and bottle wastes were mostly dumped into public containers; this was especially so for residents in the low-income suburb.

5.1.3 Household knowledge and different methods for converting solid wastes into resources

The study showed that the majority of the respondents had very low levels of knowledge concerning the different methods of turning wastes into resources. The alternative methods for converting waste into a resource were waste reduction, reuse, recycling and composting. The assessment across the three suburbs revealed behaviour patterns not commonly observed in other parts of the world as reported in the literature. For this study area, a higher proportion of those living in the low-income suburb were found to have *a high level* of knowledge about the conversion of wastes into resources than the proportions of those living in middle-income and high-income suburbs.

5.1.4 Household practices of converting solid waste into resources

The study showed that knowledge was a significant factor in influencing household to adopt waste management practices that could convert solid wastes into resources. The majority of people with high knowledge about a particular management strategy for converting waste into resource were more likely to adopt such strategies such as pre-cycling, reuse, composting, and recycling as compared to those with low and medium knowledge.

Household size was not a significant factor in determining whether people would adopt a different method for converting solid waste into a resource. The type of occupancy was however a statistically significant variable in showing whether or not households would adopt different methods. Those living in compound houses were more likely to adopt all the alternative methods than those living in separate or semi-detached houses.

As expected, people living in the high-income suburb paid more money for waste collection services than those living in the middle-income and low-income suburbs. This result was due to the relatively large number of respondents living in the high-income suburb who subscribed to the services of private waste collection companies. For the use of community waste dumps and containers, those living in the middle-income suburb paid more money than those living in the low-income and high-income suburbs. This result reflected to some extent the demand for use of public waste collection containers and dumps by people living in middle-income suburbs. People living in the low-income suburb often resorted to relatively unimproved practices while those living in the high-income suburb often used private waste collections services based on home collection of wastes.

5.1.5 Acceptability of new strategies of converting solid waste as resources

The findings show that majority of the respondents were willing to accept alternative waste management strategies in general. A little more than 90% indicated that they were willing to accept the alternative waste management strategies and only a few (less than 10%) were unwilling to accept the new strategies. For the specific strategy of waste reduction, income, knowledge of the strategy and educational attainment were not statistically significant in influencing willingness to adopt this strategy to convert solid waste into resource.

For reuse, the majority of those living in the high-income suburb were more willing to accept reuse than those living in the low-income and middle-income suburbs. Knowledge and education were however not significant in influencing willingness to accept reuse. In the case of composting, income, knowledge of the strategy and educational attainment were not statistically significant in influencing willingness to adopt this strategy to convert solid waste into resource. Finally, for segregation of wastes, those living in the high-income suburb were willing to accept this strategy than those living in the low-income and middle-income suburbs. Educational attainment and knowledge of the strategy were not statistically significant in influencing the acceptance of segregation of wastes.

5.1.6 Factors influencing levels of income received for selling household plastic waste

The study established that women aged over 50 received more money from selling household plastic waste as compared to women aged 50 and below and men from all age groups. This result was largely due to the fact that it was women aged over 50 who were more interested in collecting household plastic waste and selling them for money as a poverty alleviation measure.

5.2 Conclusions

The study concludes that solid waste generation by households in the study area is appreciable with at least 12 different types of solid wastes identified. However, waste disposal methods are largely of the traditional types with relatively few modern methods used to dispose of wastes. The traditional disposal methods are also largely of the unimproved types such as burning wastes around the home, burying wastes in the neighbourhood and throwing wastes into the bush. On the other hand, door to door waste collection services operated by private companies are subscribed by the majority of people living in the high-income suburb.

The study also concludes that there is generally low level of conversion of solid wastes into resources to earn additional money that can be used for poverty alleviation. The relatively few people living in the study area that are converting solid waste into resource for additional money are largely older women aged over 50 who collect household plastic wastes for sale.

5.3 Recommendation

In Ghana today, there are many people whose livelihoods depend on picking plastic and metallic waste and it is an undisputable fact that they are able to earn some livelihood from it. There are even many industries which depend on these wastes (esp. plastic and metal) as raw materials. Governments can contribute by making waste management a national priority. Ensuring the provision of skills, information, and ability to implement waste management programs effectively, particularly among the households to help turn the garbage and waste into to resources.

The government and institutions of state should regularize the waste market to make it more lucrative, like other developed countries so that people will have a leverage to segregate and sell their waste to make a revenue from it, which are all steps towards making waste a resource for poverty alleviation.

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APPENDIX 1
SURVEY QUESTIONNAIRE

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH

UNIVERSITY OF GHANA

CONFIDENTIAL

SURVEY OF HOUSEHOLDERS ON THE CONVERSION OF SOLID WASTES INTO RESOURCES FOR POVERTY ALLEVIATION: A CASE STUDY OF ABOKOBI

This study is being conducted in partial fulfilment for the award of a Master's Degree in Development Studies by University of Ghana, Legon. I would be grateful if you could participate in the study by completing this questionnaire. You will be assisting the researcher in purely academic work. Please be assured that all information provided will be treated with utmost confidentially.

SURVEY CODE NUMBER: **********

NAME OF RESPONDENT (member of household)…….....

STATUS……1. Head 2. Spouse 3. Other (specify)……

HOUSE NUMBER……..

LOCATION: 1. Presbyterian Church area 2. Behind District Assembly building area

3. New town area 4. Around Clinic area 5. Nazareth 6. Salem 6. Estate 7. Adjako

CONTACT NUMBER……

DATE……

TIME…….

SECTION A: TYPES OF SOLID WASTES GENERATED BY HOUSEHOLDS

Q.1.Please identify in terms of importance the types of solid wastes that your household generates in terms of volume. Please tick the number most closely representing your opinion noting that a score of 5 is "extremely important", 4 is "very important", 3 is "modestly important", 2 is "less important" and 1 "not important" and 0"means does not generate that type of waste"

TYPE OF WASTE	5	4	3	2	1	0
Food Waste						
Plastics/Rubber						
Paper						
Aluminium						
Bottles						
Wood						
Metals						
Glass						
Textiles						
Leather						
Diapers						
Special Waste (electronics, batteries, tires)						
Other Organic Waste						
Others……..						

SECTION B: SOLID WASTES DISPOSAL METHODS

Q.2. How does your household dispose the solid wastes that it generates? Please tick one or more as applicable

#	Disposal method	1. Yes	2. No
1	Burning garbage around your house		
2	Throwing the wastes in the bush		
3	Throwing the wastes around your neighbourhood …….		
4	Sweep or put solid wastes in the gutters and drains		
5	Burying the wastes in the ground around your house……..		
6	Putting the wastes into the container for collection		
7	Dumping the waste at the public dump {Container)		
8	Given to livestock		
9	Others, (please specify)		

SECTION C: KNOWLEDE OF ALTERNATIVE SOLID WASTE MANAGEMENT PRACTICES

Q.3. Do you know that waste can be turned into resources for use?

1. Yes 0. No

Q.4. Are you aware of these practices to turn household solid waste into resources for use?

Practices	**Yes**	**No**
Waste reduction		
Reuse		
Recycling		
Composting		

Q. 5. What is the method of waste disposal you use specific to these waste products?

Tick the box which applies

Type of Household solid Waste	**Method of Disposal**									
	Dumping In Container	Burning	Segregating for Composting	Reuse	Segregating for Recycling	Burying	Collected	Given to livestock	Does not produce this kind of waste	Other (specify)
Food waste										
Plastics/ Rubber										
Paper										
Aluminium										
Bottles										
Metals										
Glass										
Textiles										
Diaper										
Special waste(white good)										
Wood/other organic Waste										
Leather										
Others										

SECTION D: HOUSEHOLDS USING USER-PAY WASTE COLLECTION SERVICES

Q.6. Is there a waste collection service in this community?

1. Yes…. 0. No……>> next section

Q.7. Are you using the service?

1. Yes …….. 0. No>> next section

Q.8. If you use private or public companies to collect and dispose of your household solid wastes, please indicate the name of the company

……

Q.9. How often does this company collect your garbage or solid wastes from your house?

	Period	***tick***		**Period**	***tick***
1	Daily		4	Every two weeks	
2	Weekly		5	Monthly	
3	Twice weekly		6	Other (*specify*)	

Q.10. How much do you pay to the company for the waste collection and disposal service per month?

GHC……..

Q.11. Do you think the amount spent/charge on solid waste disposal is high?

1) Yes ☐ 0) No ☐

b) Please give reasons…….

Q.12. On a scale of 1 to 5 with 1 being very poor and 5 being excellent, how would you rate the quality of service provided by the company?

5	4	3	2	1
Excellent	Good	Fair	Unsatisfactory	Very poor

Q.13. In what ways do you think the company can improve its service?

……

……

……

Q.14. Do you plan to continue hiring this company to do the collection and disposal of your household garbage? Please state the reason.

1. Yes ☐ 2. No ☐

SECTION E: HOUSEHOLDS USING COMMUNITY WASTE COLLECTION CENTRES FOR DISPOSAL OF SOLID WASTES

Q.15. Is there a community damp (container) in this community?

1. Yes…. 0. No……>> next section

Q.16. Are you using the service?

1. Yes …….. 0. No>> next section

Q.17. If your household disposes its solid waste or garbage through community waste collection centres, how often do you or any family member or any person dispose it?

	Period	***tick***		**Period**	***tick***
1	Daily		4	Every two weeks	
2	Weekly		5	Monthly	
3	Twice weekly		6	Other (*specify*)	

Q.18. Which member of your family normally carries your house garbage to the community waste collection centres?

……

Q.19. Why do you/your household ***not***hire private/public Company to collect and dispose of your household wastes?

……
……
……
……
……..

Q.20. How much do you pay to the company/community for the waste collection and disposal service per month?

GHC……..

Q.21. Do you think the amount spent/charge on solid waste disposal is high?

1) Yes ☐ 0) No ☐

b) Please give reason

……
……
……
……

Q.22. How far is your house to the community central collection point?

……meters

b) How do you carry your garbage or solid waste to the roadside community collection centres?

……

SECTION F: CONVERSION OF SOLID WASTES INTO RESOURCES

Q.23. Have you in the past 12 months received any training/education/information on new ways of solid waste management?

1. Yes [ ] 0. No [ ] >>**skip to 25**

b) If yes by whom? …….

Q.24. If yes, what kind of training/education/information did you receive?

……
……
……
……
……..

Q.25. If no, would you like to go through such training

1. Yes [ ] 2. No [ ]

Q.26. Please identify in terms of importance the type of method used by your household if any to turn the specific type of solid waste generated into resources for income. Please tick the number most closely representing your opinion noting that a score of 5 is "extremely important", 4 is "very important", 3 is "modestly important", 2 is "less important" and 1 "not important" and 0"means does not generate that type of waste".

Method of Disposal	**5**	**4**	**3**	**2**	**1**	**0**	Are you earning income or benefits from the use these forms of waste? 1. **Yes** 2. **No**	Please estimate in cedis (if any) the monthly income/ benefits you gain from the conversion these forms of waste into resources **(GhC)**
A. ORGANIC WASTE – WASTES FROM LEFT-OVER MEALS (COOKED FOOD)								
Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Reuse by Domestic Animals								
Segregating for sale								
Others……..								
B. ORGANIC WASTE – UNCOOKED FOOD, EG. PLANTAIN AND CASSAVA PEELS								

Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Reuse by Domestic Animals								
Segregating for sale								
Others……..								
C. ORGANIC YARD WASTE								
Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Reuse by Domestic Animals								
Segregating for sale								
Others……..								
D. WOOD								
Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale								
Others……..								
E. PLASTICS/RUBBER								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale/ Recycling								
Others……..								
F. PAPER PRODUCTS								
Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale								
Others……..								
G. ALUMINIUM CANS								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale								
Others……..								
H. METALS								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale								
Others……..								
I. BOTTLES								
Gifts to other Human beings								
Reuse by Humans								
Segregating for sale								
Others……..								
J. GLASSES/CERAMICS								

Segregating for sale/ Recycling								
Others……..								
K. TEXTILES								
Gifts to other Human beings								
Segregating for sale/ Recycling								
Others……..								
L. SPECIAL WASTE (bulky items, consumer electronics, white goods, batteries)								
Reuse by Humans								
Segregating for sale								
Others……..								
M. DIAPERS								
Segregating for composting								
Segregating for sale								
Others……..								
N. LEATHER WASTE								
Reuse by Humans								
Segregating for sale								
Others……..								
O. OTHERS (Specify)…….								
Segregating for composting								
Gifts to other Human beings								
Reuse by Humans								
Reuse by Domestic Animals								
Segregating for sale/ Recycling								

SECTION G: ACCEPTABILITY OF WASTE MANAGEMENT PRACTICES OF CONVERTING WASTE INTO RESOURCES FOR POVERTY ALLEVIATION

WASTE REDUCTION

Q.27. Waste generation can be reduced to save money. If taught new practices of waste reduction,please indicate on a scale of 1 to 5 in order of preference how willing you are to practice these to turn solid waste into resources for poverty alleviation

Very willing	willing	slightly willing	Unwilling	Very unwilling
5	4	3	2	1

REUSE

Q.28. Plastic and Rubber bottles can be re- used to make bracelets, baskets, bags for sale to generate income. If taught such new ways of reusing solid waste, please indicate on a scale of 1 to 5 in order of preference how willing you are to practice these to turn solid waste into resources for poverty alleviation

Very willing	willing	slightly willing	Unwilling	Very unwilling
5	4	3	2	1

SEGREGATING FOR COMPOSTING /RECYCLING

Q.29. Zoomlion Ghana Waste Management Company is planning to undertake a project called 'Buy Back,' where waste separated from source will be bought from household. If taught ways of segregating waste for recycling and composting, how willing are you to segregate solid waste for sale for income?

Very willing	willing	slightly willing	Unwilling	Very unwilling
5	4	3	2	1

COMPOSTING

Q.30. Composting produces fertilizers for use and sale for income. If taught ways of composting, how willing are you to practice to turn solid waste generated by your household into resources for poverty alleviation

Very willing	willing	slightly willing	Unwilling	Very unwilling
5	4	3	2	1

SECTION H: SOCIO-ECONOMIC INFORMATION OF RESPONDENT

Q.31. Are you: 1) Male ☐ (0) Female ☐

Q.32. Marital status:

	status	***Tick***		**status**	***tick***
1	Single		4	widowed	
2	Married		5	Cohabitation	
3	Divorced		6	Other (*specify*)	

Q.33. What is your age? ……

Q.34. What is your highest educational level completed? (Please tick the appropriate)

	Education	***Tick***		**Education**	***tick***
1	No school at all		6	HND	
2	Primary		7	Diploma	
3	Junior high school		8	Bachelor degree	
4	Senior high school		9	Postgraduate degree	
5	Technical/Voc. school		10	Other (*specify*)	

Q.35. Please indicate your religious affiliation…….

Q.36. Please indicate your ethnic background……

Q.37. Please state the number of people in your household? _____people

Q.38. Please indicate your type of occupancy

	Response	***tick***
1	Separate house/Bungalow	
2	Semi-detached	
3	Compound house	
4	Other (*specify*)	

Q.39. what is your major occupational activity? Please tick the appropriate occupation

	Occupation	***tick***
1	Government sector employee	
2	Private sector employee	
3	Artisan	
4	Self-employed/ own business	
5	Farmer	
6	Unemployed	
7	Other (*specify*)	

Q.40. Your approximate total **personal** income per month (please tick the appropriate box).

1. Less than 100		11. 1001-1100		21. 2001-2100	
2. 100-200		12. 1101-1200		22. 2101-2200	
3. 201-300		13. 1201-1300		23. 2201-2300	
4. 301-400		14. 1301-1400		24. 2301-2400	
5. 401-500		15. 1401-1500		25. 2401-2500	
6. 501-600		16. 1501-1600		26. 2501-2600	
7. 601-700		17. 1601-1700		27. 2601-2700	
8. 701-800		18. 1701-1800		28. 2701-2800	
9. 801-900		19. 1801-1900		29. 2801-2900	
10. 901-100		20. 1901-2000		30. 2901-3000	

b) Others above 3,000 Ghana cedis.....

c) No idea of personal income or no answer.....

Q.41.Your approximate total family income per month (please tick the appropriate box).

1. Less than 100		11. 1001-1100		21. 2001-2100	
2. 100-200		12. 1101-1200		22. 2101-2200	
3. 201-300		13. 1201-1300		23. 2201-2300	
4. 301-400		14. 1301-1400		24. 2301-2400	
5. 401-500		15. 1401-1500		25. 2401-2500	
6. 501-600		16. 1501-1600		26. 2501-2600	
7. 601-700		17. 1601-1700		27. 2601-2700	
8. 701-800		18. 1701-1800		28. 2701-2800	
9. 801-900		19. 1801-1900		29. 2801-2900	
10. 901-100		20. 1901-2000		30. 2901-3000	

b) Others above 3,000 Ghana cedis.....
c) No idea of family income or no answer.....

Q.42. Any additional information provided by the respondent.

……
……
……
……
……
……
……

THANK YOU VERY MUCH. END OF SURVEY QUESTIONNAIRE.

APPENDIX 2
INTERVIEW GUIDE FOR THE GA EAST MUNICIPAL ASSEMBLY

Q.1. What is the municipal assembly's role in Domestic waste management

Q. 2a.What are the objectives of this municipality in waste management?

Q. 2b. Do you achieve it?

Q.3. Could you please give me an overview of how domestic solid waste is managed?

Q.4. Do you involve private waste collectors?

Q.5a. If yes, please name them……

Q.5b. What percentage/ proportion of greater Abokobi does each waste collection service

Q.6. What challenges do you encounter in executing your daily activities?

Q.7a. Do you involve households and communities in the waste management process?

Q.7b. If yes how?

Q.8. What are the challenges involved in domestic waste management

Q.9. what are some of the current trend in solid waste management?

Q.10.What are the prospects for turning solid waste into resources in the municipality

Q.11. Are you currently involved in any domestic waste management processes that have the potentials of generating income for household or the community?

Q.12. what is the municipality's expenditure and revenue from household solid waste management.

APPENDIX 3

INTERVIEW GUIDE FOR WASTE COLLECTION AGENCIES

Waste Collection agencies (ZOOMLION AND ASADU ROYAL WASTE LIMITED)

Q.1. What are the objectives of this waste management company?

Q.2. Do you achieve it?

Q.3. Could you please give me an overview of how domestic solid waste is managed?

Q.4. Approximately how much waste per ton is generated by households that u serve within Abokobi

Q.5. what challenges do you encounter in executing your daily activities?

Q.6a. Do you involve households and communities in the waste management process?

Q.6b. If yes how?

Q.7. What are the challenges involved in domestic waste management

Q.8. what are some of the current trend in solid waste management?

Q.9. What are the prospects for turning solid waste into resources in the municipality

Q.10. Are you currently involved in any domestic waste management processes that have the potentials of generating income for household or the community?

Q.10b. If yes, how ?

Q.11. what is the companys expenditure and revenue from waste within the study area?

APPENDIX 4

SPSS PROGRAMME USED TO ANALYSE THE DATA BASED ON SIMPLE DESCRIPTIVE ANALYSIS AND MULTIPLE REGRESSION ANALYSIS INCLUDING TESTS FOR NORMALITY OF THE ERROR TERM, CORRECT MODEL SPECIFICATION AND TEST FOR HETEROSCEDASTICITY.

```
GET DATA

/TYPE=XLSX

/FILE='C:\appiahjoyce\survey01.xlsx'

/READNAMES=ON.

frequencies variables=v10 to v23 v25 to v32 v34 to v54 v65 to v67 v71 v78 v83 to v119
v121 to v144 v146 to v182 v184, v185 v186 v188 v189 v190 v191.

descriptives variables=v72 v76 v120 v145 v183 v187.

if v190=1 pincome=50.

if v190=2 pincome=150.

if v190=3 pincome=250.

if v190=4 pincome=350.

if v190=5 pincome=450.

if v190=6 pincome=550.

if v190=7 pincome=650.

if v190=8 pincome=750.

if v190=9 pincome=850.

if v190=10 pincome=950.

if v190=11 pincome=1050.

if v190=12 pincome=1150.

if v190=13 pincome=1250.

if v190=14 pincome=1350.

if v190=15 pincome=1450.

if v190=16 pincome=1550.

if v190=17 pincome=1650.

if v190=18 pincome=1750.

if v190=19 pincome=1850.

if v190=20 pincome=1950.
```

```
if v190=21 pincome=2050.
if v190=22 pincome=2150.
if v190=23 pincome=2250.
if v190=24 pincome=2350.
if v190=25 pincome=2450.
if v190=26 pincome=2550.
if v190=27 pincome=2650.
if v190=28 pincome=2750.
if v190=29 pincome=2850.
if v190=30 pincome=2950.
if v25=1 unimprovedwc1=1.
if v25=2 unimprovedwc1=0.
if v26=1 unimprovedwc2=1.
if v26=2 unimprovedwc2=0.
if v27=1 unimprovedwc3=1.
if v27=2 unimprovedwc3=0.
if v28=1 unimprovedwc4=1.
if v28=2 unimprovedwc4=0.
if v29=1 unimprovedwc5=1.
if v29=2 unimprovedwc5=0.
if v30=1 improvedwc1=1.
if v30=2 improvedwc1=0.
if v31=1 improvedwc2=1.
if v31=2 improvedwc2=0.
if v32=1 improvedwc3=1.
if v32=2 improvedwc3=0.
compute edu=v184.
compute age=v183.
compute distancetohome=v76.
compute phouse=v187.
```

```
compute incomepw=v120.
if v189=6 unemploy=1.
if v189 ne 6 unemploy=0.
if v182=2 married=1.
if v182 ne 2 married=0.
if v188=3 compoundhouse=1.
if v188=2 compoundhouse=0.
if v188=1 compoundhouse=0.
if v181=1 gender=1.
if v181=0 gender=0.
compute status=v3.
if gender=0 and status=1 fhh=1.
if gender=0 and status=2 fhh=0.
if gender=0 and status=3 fhh=0.
if gender=1 and status=1 fhh=0.
if gender=1 and status=2 fhh=0.
if gender=1 and status=3 fhh=0.
compute age1=50.
if age gt age1 ageold=1.
if age le age1 ageold=0.
if age gt age1 and gender=0 ageoldwoman=1.
if age gt age1 and gender=1 ageoldwoman=0.
if age le age1 and gender=0 ageoldwoman=0.
if age le age1 and gender=1 ageoldwoman=0.
descriptives variables=ageold ageoldwoman gender.
frequencies variables=ageold ageoldwoman gender.
regression variables=incomepw edu ageoldwoman fhh
pincome/descriptives=corr/statistics=coeff r tol collin anova/dependent=incomepw/method=
enter edu ageoldwoman fhh pincome/residuals/save=pred(pred1) resid(resid1).
descriptives variables=resid1/statistics=all.
examine variables=resid1/plot=npplot.
```

compute absresid1=abs(resid1).

compute resid1sq=resid1*resid1.

compute pred1sq=pred1*pred1.

regression variables=incomepw pred1sq edu ageoldwoman fhh pincome/descriptives=corr/statistics=coeff r tol collin anova/dependent=incomepw/method=

enter pred1sq ageoldwoman edu fhh pincome.

regression variables=pred1sq resid1sq/descriptives=corr/statistics=coeff r tol collin anova/dependent=resid1sq/method=

enter pred1sq.

APPENDIX 5

TSP PROGRAMME USED TO UNDERTAKE TOBIT MULTIPLE REGRESSION ANALYSIS (TOBIT COMMAND) IN ADDITION TO THE STANDARD MULTIPLE REGRESSION ANALYSIS (OLSQ COMMAND).

```
smpl 1,165;

read(file='c:appiahjoyce\survey09.xls');

olsq incomepw c edu ageoldwoman fhh pincome;

tobit incomepw c edu ageoldwoman fhh pincome;
```