MUNICIPAL SOLID WASTE RE-USE AND RECYCLING FOR WEALTH CREATION AND SUSTAINABLE ENVIRONMENT IN ZARIA, KADUNA STATE, NIGERIA.

BY

Amos Gyes BAKO

(B.Sc. Geography, A.B.U, 2008)

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DEPARTMENT OF GEOGRAPHY,

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AHMADU BELLO UNIVERSITY,

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JUNE, 2014.

DECLARATION

I declare that the thesis entitled "Municipal Solid Waste Re-use and Recycling for Wealth Creation and Sustainable Environment in Zaria, Kaduna State, Nigeria" has been written by me in the Department of Geography under the supervision of Prof. E.O. Oladipo and Dr. R. O. Yusuf. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this project thesis was previously presented for another degree or diploma at any university.

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Name of student	Signature	Date

CERTIFICATION

This thesis entitled “Municipal Solid Waste Re-use and Recycling for Wealth Creation and Sustainable Environment in Zaria, Kaduna State, Nigeria” by BAKO, Amos Gyes meets the regulation governing the award of the Degree of Masters of Science Environmental Management in Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

……………………………………….. ……………………………

Prof. E.O. Oladipo Date

(Chairman, Supervisory Committee)

……………………………………… ………………………….

Dr. R. O. Yusuf Date

(Member, Supervisory Committee)

…………………………………….. ……………………………

Dr. I. J. Musa Date

(Head of Department)

………………………………………… …………………………....

Prof. A. A. Joshua Date

(Dean, PostGraduate School)

DEDICATION

This thesis is dedicated to my Lord and personal Saviour Jesus Christ, the author and finisher of my faith; who saw me through the entire programme. To Him i pledge allegiance with all my life and strength.

To my beloved parents, Mr. and Mrs. Danladi Bako, who gave me all the financial, spiritual and moral support. I will always live to remember your love and care.

I also dedicate this project to the memory of my late Grandfather, Chief Gyes Kpyeh, Mr. (Uncle) Ayuba Dogo, Mr. (Uncle) Ladan Doh, (Cousin) Shuna James (Senator) who saw it when the journey started, but are not present to witness its successful completion. May their gentle souls continue to rest in perfect peace. Amen.

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ABSTRACT

Municipal solid wastes re-use and recycling have multiple socioeconomic and environmental benefits that have not been adequately examined in Zaria, Kaduna State, Nigeria. The objectives of this research are to: examine the socio-economic and demographic characteristics of waste management entrepreneurs; identify the sources and destinations of recyclable municipal solid waste; analyse the quantity of waste materials (metal scraps, plastics and cans) recovered, reused and transported for recycling; identify the type of uses recyclable materials are put into in the study area; and examine the socioeconomic benefit of waste re-use and recycling. A total of 252 scrap metal/plastic collectors, scavengers and artisanal recyclers' were studied using purposive and snowball sampling techniques. Tables, percentages, charts and multiple linear regression techniques were used for the analysis. The results showed that majority of the waste collectors within the twelve localities of Zaria were less than 20 years old. Generally, the low educational level of the respondents indicates that formal educational qualification is not a major determinant of being an actor in this type of business. Cans and aluminium, scrap metal, assorted plastics, are the major materials that attract waste entrepreneurs in Zaria. about 71.8% of waste collectors collect waste from multiple sources and majority of the waste actors about 61.5% collect less than 100 kg of valuable waste materials every week. Products produced by artisanal recyclers from cans and scrap Aluminium includes majorly pots and frying pan. A relatively high proportion (56.7%) of plastic collectors disposes the assorted plastics to those involved in reuse like, bottling of locally made drinks (Zobo and Kunu), traditional herbs and honey. The average monthly income for about 43.3% was above ₦16, 000. 00 which is quite better compared with the Nigerian minimum wage standard. Also all the respondents claimed that no harmful solid substances were released into the environment as a result of artisanal recycling activity. Further, about 30% of waste management entrepreneurs are employers of labour, with 13.5% having more than 6 employees. The multiple regression analysis revealed that the number of people employed in waste business and quantity of waste collected have significant impact on their income with coefficients of 0.343 and 0.360 respectively, while the coefficient of multiple determination (R^2) indicate a total variation of 42.5% at 5% level of significance. However, challenges militating against waste recycling in Zaria include lack of a functional recycling plant; price fluctuation and the cost of conveying recyclables to recycling plants outside the study area among others.

It is concluded that municipal solid waste re-use and recycling activities contribute more to waste management than the government owned agencies in the study area. Their activities in sustainable waste management should be incorporated into the state environmental protection agency institutional framework.

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The term ‘waste’ has a different meaning for different people. In general, waste is ‘unwanted’ for the person who discards it; a product or material that does not have a value anymore for the first user and is therefore thrown away. But ‘unwanted’ is subjective and the waste could have value for another person in a different circumstance, or even in a different culture (Van de Klundert and Justine, 2001). There are many large industries that operate primarily or exclusively using waste materials such as paper and metals as their industrial raw materials. In the context of Integrated Solid Waste Management (ISWM), waste is regarded both as valueless and as a useful material providing a potential source of income. This real value of waste in many low-and middle-income countries (developing countries) is confirmed by the huge informal sector that lives on waste collection and recovery (Van de Klundert and Justine, 2001).

Waste, either in solid or liquid form is being produced since the dawn of human existence and it is not excessive to say, waste is the first thing generated before people are able to contribute to the betterment of lives. Due to social and environmental consequences, waste reuse, recycle and recovery have become essentials in minimizing the environmental damage that could occur through indiscriminate waste disposal (Sivapalan, Mohamad, Mohamad, and Muhd-Noor, 2005).

Davies (2008) notes that “what some people consider to be waste materials or substances are considered a source of value by others” This relative attribute of waste can be compared with the concept of ‘resource’ which has also been defined as material that has use-value and “a reflection of human appraisal” (Jones and Hollier, 1977). Just as a material becomes a resource when it gains use-value, it also becomes waste when it loses its use-value. Like resources, waste is also a relative concept of human appraisal because what constitutes waste can vary from one person to another, one society to another and over time. As noted by Jessen (2002) “our waste stream is actually full of resources going in the wrong direction”.

Waste reuse and recycling as an alternative management option for waste is now recognized as an important approach to solving waste problem both in developed and developing world. Resource recovery from dumped consumer products is growing in significance, as waste is increasingly seen as a valuable resource. As human beings continuously realized that resources are finite, efficient use of resources and resources recovery from wastes are vital for global environmental sustainability (Zaman and Lehmann, 2011).

Developed countries generally rely on land filling to overcome the problem of waste accumulation (Girling, 2005; Pacione, 2005). The landfill seems to have a special attraction for municipal waste managers because it offers a cheap and convenient option for waste disposal compared with other strategies such as reuse, recycling and energy recovery (Charzan, 2002). In fact, with the exception of few countries like Austria, the Netherlands and Denmark who recycle substantial proportions of their waste, most countries in Europe and North America still dump the bulk of their municipal solid waste in landfills (OECD, 2002; Girling, 2005). For instance, In May, 2008, the inadequacy of waste disposal land created mayhem in the Italian city of Naples when the streets became laden with waste, blocking traffic and causing nuisance and hazards (Anthony, 2009). The European Commission's thematic strategy on the prevention and recycling of waste (European Union, 2005) called for life-cycle thinking in waste policies and moving towards a recycling society. This has in turn highlighted the opportunities for improved coherence between policies on waste and those on climate change and resource efficiency (European Environment Agency (EEA), 2011).

Recent studies in Africa have shown that the problem of waste management has become intractable and threatens to undermine the efforts of most city authorities. Kirondi (1999) observed that the city environment in most developing countries is characterized by heaps of garbage, overflowing waste containers, chocked drains, clogged streams and stinking gutters. Hardoy, Mitlin and Satterthwaite (2001) have, therefore, aptly described the Third World urban environment as among the most health and life threatening of all human environments. Scavenging has become a major feature of waste management in many cities in developing countries.

Scavenging is now regarded as a means to reduce the amount of solid waste to be disposed and help to save the natural resources that leads to sustainable development (Muktar, 2011). It creates jobs and extra income for people especially the poor. Scavenging makes people to sort out materials from wastes in exchange for money and supplies raw materials for recycling enterprises. Nigerian Environmental Study Action Team (NEST) (1991) revealed that; the present harsh economic condition in the country has led to the emergence of interest in waste recycling. It is now quite common to see scavengers at work on most waste disposal sites salvaging all items they believe to be salvageable, usable as they are or in demand as industrial raw materials. Examples include; unbroken bottles, rusty pots and pans, broken metal chair legs, leaking plastic containers, old car tyres and plastic shoes, clothes, buttons, and zip fasteners, as well as milk tins, among others. Despite the obvious health hazards which scavenging poses to both the scavengers and their customers, it must be admitted that it is helping the society to cope with solid waste disposal problem.

Recycling is also now accepted as a suitable option on the waste management hierarchy namely; source reduiction, reuse/recycling, composting, incineration and land filling (Agarwal, Singhmar, Kulshrestha, and Mittal, 2005; Bolaane 2006) (see Figure 1.0).

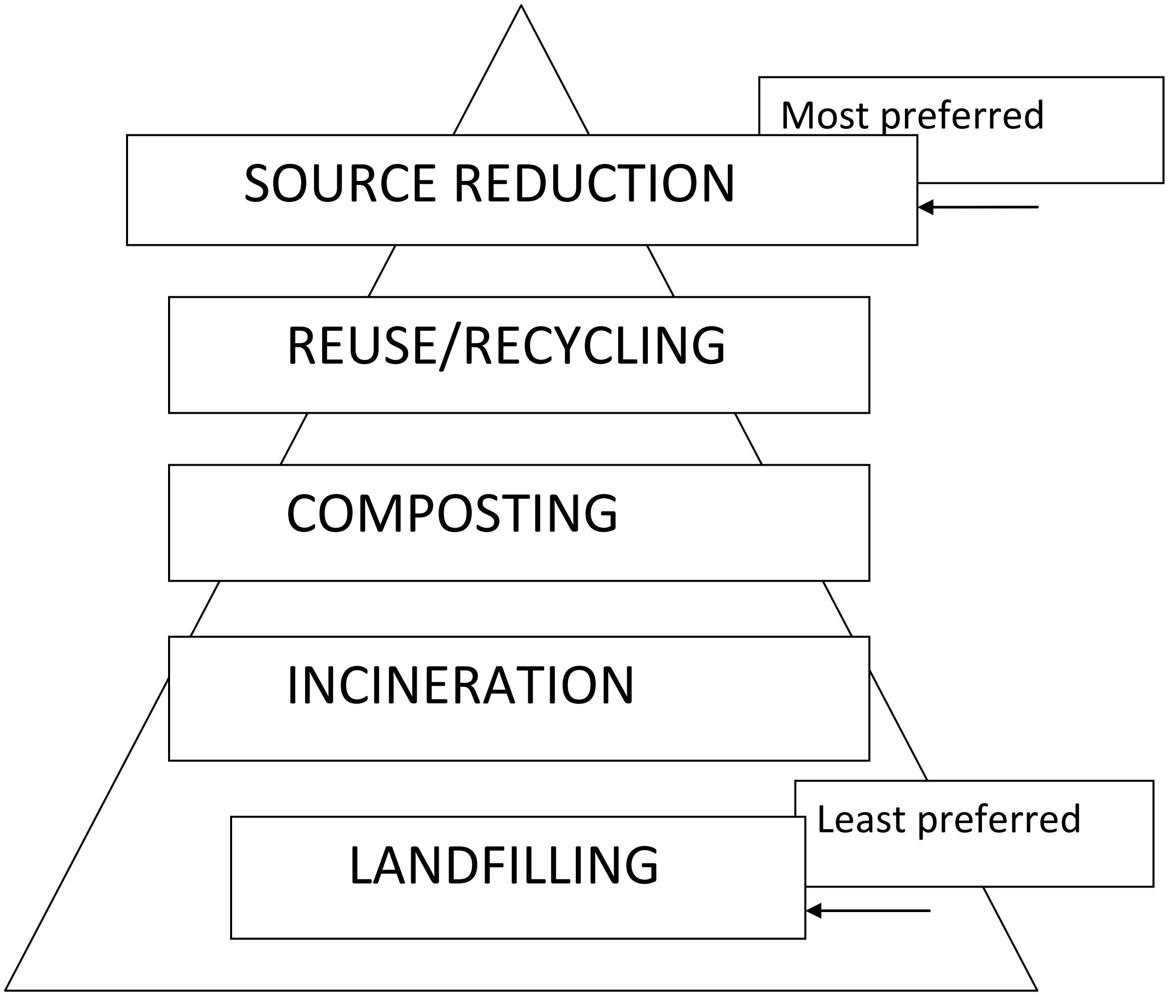

Figure: 1.1: Hierarchy of Integrated Solid Waste Management.

Source: Richard, Wolfville and Nova (2002).

This is because it does not only provide an avenue for the identification, recovery and exploitation of waste as a resource (Sicular, 1992; The Chartered Institution of Wastes Management, 2007) but also for its potential contribution towards environmental management and livelihoods (Masocha, 2006; Langenhoven and Dyssel, 2007). Waste recycling in developing countries is being driven by the informal sector, often with minimal, if any, input from institutions of the state (Castells and Portes, 1989; Ahmed and Ali, 2004; Wilson, Velis and Cheeseman, 2006). At the same time, the informal sector is becoming increasingly integrated into the social, cultural and economic systems of most developing countries. Consequently, solid waste management (SWM) and recycling by the informal sector, unarguably of contemporary phenomena, which have contributed to socioeconomic development in low-and middle- income countries (Berthier, 2003; Wilson *et. al.,* 2006; Gonzenbach and Coad, 2007; Medina, 2007; Gutberlet, 2008).

An important component of ISWM is to encourage producers to produce environmentally friendly goods and to produce less waste in the production cycle. It also mandates producers to take more responsibility for the waste they produce (Ukoje, 2011). In general, source reduction (most preferred) is the most difficult stage to achieve in ISWM hierarchy, but the stage together with recycling/reuse is the conceptualized application to resource and environmental management.

The next favorable option is waste recycling and reuse; waste recycling is a process that involves collecting, reprocessing, and/or recovering certain waste materials (e.g. glass, metal, plastics, paper etc.) to make new materials or products. Waste reuse and recycling are often undertaken as a survival strategy by scavengers and recycling businesses (Cointreau and De kadt, 1991) thereby reducing the total amount of solid waste headed for the landfill. Waste reuse plays a valuable resource-conserving role: by recycling materials, further exploitation of scarce natural resources is minimized, thus containing the spreading ecological footprints of the city.

In addition, composting as an option is a controlled natural process of decomposition of organic waste materials. It reduces the cost of waste disposal, minimize nuisance potential and produce a clean and readily marketable finished product. Composting helps in increasing the recovery rate of recyclable materials. Furthermore, reuse, recycling and composting are land-saving and pollution- reducing strategies.

Next is incineration, which is another method of disposal and it involves passing the waste through a chamber at high temperature with an adequate supply of oxygen to oxidize all organic material. Its advantage is that it requires less land than landfills. Incineration disposes 99.999% of organic waste if properly carried out at 1200°C temperature and ambient oxygen. Combustion in an incinerator reduces volume by 90% and weight by 75% and ash uses about a third as much landfill space as solid waste itself does (Hill, 2004).

Energy recovered from the process can be utilized for electricity generation. Although incineration appears to be an extremely attractive option, the high financial start-up and operational capital required to implement incineration facilities is a major barrier to successful adoption in developing countries (United Nations Environmental Programme, 1996). A large portion of that cost goes to the environmental hazard mitigation components, including emissions (Rand, Haukohl and Marxen, 2000).

Additionally, specific technical expertise and related general repair and maintenance technology are often absent in developing nations' scenario. Incineration in Africa would be infeasible if the waste stream is indeed 70% wet organic content. Under these conditions, incineration is likely to be energy consuming rather than an energy-producing option. There is environmental-health problems associated with incineration. When conditions are not optimal, incineration volatilizes many compounds, such as dioxins, sulfur dioxide and carbon monoxides, which are potentially harmful to human health, atmosphere, plants, and animals (Manyanhaire *et al*, 2009).

Lastly in the hierarchy is land disposal (landfill), which involves haulage of garbage in open areas. Such areas range from unsanitary open dumps to properly operated sanitary landfills (Ukoje, 2011).

In the past few years, research on SWM in Nigeria has focused essentially on contextualizing waste recycling as an approach to urban environmental management and livelihoods (Adeyemi, Olorunfemi and Adewoye, 2001; Agunwamba, 2003; Nzeadibe and Eziuzor, 2006; Nzeadibe and Iwuoha, 2008). Unfortunately, SWM appear to have received little attention from Nigerian social scientists especially from the viewpoint of the socially-related Millennium Development Goals (MDGs) (Nzeadibe, 2009). Environmental concerns and sustainable development are germane to MDGs, which make an investigation into how wealth generated from waste helps in sustainable environmental management an appropriate subject of inquiry.

1.2 STATEMENT OF THE RESEARCH PROBLEM

In the pursuit of sustainable waste management, the prevention of waste generation is the first priority, followed by waste recovery and safe disposal of waste on the hierarchy of principles for waste management (Figure 1.1). These principles need to be put in practice through joint waste prevention and management measures if growing environmental degradation is to be avoided. For example, the use of valuable land for waste disposal, the release of harmful substances from landfills and waste transports into air, soil and water, and the use of resources that are transformed into disposed waste instead of being reused or recycled will all have negative impacts on the environment, and will have a long-lasting direct and indirect influences on the quality of life (European Urban Waste Management Cluster (EUWMC), 2005).

It is known that there have been some local methods by which solid wastes were been reused or recycled. The knowledge of waste reuse and recycling might not be totally new in the Nigerian context. Rather, it is the current sophistication involved that is rather new. Waste facilities in developing countries are minimal, but substantial quantities are diverted for recycling (Tajuddeen, 2003). So there was this reuse culture that has been planted in to Nigerians subconsciously. Every item used were structured for reuse. Even today, the sachets of "pure water" are used by horticulturists for flower nursery and paper wrappers are reused. The reuse tradition is what makes old newspapers useful for wrapping roasted groundnut (*Arachis hypogea Linn*) and pop corn (*guguru*) or *akara*, the popular fried beans cake. Apart from the fact that the reuse culture saves lots of money, it is highly conservative resulting in waste management (Ajibade, 2005).

In spite of the enormous benefits associated with sustainable waste management strategies such as re-use and recycling, only a handful of countries are able to put them into practice. For instance, most of the economically developed countries are still unable to recycle much of their waste (Anthony, 2009). Besides, growing land scarcity and stricter environmental standards now make it difficult for many rich cities to find adequate and suitable disposal sites for the large volumes of waste being generated by their urban populations (Pacione, 2005; Charzan, 2002).

Hardoy, *et. al.*, (2001) researched on environmental problems in an urbanizing world and estimates that between one third and one half of all solid waste generated in Third World cities remains uncollected and the collection rate could be as low as 10 – 20 percent in some cases. Depicting a similar picture of the problem, Cointreau (2001), has estimated that in some cases, up to 60 percent of solid waste generated within urban centres in poor countries remains uncollected and such refuse accumulates on waste lands and streets, sometimes to the point of blocking roads. Moreover, uncontrolled solid waste disposal can also cause environmental problems like traffic congestion on the streets and roads, municipal floods when dumped on waterways, etc. (Lawal, 2011).

According to Solomon (2009), in his study on the state of solid waste management in Nigeria; it is estimated that an average Nigerian generates about 0.49kg of solid waste per day with households and commercial centres contributing almost 90% of total urban waste burden. Little information exists on industrial, agricultural and biomedical waste profiles. As with most developing countries, a greater percentage of solid waste composed of organic matter, but recently there has been a marked increased in the amount of plastic wastes generated in Nigeria (Solomon 2009).

Adeyemi *et. al.*, (2001) examined the role of waste scavengers in the waste recycling process in Ilorin, Nigeria. Using plastic waste as an example, it was demonstrated that such recycling is economically viable. The preliminary findings indicate that, scavengers who operate in the informal sector have contributed significantly towards the provision and separation of recyclables for the recycling industries. Scavenging is a source of employment to poor people. They finally recommended that, the waste scavenger could be incorporated formally into the recycling process. Ado (1998) studied the economic importance of solid wastes in Kano metropolis. The findings showed that on the average scavengers that buy recyclables from households generate an income that is equivalent to 50% of the cost of purchase (e.g. for each recyclable they bought at ₦1.00, they would get 50k as profit).

Nzeadibe's (2006) study on "Cash for Trash", asserts that waste recycling system in Nsukka region is run by the informal sector. This is because statutory measures for achieving improved recycling rates are non-existent in Nigeria. As a result, households and businesses can neither be compelled to achieve higher recycling targets nor enforce compliance. Also, because no formal resource recovery programmes exist, residents neither have the incentive nor do they see the need to recycle their wastes.

The foregoing review demonstrates that waste to wealth has multiple socioeconomic and environmental benefits yet it has not been systematically examined in Zaria. The dearth of such work is an important research gap needed to be urgently filled. The research questions posed are as follows:

i. What are the socio-economic and demographic characteristics of waste management entrepreneurs (WMEs) in the study area?
ii. What are the sources and destinations of recyclable Municipal Solid Waste, in Zaria metropolis?
iii. What is the quantity of waste materials (metal scraps, plastics and cans) recovered, reused and transported for recycling?
iv. What type of uses are the recyclable materials put into?
v. What are the socioeconomic benefits of waste management to waste management entrepreneurs (WMEs) in the study area?

1.3 STUDY AIM AND OBJECTIVES

The aim of the study is to evaluate the potential for municipal solid waste re-use/recycling as waste management strategies in Zaria metropolis to create wealth and promote a sustainable environment. The specific objectives are to:

i. examine the socio-economic and demographic characteristics of waste management entrepreneurs (WMEs) in the study area

ii. identify the sources and destinations of recyclable Municipal Solid Waste, in Zaria metropolis;

iii. analyse the quantity of waste materials (metal scraps, plastics and cans) recovered, reused, transported for recycling.

iv. identify the type of uses recyclable materials are put into in the study area.

v. examine the socioeconomic benefits of waste management to waste management entrepreneurs (WMEs) in the study area.

1.4 JUSTIFICATION FOR THE STUDY

There are several reasons for continuous research on waste problem at local, national and global levels. Firstly, the earth's natural resources are fast dwindling, hence the need to conserve the resources. Reuse and recycle are some of the conservation means for sustainable natural resource management, including municipal solid waste. This is the environmental justification for this study. Also, this study will provide evidence on the volume of wealth/job created from managing municipal solid waste (MSW) that can be used for future development planning in the area of employment generation. Evidence from other countries such as Germany, Australia and the US demonstrate how significant job creation at the local level has been achieved through high recycling rates, thus supporting new business formation (Mayor of London, 2003).

In terms of contribution to knowledge on solid waste and urban environmental management, findings of the study will form a base knowledge for researchers interested in that area. It is hoped that this work will contribute to finding a sustainable way of handling scrap metal, can and plastic waste menace in Zaria with adaptive implications for the whole country and beyond.

1.5 SCOPE AND DELIMITATION OF THE STUDY

The purpose of this study is to evaluate the potential for solid waste re-use and recycling as a management strategy to create wealth and promote a sustainable waste management. The spatial scope of this work are localities in Zaria which include; Samaru, Palladan, Basawa, Gyllesu, Muchia, Chikaji, Wusasa, Dogarawa, Sabon-Gari, Tudun Wada, Gaskiya and Zaria city. The areas were chosen based on the prominence of collection points. By indication, Zaria as used in this study comprises Zaria and Sabon-Gari Local Government Areas (LGAs), with four (4) districts namely; Zaria city district, Tudun Wada district, Sabon-Gari district and Samaru district.

This study will therefore examine recovery, reuse and recycling of MSW. The focus will be limited to scrap metal, plastic bottles and cans; since they are the items that are majorly recovered by the entrepreneurs. The temporal scope for the field work was limited to one month (i.e. from second week of November to first week of December 2012).

CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 CONCEPTUAL ISSUES

2.1.1 Scavenging

A waste picker is a person who collects reusable or recyclable materials discarded by others to sell or for personal utilization. Many terms are used to refer to people who salvage recyclables from the waste stream for sale or personal utilization. These terms include informal resource recoverer, salvager, reclaimer, waste picker, recycler, and scavenger. Although the term "scavenger" is also commonly used, but many waste pickers find it demeaning due to the implied comparison with animals (Samson, 2008). "Waste picking" is an activity motivated purely by economic need. Forms of waste picking have been practiced since antiquity, but modern traditions of waste picking started during industrialization in the nineteenth century and over the past half century have expanded vastly in the developing world due to urbanization (Wilson, *et. al*., 2006; Martin, 2007). This has led to millions of waste pickers worldwide, predominantly in developing countries, but increasingly in post-industrial countries as well (Gowan, 1997).

2.1.2 Re-use

Re-use is a process by which discarded materials like plastic bottles, sachet water bags, glass, paper, woody furniture, scrap metals etc. in their original form are utilized or sold to other users who need them. In other words, re-use is simply using materials for something other than the purpose for which they were originally designed (Bill, 2009). Re-use can be a creative process for using an item rather than throwing it away. Reuse conserves resources and energy too. Re-use is also known as "upcycling" as opposed to "recycling", since materials such as plastic water bottles are often reused than recycled it can also be used for another purpose such as insulator (Bill, 2009).

2.1.3 Recycling

Recycling is a process whereby recovered waste materials like paper, aluminum, animal by-products, plastics scrap metals etc, are converted to valuable materials (e.g. aluminum scrap and cans are transformed into frying pans and pots by artisanal recyclers) or as raw materials for utilization by the industrial sector. Recyclers form a component in the informal private sector comprising micro and small scale recycling companies. The recycling sector is a multi- million-naira investment, where some specialized equipment and machines are used for the conversion of the recovered items to finished products or raw materials that are also used in several other applications (Adebola, 2006).

Waste recycling has a significant environmental benefit to the reduction of waste in landfills and the environments, hence a reduction of waste toxicity transferred to the soil and water bodies within and surrounding landfill areas. In general, there will always be some materials that cannot be recycled, simply because they have lost all usefulness. A well articulated solid waste recycling system will have positive effect for a cleaner environment, good health of urban residents and create a more balanced allocation of resources (UNIDO, 2012).

2.2 CONCEPTUAL FRAMEWORK

There is no over-arching approach or single solution identified that has completely answered the question of what to do with solid waste both in developed and developing countries. The attitudes of people in different countries vary regarding waste management practice. The diversity of communities and their waste is one reason why no single approach to waste management has been accepted as "the best" method. Since there is no preferred method, every community must create its own "best approach" in dealing with its waste. However, all communities have the same alternatives (Palczynski and Scotia, 2002).

The conceptual framework for this study is based on the well known concept of integrated sustainable waste management (ISWM), which has been extensively discussed by Schubeller, Wehrle and Christen (1996). It defines the main concepts of ISWM and identifies the goals and principles that normally guide ISWM system development. The key objectives and issues which should be addressed by ISWM strategies with regard to political, institutional, social, financial, economic and technical aspects are identified. In a simplified tabular manner, the scopes of waste management activities, actors and strategic actions imperative for sustainable waste management are presented (see Table 2.1). This framework is a modified version of the work done by UNIDO (2012). The researcher uses this framework to triangulate and conceptualize the data generated from the field study. This section further offers brief definitions of the central concepts of ISWM and identifies goals and principles which normally motivate and guide solid waste management; the scope of waste management activities and the concerned actors and partners in development cooperation are then described.

Keeping our environment free from the contaminating effects of waste materials is generally referred to as waste management (Anthony, 2009). Similarly, Gilpin (1996); Gbekor (2003) has defined waste management as "purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner" while Schubeller *et. al.*, (1996) focus on municipal solid waste management which they define as "the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas". From these definitions, we can define waste management as the practice of protecting the environment from the polluting effects of waste materials in order to protect public health and the natural environment.

Table 2.1: Conceptual framework for Integrated Solid Waste Management (ISWM)

Strategic Objectives					
POLITICAL	**INSTITUTIONAL** (Laws and processes)	**SOCIAL** (Local customs and religious practices, public education)	**FINANCIAL** (Funding)	**ECONOMIC** (Costs and job creation)	**TECHNICAL** (Location and equipment)
Determine MSWM goals and priorities	Device responsibility and authority for MSWM to local governments.	Orient MSWM to real needs of people including, the poor, women and children.	Establish practical and transparent cost accounting and budgeting systems.	Promote economic productivity and development through adequate MSWM service.	Achieve low life cycle cost of waste management facilities and equipment.
Define clear roles and jurisdiction for MSWM.	Establish effective municipal institutions for MSWM.	Encourage proper waste handling patterns by the population	Mobilize adequate capital investment resources.	Environmentally sound waste collection, recovery and disposal.	Technology that facilitates user and private sector collaboration.
Establish an effective legal and regulatory framework.	Introduce appropriate management methods, procedures and service targets.	Raise people's awareness of MSWM problems and priorities.	Raise sufficient revenues for recurring expenses.	Ensure long-term economic effectiveness of MSWM systems.	Ensure that technical systems effectively limit environmental pollution.
	Build municipal capacity for MSWM.	Mobilize community participation in local waste management.	Improve the efficiency and reduce costs of MSWM service.	Promote waste minimization and material efficiency.	
	Increase efficiency and through private sector involvement.	Protect health and socio-economic security of waste workers.		Generate employment and income in waste management.	
	Extend lower cost MSWM service through community participation.				
Strategic Issues					
Relative priority of collection services in relation to safe waste disposal.	Optimal distribution of functions and responsibilities.	Adaptation of waste management services to the needs of poor households and women.	Failing incentive of local institutions to use available cost accounting methods.	Trade-off between low-cost waste service and environmental protection.	Coherence of technical systems in spite of differing requirements and decision makers.
Priority attributed to waste minimization-reduction and recovery.	Devolution of MSWM responsibility in spite of limited local government capacity.	Effectiveness of awareness building or direct community involvement.	Use of collected revenues for the intended MSWM purposes.	Control of industrial and hazardous waste in spite of small, scattered sources.	Estimation of life-cycle cost of technical alternative.
	Involving local governments in system planning and development.	Equity of MSWM service access to the poor.	Incorporating incentives for cost reduction and efficiency.		Appropriate standards for sanitary landfill design and operations.
Mix of instruments for waste management: regulations, incentives and/or motivations.	Responsiveness of waste management to real needs and demands.	Collaboration with and support of informal waste workers.			
Contribution of External Support Agencies (ESAs) to MSWM policy formulation.	Raising the professional standing of waste managers.				

Source: Schubeller *et. al.*, (1996) modified by UNIDO (2012).

The priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment (Cooper, 1999). Further, Gilpin (1996) regards the business of waste management as a professional practice which goes beyond the physical aspects of handling waste. It also “involves preparing policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public”. Waste management, therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment. Effective waste management is, however, a growing challenge to all municipal governments, especially in developing countries (Anthony, 2009). While these are important aspects of waste management, several other issues are equally important including good governance, public and private sector participation (Cointreau, 2001).

2.3 LITERATURE REVIEW

2.3.1 Waste management

Generally solid waste management system can be classified into three categories which are municipal solid waste; industrial solid waste; and hazardous solid waste management.

Municipal solid waste management is an essential public service that benefits all urban residents. These are defined to include refuse from households, non-hazardous solid (not sludge or semisolid) waste from industrial and commercial establishments, refuse from institutions, (including non-pathogenic waste from hospitals), market waste, yard waste and street sweepings. Sometimes, construction and demolition debris is also included. Industrial waste is generally referred to as a material from a manufacturing process that has no value to the manufacturer and that has to be disposed of in some manner.

With rising economic standards and with many imported consumer goods (particularly food items), Nigerians increasingly have access to packaged goods, often using plastics, which makes waste disposal difficult. The development and widespread use of new packaging substances such as plastics have improved the standards of living for millions, but they have also introduced new threats to the environment, as typified by the histories of dichlorodiphenyltrichloroethane (DDT) and polychlorinated bi-phenyls (PCBs). Thus, industrial development also brings in its wake problems of environmental pollution and generates hazardous waste that often needs abatement.

A waste classified as hazardous by definition and convention usually has one or more of the following four characteristics: ignitability, corrosivity, reactivity and toxicity. These definitions show that a wide range of substances of different physical forms (liquid, gaseous, solid, or in solution) fall into the class of hazardous materials which may become waste. Hazardous wastes have been known to cause serious environmental and epidemiological disasters as a result of the lack of or inadequate handling and management of these wastes.

Although some developed countries have institutionalized waste management policies, in many African countries solid waste management policies either not existing or at best are fragmentary. For example, Cameroon with a population around 14 million of which half is living in towns does not have door to door solid waste collection programme. Thus, in many cases, solid waste disposal points are spontaneously created along the most accessible roads around the areas. Depending on the performance of the official collecting system, the disposal points are more or less important. Traditionally, organic waste is also used for feeding domestic animals and as fertilizer in gardening (composting). At times, fire is used to burn heaps of waste. This creates toxic smoke, which is detrimental to health (Richard *et. al.*, 2002).

Despite the increase in awareness, waste management system in many third world cities is seriously challenged (Tevera, Conyers and Matovu, 2002). In the late 1990s, it was estimated that each person in the world generated 200 kg of solid waste per year (UNCHS, 2001) and this was expected to increase with the growth in population. It is estimated that in 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tonnes, representing a 7% annual increase since 2003. It is further estimated that between 2007 and 2011, global generation of municipal waste would have risen by 37.3%, equivalent to roughly 8% increase per year. Based on reports from its participants, The Basel Convention estimated that about 318 and 338 million tonnes of hazardous and other wastes were generated for 2000 and 2001 respectively (Global Waste Management Market Report, 2007).

Regional studies revealed varying patterns among developed and developing areas. For instance Mukuka and Masiye (2002), reported increase in population growth and waste produced in Lusaka, Zambia. A more alarming example was also found in Indonesia's region of Jabotatek, which includes Jakarta, where population growth was fast and waste generation rate was estimated at 50,000 m3/day or 7 million tonnes per year (Otten, 1997).

With increase in population, urbanization and industrialization including globalization, in Nigeria, the challenge of solid waste management (SWM) in the country has increased and even now more complex. Contributory factors to the challenge include inadequate regulatory framework that has manifested in lack of interest of private sector investment in service delivery (infrastructure); uncoordinated institutional functions; low political will, low capacity to discharges duties, poor data information for planning, wrong attitude of waste generator amongst others. Yet on the increase is the demand for sustainable waste management service for public health and environmental protection. However, the above generality in SWM in Nigeria, the commitment of the Lagos State Government towards sustainable waste management has made Lagos state a model for other states in the country.

Presently, the rate of waste generation in Lagos (with estimated human population of over 10 million in 2012) is 9, 000 tonnes/day while in Kano State, the rate is 3, 849 tonnes/day. Generally, the average rate of generation is estimated as 0.5kg/capita/day. Biodegradable waste account for over 50% of waste generated with other component estimated at different composition in different States. A study carried out by the Bayero University Kano Consultancy Unit (2012) estimated the following composition for polythene/cellophane as 19%, paper 12.7%, metal 10%, glass 8.7%, plastics 11.3%, ash, dust and sand 12%, miscellaneous 9% while a study by the Basel Convention Coordinating Centre for Africa (2009) reveals that 70% of all imports were used electronic electrical equipment of which about 30% could be described as E-Waste. Generally, all waste streams are stored together in either bags or containers (such as used buckets) and plastics waste bins. Lagos state waste management authority (LAWMA) provides 240 litres bins for households after annual payment of the Land Use charge through the Land Records Company (Iriruaga, 2012).

Waste Collection service is offered mainly by the public sector though some State Governments operate some level of formal public-private participation (PPP). It is not, however, uncommon to see informal waste collector using local vehicles (push carts) for collection services from door to door in some parts of Nigerian cities (these form of collection is very common in Zaria especially in Samaru). Collection service is mostly exclusive to the urban cities with not higher than 50% efficiency in most cities with Lagos and Calabar (in Cross Rivers

State) as exception. The rural areas and urban slums are hardly rendered such services. The relatively success story of Lagos could be traced to the level of cost recovery from the public (waste generators) and strong political will towards good waste management practices in the state.

The Lagos State Government through LAWMA engages, coordinates and evaluates the activities of its private sector participants (who are over 300) in municipal solid waste collection. Collection frequency is either once or twice a week and usually on door –to-door basis. This is usually difficult in densely populated areas and it is not uncommon that collection frequency is elongated. Waste transfer station on the other hand is not common in Nigeria; the only state that has a waste transfer station is Lagos State (Iriruaga, 2012).

Responsibility for solid waste management in the city of Abuja lies with the Abuja Environmental Protection Board (AEPB). Amongst a range of mandates, it is required to; assess recycling as a waste management option for industries and government agencies. Furthermore, the only recycling in the city is performed by the informal sector. They advocate for greater co-operation between the informal sector, formal collectors, communities and the state and that waste pickers should be involved in source segregation programmes (Imam, Mohammed, Wilson, and Cheeseman, 2008). However, they do not specifically comment on whether local waste management policy has included any effort to engage with scavengers.

Nzeadibe (2009) studied solid waste reforms and informal recycling in Enugu. The findings reveal that the State Government received support from the Department for International Development (DFID) in the United Kingdom to improve the solid waste management system. In 2004, Law No. 8 was passed. It delineates roles to be performed by a newly created Ministry of the Environment and the Enugu State Waste Management Authority, which is responsible for managing waste in the state. The researcher criticizes these developments for having been primarily preoccupied with formal private sector participation. No policy exists on informal recycling and no provisions were made to accommodate the waste pickers who quickly took over the new landfill that was developed as part of the reforms. While the authorities do not persecute the scavengers they also do not assist them, even though they do not have any formal recycling programmes at the landfill**.**

Waste handling and separation involves activities that are associated with the management of waste until they are placed in storage containers for collection (Tchobanoglous, Theisen, Vigil, 1993). Waste storage involves the management of wastes until the generator places them in a suitable container for collection. Storage containers include black refuse bags, hard plastic bins, skips, metal bins, informal bags, and bulk containers. Waste receptacles differ in shape, size, and materials, which they are made of. They also differ in durability; for example, metal bins have a life span of about five years and carry waste ranging from hot ash to glass. For instance: Sanyanga and Masundire (1999) revealed that in areas, such as Kasane (Botswana), Livingstone (Zimbabwe), and Chirundu (Zambia) were there are few litterbins, people ends up sharing bins thus, resulting in over spilling of the bins. Lack of refuse storage containers in overcrowded towns and cities resulted in prevalence of odours, housefly infestation, and visual pollution produced by exposed and decomposed garbage.

Furthermore, waste collection, transport, and transfer have also presented a number of challenges in the third world cities like; Dares Salaam (Tanzania), Kasane (Botswana), Livingstone (Zimbabwe), Chirundi (Zambia), Abidjan (Cote d' Ivoire), Kinshasa (Democratic Republic of Congo) etc . These range from lack of waste removal equipment, personnel, finance, and above all, lack of commitment by management. Skip vehicles, tractors, trailers, and trucks are used to collect waste. The collection system in most developing countries is grossly inadequate and local authorities are blamed for inefficient and unreliable domestic waste collection with 30-50% of domestic waste generated left uncollected (Hardoy, 1997, MLGRUD, 1995; UNCHS, 2001; Sanyanga and Masundire, 1999).

In Nigeria, the scale of consumption and waste generation and the negative impacts associated with them varies dramatically from city to city, depending in a large part on a city's wealth and size. Perhaps the greatest environmental nuisance and threat facing the ever growing urban agglomeration in Nigeria today is the collection, transportation and disposal of both municipal and industrial waste. Transversing the length and breadth of Nigerian urban centres and even rural communities are heaps of solid waste constituting eyes sore in the urban (UNIDO, 2012; Majani, 2002; United Nations Environmental Programme, 1996; Attahi, 1999**).** Palczynski and Scotia (2002) indicated that in Port Harcourt, River State there is also a severe municipal waste problem. The city which was once known as the "Garden City" for its trees and clean streets has now gained the nickname "Garbage City" because of the dire waste situation which now characterizes it.

The waste accumulation problem is not only limited to African cities. Asian and Latin American cities equally face daunting solid waste problems and many are unable to provide adequate waste disposal services for their residents (Anthony, 2009). Hardoy *et. al.,* (2001) revealed that there are also great inadequacies in the provision for rubbish collection in Baroda, Bhilwara, Sambalpur, and Siliguri (all in India). Similarly, Federation of Indian Chambers of Commerce and Industry (FICCI), (2007); Perera, (2003) pointed out that waste management operations in 35 Indian cities with more than one million populations fared badly in handling solid waste (FICCI, 2007).

Furthermore, Perera (2003) observed that there is improper management of garbage which led to poor sanitary conditions and waste-clogged drains in the cities with associated health problems. Even China, with its speedy industrial development, seems to have left the waste problem largely unsolved. The nation's 668 cities generate an estimated 150 million tonnes of rubbish each year, accounting for roughly one-third of the world total. Currently, as much as 7 billion tonnes of this garbage remains untreated and two thirds of China's cities have been inundated by rapidly spreading garbage mounts (Liu, 2007; Imam *et. al.,* 2008; Omuta, 1987; Arreaza, 2005; Hardoy *et. al.,* 2001).

In Nigeria, waste generation increases with urbanization, and the four most industrialized states are Lagos (home to approximately 60% of the Nigerian industries), Rivers, Kaduna and Kano. Consequently, the waste compositions for 2005 are summarized in table 2.2 for comparative purpose.

Table 2.2: Composition of solid waste generated in four Nigerian cities (2005).

S/N	CAPITAL CITIES	ORGANIC WASTE % (KG)	PAPER % (KG)	GLASS % (KG)	METAL % (KG)	PLASTIC % (KG)
1	Lagos	35.50	9.80	3.90	4.00	19.50
2	Portharcourt	60.00	6.50	3.60	4.20	10.50
3	Kaduna	63.05	5.67	7.50	6.22	5.37
4	Kano	50.50	10.20	3.85	4.60	25.40

Source: Adapted from UNIDO, 2012.

Basically, one of the major issues related to solid waste management in Nigeria is open and uncontrolled burning of solid waste and release of environmental pollutants associated with it especially the persistent organic pollutants (POPs). Table 2.2 reveals that organic waste constitute the highest in the waste composition and thus forms the (POPs) in the four most industrialized states of Nigeria; Lagos, Portharcourt, Kaduna and Kano accounts for about 35.50%, 60.00%, 63.05%, and 50.50% respectively. While about 19.50%, 10.50%, 5.37%, and

25.40% are waste from plastic in Lagos, Portharcourt, Kaduna and Kano respectively. Furthermore, paper accounts for about 9.80% (Lagos), 6.50% (Portharcourt), 5.67% (Kaduna), and 10.20% (Kano). Whereas, for metal waste about 4.00% (Lagos), 4.20% (Portharcourt), 6.22% (Kaduna), and 4.60% (Kano). The least waste material in the composition of solid waste generated in the four Nigerian cities is glass which accounts for about 3.90% (Lagos), 3.60% (Portharcourt), 7.50% (Kaduna), and 3.85% (Kano).

2.3.2 Scavenging Activities

Waste pickers are key actors in the informal economy, as they make vital social, ecological, and economic contributions to their cities and help mitigate global warming. In many cities, they provide the only solid waste collection service. Yet they face many hardships, including stigma, exploitation by middlemen, and hazardous working and living conditions (Scheinberg and Anschütz, 2007).

In Nigeria, recycling activities are not popular. However, the recovery of materials from wastes (scavenging) is practiced on a daily basis by small enterprises and waste pickers who are driven by poverty and desire to earn a living. This type of recovery takes place at both legal and illegal dump sites where scavengers search continually for valuable metals, plastics, and bottles to be reused or for sale to buyers of different type of scraps. Waste market in Zaria is presently an informal private sector market with unregulated activities, which is also operated mainly by waste actors.

Scavengers operate by salvaging waste directly from the various dumpsites, the streets of neighbourhood in search of abandoned metal scraps and other useful recoverable waste. In the course of their activities, they are open to negotiations for the purchase of valuable waste from households and establishments. These collected wastes are then taken to the scrap market locations which are owned and operated by individuals who play the role of middlemen in the waste market business, especially for plastics and scrap metals. At the scrap shops the waste are further sorted, weighed and bought from the waste pickers. These middle men known as “Waste Traders” then take upon themselves the responsibility of transporting and supplying these wastes to the various recycling industries which utilize them as raw materials.

The financial gain made by the waste picker is dependent on the purchasing price of the waste trader and also on the bargaining power with waste generators in situations when the waste has to be purchased. An investigation show that only about 50% of the recovered items serves as raw materials to the industries within Lagos state and the entire country, the remaining 50% is exported to some other countries in Africa like; Ghana Togo, Cameron, Mali, Republic of Niger, Sudan etc, for both industrial and personal use (Adebola, 2006).

In several developing countries (e.g. Nigeria, South Africa, Egypt, Ethiopia, Kenya, Zambia, Zimbabwe, India, Philippines, Mexico, Colombia, Brazil and Argentina) scavengers or waste-pickers, are involved in waste collection and recycling as a means of income generation. This activity generates a positive social externality as production costs in some sectors have been reduced and landfills’ lifetime has been lengthened. In addition, virgin materials are used less intensively, lengthening the availability of natural resources. Efficiency in the economy of production, consumption and waste disposal, requires the implementation of a set of policies working simultaneously rather than a single policy. A policy aimed at recognizing the activity of waste pickers in developing countries is necessary for efficiency (Gonzales, 2003; Ojeda-Benitez, Armijo-de-Vega and Ramirez-Barreto, 2002; Medina, 2001; Sharma, Van-Beukering and Nag, 1997; Van Beukering and Bouman, 2001; Van Beukering and Curleed, 1998). On the other hand, Hogland and Marques (2000) argue that the existence of scavenging as a distinct occupation is based on: markets for recovered materials; waste in sufficient quantity and quality to meet industrial demands and people that are willing or compelled to do work that is poorly paid, hazardous and of a low status.

Gonzales (2003) notes that scavengers generally see the junk shop (middlemen) as a necessary evil: it depresses prices, monopolizes information, and sometimes even threatens to arrange their eviction from the dump. Supports from government and Non Governmental Organizations (NGOs), will motivate waste pickers to look beyond the dumpsite for more economic opportunities in the recycling arena.

The role of waste pickers in cities of developing country is essential for both environmental and economic reasons. Several authors (Medina, 1997; Assaad, 1996; Medina, 2001; Tuason, 2002; JICA-MMDA, 1998) revealed that scavenging provides various social, economic and environment benefits: recycling of solid wastes reduces air and water pollution, saves energy, reduces waste from industrial processes compared with the use of virgin materials, and in many cases reduces imports of raw materials; greatly reduce the cost of a city's solid waste management (SWM) programme; it also reduces the amount of waste that needs to be collected, transported, and disposed of; which in turn becomes an income-generating activity for the poorest in the developing world.

In the economics of waste picking, De Coverly, Macdonagh, O' Malley and Patterson (2008) note that waste is an inevitable consequences of consumption, thus as consumption has escalated, so too has the production of waste. Medina (2000) asserted that waste picking makes up a significant portion of the world's growing informal economic sector. For waste pickers, discarded wastes were neither simple utilities nor necessarily polluting, but complex and potentially enriching materials (Reno, 2009). The different waste streams yield very different returns (Gill, 2007). Worldwide, at least 15 million people make a living by recovering and recycling waste (Medina, 2008).

In spite of its significant contribution to the recovery and recycling processes, the role of informal waste pickers in municipal waste management is still not acknowledged by the authorities of many developing countries (Ojeda-Benitez, *et. al*., 2002; Medina, 2000; Torres, 2002; Kaseva and Gupta, 1996).

2.3.3 Recycling Activities

Recycling activities have been more of the informal sector on selected valuable materials. Source separation of waste is very important and should be encouraged. Now, the formal sectors in most states in Nigeria are becoming interested in recycling. Examples of recycling activities running or planned for in Lagos state include: Compost plant at Ikorodu for the treatment of market waste - where between 24, 000 and 42, 000 tonnes of compost waste generated in 2011; Waste-To- Energy plant at Ikosi Market that generates biogas from the market waste that is used to operate 2KVA generator at the market; Plastic recycling plant at Olushosun for the conversion of water sachet into garbage bags. The government also introduced a buyback programme for water sachet, cartons, paper and glass and creation of recycling clubs in secondary schools to encourage recycling habit in young people. The Informal recycling sector is very active in waste management system in Nigeria. They operate either as itinerant waste buyers or scavengers and they target valuable materials such as plastics, paper, used electronic electrical equipment, glass, metal etc. Their activities have great impact in the reduction of the net volume of waste disposed of. However their importance, there is no formal integration of this stakeholder into the system except in Lagos state (Iriruaga, 2012).

Lagos State Waste Management Authority (LAWMA) introduced recycling banks in some organized areas where households are encouraged to deposit their recyclables like plastics, cans, bottles while the organic component are collected from door-to- door. Some of the scavengers in the State are employed by LAWMA as resource managers of the recycling banks. The resource managers, in addition to the income received from the Authority, are also given the recyclables to trade to supplement their income. The wages paid to them is a sort of incentive to dissuade them from working at the dumpsite. However, the numbers of the recycling banks are not sufficient to cater for the numbers of scavengers in the cities hence some of them are still allowed to scavenge materials at the site but are encouraged to use protective equipments (Iriruaga, 2012).

One major challenge in Nigeria is the enforcement and implementation of policy on sustainable waste management. Notable challenges in waste management service delivery include: Lack of comprehensive legal framework and enforcement of the existing regulations; Low investment from the private sector in infrastructure; Inadequate human capacity for administrative and technical issues; Wrong attitude of the public towards solid waste disposal; low cost-recovery financing; Poor Planning; Low data management and uncontrolled urbanization; Uncoordinated institutional functions; Low academic research and industry linkages; and lack of the needed political will (Iriruaga, 2012).

Most cooperatives involved in recycling are usually based in cities worldwide; informal recyclers collect and sort paper, plastic, metal waste, vegetable oil etc. The sorting centre is both provided and maintained by the municipality. The transport of waste paper, metal, and plastic to recycling brokers is covered by money made from the sale of the recyclable waste (Gurdian and McDonald, 2011).

Anthony (2009) revealed that until recently in Ghana, scrap metal was a much more important item in the solid waste stream in the country, emanating from abandoned vehicles, industrial sources and households hard wares. Currently, there is a surge in scrap metal recycling for iron rod production in the country. Scrap metal is, therefore, in high demand and it is common to see young men rummaging for every piece of metal including scrap auto parts, bicycle parts, pressing irons, among others. These are cleaned and sold to buyers who in turn sell to the recycling firms. Scrap metal recycling factories are springing up in several cities including Accra, Tema and Kumasi and these have greatly reduced the proportion of metal in the waste stream. Waste recycling projects are affected by the availability of industry to receive and process recycled materials.

According to Langenhoven and Dyssel (2007), solid waste collection and recycling is realized as a strategic management option for municipal solid waste management. This buttresses the previous study in Dar es Salaam by Kaseva and Gupta (1996) like (Nzeadibe, 2009) (Fofana, 2009) A very recent study in Enugu state in Nigeria and Free town, Sierra Leone support the previous two studies that recycling and re-use reduce the quantity of waste in landfills.

However, the low industrial base of most poor countries fails to provide ready markets for recyclables and can therefore be regarded as an obstacle to the development of recycling projects which could significantly reduce the volume of waste lying on the streets or going to landfills (Anthony, 2009).

The relationship between the formal and informal sectors; as is argued within the informal economy, the informal sector encompasses a range of highly divergent activities, and each economic sector includes both formal and informal components. Importantly, the informal economy that focuses solely on the characteristics of the company has now included employment conditions. This further reveals the intricate ways in which the formal and informal sectors are bounded up in one another (Skinner 2002). Mueller (2005) note that a small family recycling business may be registered as a formal company, but its survival is predicated on the exploitation of informally employed labour. Similarly, large, formal recycling companies increase profits by sub-contracting other companies to provide them with drivers, who may be employed informally.

2.3.4 Re-use Activities

Unlike metal which is on the decline in the waste stream due to recycling, plastic waste is a growing menace in Ghanaian cities. According to Integrated Regional Information Networks (IRIN) (2007), 270 tonnes/day of plastic waste is generated in Accra and plastic water sachets alone account for about 85 percent of that refuse. Over the years, plastic has replaced leaves, paper, glass and metal as a cheaper and more convenient container and means of packaging in Ghana. But on the down-side, indiscriminate disposal of plastic materials poses major environmental problems including the clogging of drains and streams, threat to animals, soil damage and pollution of beaches in Accra.

Anthony (2009), however, found that there is a high level of re-use of both plastic and glass bottles in the country. Thus, waste pickers rummage waste dumps for bottles and gallons for sale to clients-producers of traditional medicines for use as containers. Also some of the collections are sold to producers of traditional drinks like *pito* (brewed from guinea corn or maize), palm wine and *Hausa beer* (also brewed from maize) who, in the past, used calabash gourds and earthen pots as containers for their products.

2.3.5 Laws/Regulations on Solid Waste Management in Nigeria

Environmental management in Nigeria is hinged on the 1989 National Policy on the Environment as revised in 1998, as well as a set of laws, regulations and guidelines to ensure the conservation of natural resources and the protection of the environment and human health. The goal of the National Policy on the Environment of the Nigerian Government is to achieve sustainable development in Nigeria. The purposes are to secure for all Nigerians a quality of environment adequate for their health and well being; restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of these natural resources and ecosystems; raise public awareness and promote understanding of essential linkages between environmental and development and to encourage individual and community participation in environmental improvement efforts; and cooperate in good faith with other countries, international organizations/agencies to achieve optimal use of trans-boundary natural resources and effective prevention of trans-boundary environmental pollution (UNIDO, 2012**)**.

The Federal Environmental Protection Agency (FEPA) Act is the major legal framework on environment in Nigeria. At the return to democratic governance in 1999, FEPA metamorphosed into the Federal Ministry of Environment in June 1999. Since a ministry is more of a policy-making organ, the Federal Government established in November 2006 the National Environmental Standards and Regulations Enforcement Agency (NESREA) with powers similar to the defunct FEPA for effective enforcement of environmental regulations in the country. All FEPA's laws have been repealed with the NESREA act signed into laws by the President of Nigeria in July 2007. The federal laws are the minimum standards in the states. The Constitution allows states to establish stricter standards than the Federal and also impose stiffer penalties on violators (UNIDO, 2012**).**

Nigeria has various Ministries, Agencies and Departments (MDAs) involved directly or indirectly with environmental issues. These include Federal Ministry of Environment, State Environmental Protection Agency, State Ministry of Environment, various Local Government and Area Councils and NESREA. The local government authorities are given the responsibility of municipal solid waste management by law, however due to inefficiency hence the intervention in waste management activities by various States environmental protection board/agency (see Table 2.3).

The National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations S.I.9 of 1991 imposes restrictions on the release of toxic substances and stipulates requirements for monitoring of pollution; it also makes it mandatory for existing industries and facilities to conduct an environmental audit. The National Environmental Protection (Waste Management) Regulations S.I.15 of 1991 regulates the collection, treatment and disposal of solid and hazardous wastes from municipal and industrial source. The National Guidelines and Standards for Environmental Pollution Control in Nigeria 1991 provide the basic instrument for monitoring and controlling industrial and urban pollution in Nigeria (UNIDO, 2012).

Table: 2.3 Nigerian Laws/Regulations Related to Solid Waste Management

Law/ regulations / international conventions ratified	Content	Entry in to force
The Constitution of the Federal Republic of Nigeria 1999, S. 20.	Ensuring general environmental sustainability	
National Environmental (sanitation and wastes control) regulations, S.1. 28.	The Regulations apply to issues in environmental animation and all categories of solid wastes covering every stage of existing solid waste management chain. It is the most comprehensive regulation on solid waste so far in the country.	2009
The National Environmental Standards and Regulatory Enforcement Agency (Establishment) (NESREA Act) No 25.	Protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology including coordination and liaison with, relevant stakeholders within and outside Nigeria's on matters of enforcement of environmental standards and regulations.	2007
The Environmental Impact Assessment Act.	Provides for the need for an environmental impact assessment of all projects that may affect the environment.	1992
National Environmental Protection Management of Solid and Hazardous Waste Regulations S.1 15.	The regulations specifically provides for the management of solid and Hazardous Waste and adopts a multi-pronged approach which involves the Agency, private operators, industrial and other public agencies.	1991
The Hazardous waste (Criminal Provisions) Decree No 42.	Prohibits the carrying, depositing and dumping of harmful waste on any land, territorial waters and related matters. It prohibits activities relating to harmful wastes, and lists such activities.	1988
International Conventions and Treaties.	i. Basel Convention on the Transboundary Movement of Hazardous Wastes and their Disposal. ii. Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa.	1991 1991

Source: Adapted from UNIDO, 2012.

The various environmental institutions in Nigeria include; Federal Ministry of Environment (FME), National Environmental Standards and Regulations Enforcement Agency (NESREA), State Environment Protection Agencies (SEPAs), State Ministry of Environments (SMEs), State Ministry of Health (SMH), State Waste Management Authorities/Boards

(SWMA/B), Local Government Environmental Health Officers (LGEHO), Community Based Organizations (CBO) and Non Governmental Organizations (NGOs). The FME has responsibility to administer and enforce environmental laws in Nigeria.

The relevance of such laws/regulations is for it to be adhered to and for the various ministries, agencies and departments develop, organize, implement policies and programmes on sustainable waste management information system, training of waste management professionals(including waste pickers, artisanal recyclers etc.) in integrated solid waste management as part of institutional strengthening, development and demonstration of successful business model in integrated solid waste management (e.g. waste to wealth) using the concept of public private partnership (PPP), and national integrated solid waste management strategy (UNIDO, 2012).

2.3.6 Waste Management Practices

The goals of waste management are generally for the protection of human health and the environment from the hazards posed by waste; the conservation of energy and natural resources through waste recycling and recovery; reducing or eliminating the amount of waste generated, and ensuring that wastes are managed in an environmentally-safe manner (e.g. Schubeller *et. al*., 1996, Cointreau, 2001).

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

The waste management in most developing countries shows that the goals and principles of waste management are far from being achieved (Schubeller *et. al.,* 1996; Hardoy *et. al.,* 2001; Pacione, 2005).

Municipal waste management structures exist in most of the urban and rural areas in Nigeria. However, the overall system is characterized by the large-scale informality of operators and operations. Solid waste management in Nigeria is based on co-mingled collection (including organic components) and co-disposal of municipal waste streams in open dumps or waste piles along the streets, existing burrow pits or wetlands. The solution to this problem is an appropriate waste management structure at national, regional and local levels. This is necessary in order to improve human and environmental health. Furthermore valuable resources that are being lost due to inefficient or non-existing recycling systems will be conserved and can be used to create new industry and create jobs for growing population for the country. An efficient waste management and recycling system contributes to enhancing the resource efficiency and supports a sustainable development in the long-term (UNIDO, 2012**)**.

Poor management of waste in developing countries has led to the need to adopt integrated waste management approach.

2.3.7 Integrated Solid Waste Management Approach

In recent years, Integrated Solid Waste Management (ISWM) has become popular as a new approach to waste management. As defined by the World Resource Foundation (WRF, cited in United Kingdom Environment Council, 2000), ISWM refers to “the use of a range of different waste management options rather than using a single option". It is an approach which relies not only on technical solutions to the waste problem, but on a wide range of complementary techniques in a holistic approach. The approach involves the selection and application of appropriate technologies, techniques and management practices to design a programme that achieves the objectives of waste management (Tchobanoglous *et. al.,* 1993). ISWM have emerged from the realization that technical solutions alone do not adequately address the complex issue of waste management and that there is the need to employ a more holistic approach.

In the ISWM approach, all stakeholders participating in and are affected by the waste management regime are brought on board to participate in waste management. Furthermore, issues such as social, cultural, economic and environmental factors are considered in the design of an integrated waste management (ISWM) project (Tchobanoglous *et. al.,* 1993; Anthony, 2009; Schubeller *et. al.,* 1996). These elements most commonly associated with integrated solid waste management are waste prevention, waste reduction/minimization, re-use of materials and products, material recovery from waste streams, recycling of materials, composting to produce manures, incineration with energy recovery, incineration without energy recovery and disposal in landfills in that order of priority (Durham County Council, 2007). These elements of ISWM are frequently formulated into a waste hierarchy model which Girling (2005) has described as "a penny-plain piece of common sense that places the various strategies for waste management in order of environmental friendliness, from best to worst". As shown in the model (Figure. 1.1), waste prevention and reduction are placed at the top to show that the best way to deal with waste is to prevent its production and, where this is not possible, to produce less of it. At the other extreme, disposal is placed at the bottom to show that it should be the last resort among the strategies for waste management.

For each of the process elements, there is a dependence upon how effective each preceding element has been. This is of great importance when considering each element in the sequence. It can be seen that if there is no effort applied in the prime processes, then the secondary processes such as incineration or landfilling must be capable of accepting and processing all of the components of the waste materials. This not only affects the quantity of municipal solid waste to be processed, it also affects its combustion characteristics, and its composition (Richard *et. al.*, 2002).

Tchobanoglous *et. al*., (1993), further defined ISWM as the selection and application of appropriate techniques, technologies, and management programs to achieve specific waste management objectives and goals. Understanding the inter-relationships among various waste activities makes it possible to create an ISWM plan where individual components complement one another (Richard *et. al.*, 2002). Each of these activities requires careful planning, financing, collection, and transport. The individual components are further discussed below:

Waste Prevention: Waste prevention or source reduction seeks to prevent waste from being generated. Waste prevention strategies include using less packaging, designing products to last longer, and reusing products and materials. Waste prevention help reduce handling, treatment and disposal costs and ultimately reduce the generation of pollutants escaping to atmosphere from waste treatment and disposal processes.

Recycling and Composting: Recycling is a process that involves collecting, reprocessing, and/or recovering certain waste materials (e.g., glass, metal, plastics, and paper) to make new materials or products. Some recycled organic materials are rich in nutrients and can be used to improve soils. The conversion of waste materials into soil additive is called composting. Recycling and composting generate many environmental and economic benefits, for examples: they create jobs and income, supply valuable raw material to industry, produce soil enhancing compost leading to better agricultural productivity. All of these are very relevant and needed for Zaria and the country at large.

Disposal (Land filling and combustion): These activities are used to manage waste that cannot be prevented or recycled. One way to dispose of waste is to place it in properly designed, constructed and managed landfills (as of date none is available in Nigeria), where it is safely contained. Another way to handle this waste is through combustion. Combustion is the controlled burning of waste, which helps reduce its volume. If the technology is available, properly designed, constructed, and managed landfills can be used to generate energy by recovering methane. Similarly, combustion facilities produce steam as a by-product that can be used to generate energy.

All of these are very relevant and needed for the country of Nigeria and can be developed using the business model of public private partnership as is being practiced in other countries e.g. India.

2.3.8 Benefits from ISWM

European Environment Agency (EEA, 2011), Report using a life-cycle perspective to analyse the greenhouse gas emissions from municipal solid waste management in the EU, including Norway and Switzerland. Among other important conclusions, it finds that: improved municipal solid waste management in these countries has already cut annual net greenhouse gas (GHG) emissions by 48 million tonnes CO_2-equivalent between 1995 and 2008. The two main factors responsible for this improvement are reduced methane emissions from landfill and increased avoided emissions through recycling. And if all countries fully meet the Landfill Directive's waste diversion targets, potential life-cycle GHG emissions from municipal waste management in 2020 could be cut by a further 62 million tonnes, which equals 1.23 % of their total GHG emissions in 2008.

A complete ban on landfilling could cut emissions even further, reducing potential net emissions from waste management in 2020 by 78 million tonnes compared to 2008 — an amount slightly greater than Hungary's total emissions in 2008. EEA (2011) further revealed that in 2008 around 44 million tonnes of MSW were composted. Reduced landfilling, combined with increased recycling leads to a high increase in avoided emissions due to recycling and energy recovery operations. If all countries meet the landfill targets of reducing landfilling of biodegradable municipal waste, less waste would end up in landfills and more would be recycled than the present. In this scenario, recycling would increase to 54 % of MSW and landfilling would drop to 18 % in 2020.

Solid waste recovery and recycling system in Hanoi, Vietnam consists of collectors, buyers and traders. Collectors gather materials from three groups of sources; dumping grounds, (dumpsite scavengers, in the public places, (itinerant scavengers) and in-house places (itinerant junk buyers). The materials from scavengers and junk buyers are bought by group of depot operators at dumping grounds and within the city. About 6000 people from the rural areas are working in the scavenging field; the largest groups within the labour force are those under 20 years old (25%), adult male (31%), and adult female (44%), the system created jobs and extra income as it mobilizes all family members to work (Muktar, 2011).

In an effort to study the recycling efforts of industries in Kano, Adisa (2000) studied 60 respondents and find out that; the scavengers in Kano state are not organized in any formal way, yet their contribution to economic growth is significant. The scavengers are of two type namely; the primary and secondary scavengers. The secondary scavengers give the primary scavengers a token amount of money to buy recyclables from the neighbouring areas and in return, the materials are weighed and priced accordingly. A kilogramme of rubber shoes or plastic on the average costs ₦22 – ₦30, and the companies that recycle these materials includes Balley plastic, and Standard plastic. On the average a secondary scavenger employ 6 primary scavengers or more, by doing this, a lot of youth are employed by the profession.

2.3.9 Constraints to Effective ISWM

Solid waste management related activities are carried out by a number of different organizations at various government levels (Federal, State, and Local). The common constraints faced by environmental agencies include lack of institutional arrangement, insufficient financial resources, absence of bylaws and standards, inflexible work schedules, insufficient information on quantity and composition of waste, and inappropriate technology (UNIDO, 2012). Adisa (2000) found out that scavengers do not receive any assistance from the government, and the worst of it all is that government levy heavy taxes on the secondary scavengers who are mostly salvage dealers.

There is no clarification of relationship and responsibilities among NESREA, SEPAs Ministries and LGA councils with respect to policy development enforcement and implementation; hence there is confusion and overlap in their activities. This makes the current waste management process not to be effective because no policy exists for sorting at waste generation points, recycling, reuse, recovery, composting or sanitary landfilling.

The main institutional hindrances to an effective solid waste management are: fragmentary institutional framework and there is no definitive strategy or national state policy plans on management of waste. There is also the issue of policy reversal with different administration where it exists and also non implementation of the national guidelines on solid waste management and possibly non awareness of the guidelines in some states; where there are plans, there is no clear delineation of roles and responsibility between local government and states and other stakeholders; and limited collaboration among MDAs. Inadequate statistical data exist on waste generation, collection, treatment and disposal and there is inadequate funding/logistics to achieve a quality database on waste management practices. Also there is lack of adequately trained personnel; and inadequate capacities building of technical staff; lack of demonstration activities concerning the feasibility of public private partnership achieving successful business models for integrated solid waste management projects (UNIDO, 2012**)**.

Waste management activities is still based on ad hoc business- as usual strategy that allows task force to arbitrarily perform mandates of institution without recourse to them, and the concessional private sector to abandon areas of service because of down turn in business. No proper costing for waste management exists hence recovery of cost is low by private sector; inadequate funding of the Waste Management Authorities; lack of recycling plant and market for recycled products; ability and willingness of the residents to pay for the services provided ; and insufficient profitability which makes IWM unattractive to private companies are other constraints.

The general population in Nigeria has poor public awareness on environmental issues. A large number of people have their livelihood associated with the waste disposal sites in the form of “rag picker” or “informal recyclers”. Nigeria being a highly populated country with high unemployment rate, the informal recycling and re-use sector needs to be organized and supported and innovative approach is needed to integrate them into integrated solid waste management plan for the country and various states in Nigeria (UNIDO, 2012**)**.

General knowledge on solid waste issues and waste minimization, green engineering is very low. Appropriate public awareness tools and programmes are missing to convey integrated solid waste management related information to public and more importantly to industrial enterprises. Waste management is generally not part of the decision making process within industries.

The non-governmental organization (NGO) sector lacks the capacity to implement various programmes on public awareness activities concerning solid waste management. The current tools and measures therein for conveying environmental related information such as solid waste management to industries and the public in general are missing. As a result of these, the impact of public awareness activities in Nigeria is generally low.

The human resource capacity for the sustainable integrated solid waste management is missing, partly because there is a lack of tools and educational programmes concerning solid waste management in the country in higher education (UNIDO, 2012**)**.

2.3.10 Sustainable Waste Management

Another important concept of waste management is 'Sustainable Waste Management' (SWM). SWM is an integral part of sustainable development. The Brundtland Commission's approach to sustainable development is development which seeks to "meet the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED), 1987).

Sustainable approach to waste management recognizes that the amount of waste generated and how it is managed has profound implications for the quality of the environment and for the prospects of future generations. Thus, in keeping with the objectives of sustainable development, sustainable waste management can be regarded as an approach to waste management that, in addition to protecting human health and the environment, ensures that the scarce resources of the earth are conserved for both present and future generations of humanity. It therefore becomes important to minimize natural resource extraction and consumption by recycling and re-use waste materials, and conduct waste management efficiently to curtail the environmental impacts of waste disposal and protect ecosystem services for both current and future generations (Millennium Assessment Report, 2005).

In Nigeria, sustainable waste management is viewed as sustainable development without jeopardizing future development, i.e. in our efforts to explore and exploit the natural resources to serve us, there is an obvious paradox evident in the need to ensure economic development, while protecting the environment. It is important to note that there must be a balance between levels of development and the stock of natural resources, that is, development must be at a level that can be sustained without prejudice to the natural environment or to future generations. Therefore if there is to be sustainable development in waste management in Nigeria, the availability of land (for landfill), human resources, plant and equipment and other tools including capital must be readily available. The country need to protect the future for the next generation by cleaning up her environment of all types of waste, taking into consideration both physical and population development of the states. As such waste management must mean the collection, keeping, treatment and disposal of wastes in such a way as to render it harmless to human and animal life, the ecology and the environment generally.

In line with the waste hierarchy, depicted in Figure 1.1, the best way to achieve sustainable waste management is to reduce the amounts of waste we produce (Girling, 2005). Where waste is unavoidable a sustainable approach is to encourage re-use and recycling of products to prevent them from getting into the waste stream. Finally, where waste prevention/reduction, re-use and recycling are economically impossible, waste is processed to recover their intrinsic values such as energy. Sustainable waste management also seeks to increase co-ordination between the producers of goods, retailers, manufacturers, the public, local authorities and all concerned with the management of waste and reusable materials and equipment (London Waste Action, 2007; Schübeller *et. al.*, 1996).

For some rich countries, a way out is to export waste to poor countries and it is estimated that 50 to 80 percent of all waste collected for recycling in Western countries end up in developing countries (Coonan, 2007; Basel Action Network, 2008). In 2006 for example, Britain alone is said to have exported over 200,000 tonnes of plastic waste to China for recycling, along with more than 2 million tonnes of used paper or cardboard and large quantities of steel and redundant electrical goods (Coonan, 2007). An efficient waste management and recycling system contributes to enhancing the resource efficiency and supports a sustainable development in the long-term (UNIDO, 2012).

CHAPTER THREE: THE STUDY AREA AND METHODOLOGY

3.1 BACKGROUND OF THE STUDY AREA

3.1.1 Location

Zaria lies between latitudes 11°00’N-11° 12’N and longitudes 7° 36’E-7° 45’E (see Figure 2.1). It is about 85 km north of Kaduna. Zaria is one of the seven historical Hausa States, and it is situated within the undulating high plains in the southern part of Hausaland of northern Nigeria. It is the administrative head quarter of Zazzau Kingdom (Musa, 1993).The area lies on about 300-900 metres above sea level (Ogunleye, 2006).

Zaria urban area as used in this study is made up of two local government areas; Sabon Gari and Zaria. The study area comprises several suburbs such as Samaru (where Ahmadu Bello University, Zaria is located), Hayin Dogo, Zango, Palladan, Hanwa, Chikaji, Muchia, Government Reserve Area, Sabon-Gari, Gyellesu, Tudun-Wada, Tudun-Jukun, Tukur-Tukur, Zaria city and Wusasa. These suburbs grew differently, but have almost merged together to become an urban centre known as Zaria (see Figures 2.1 and 3.1).

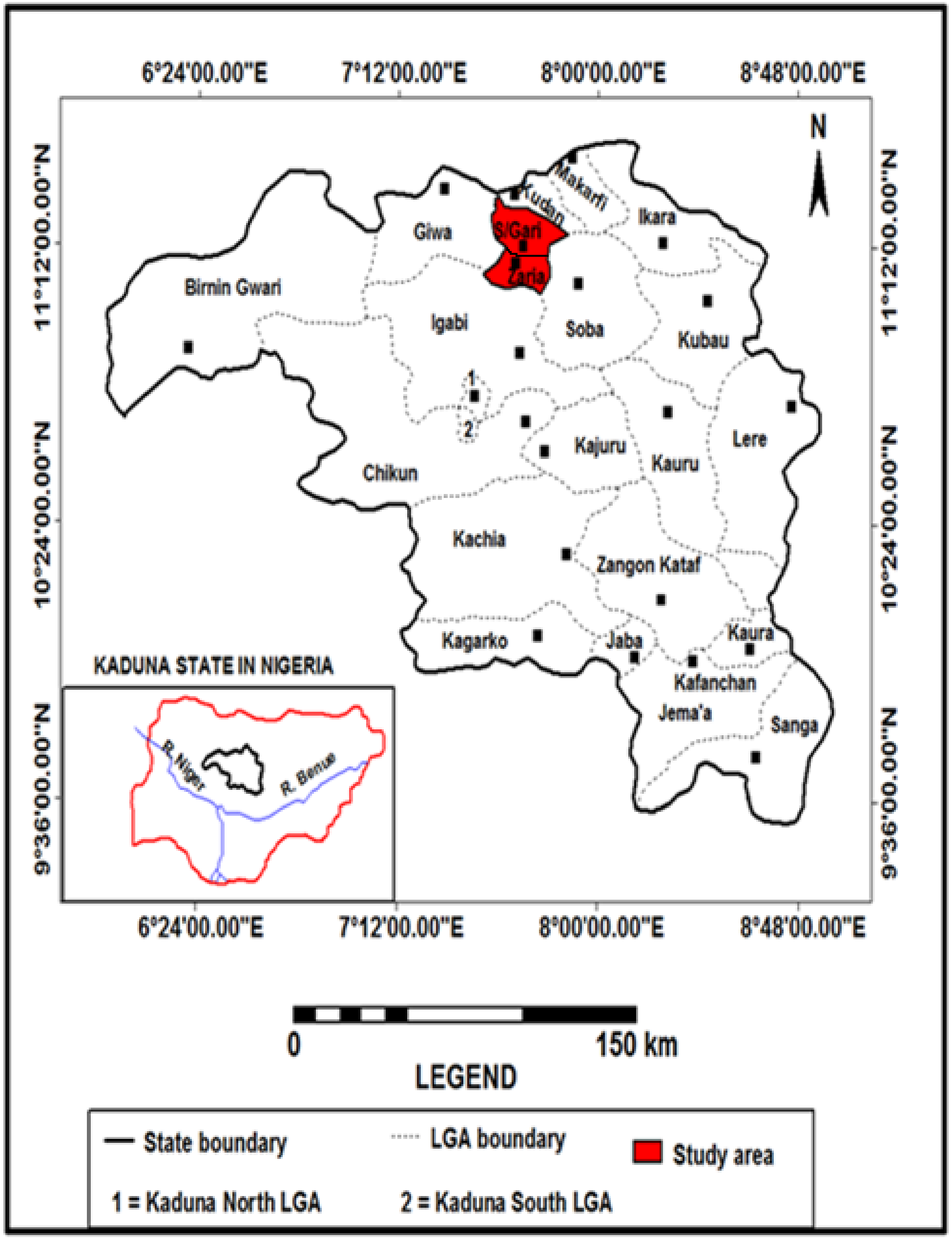

FIG. 2.1: KADUNA STATE SHOWING THE STUDY AREA

Source: Modified from the Administrative Map of Kaduna State

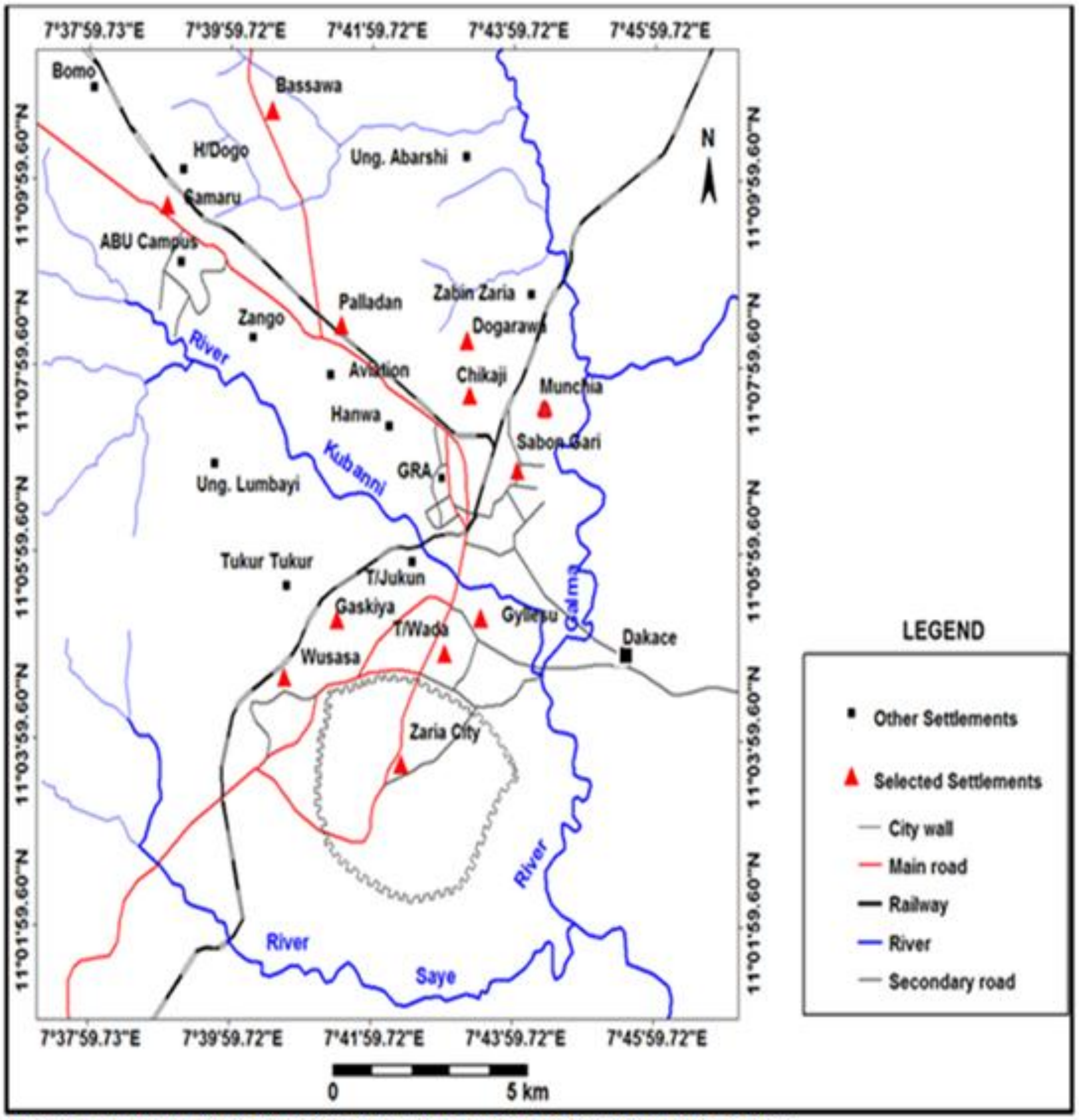

FIG. 3.1: ZARIA SHOWING SELECTED LOCALITIES AND SUB-URBS

Source : Adapted and Modified from Topographic Map of Zaria, sheet 102, SW

3.1.2 The Physical Features of Zaria

3.1.2.1 Weather and Climate

In terms of climate, Zaria lies within a region which has a tropical savannah climate, the tropical wet and dry (AW climate of Koppen's classification) with distinct wet and dry seasons (Hore, 1970). Precisely, it experiences five months of rainy season and seven months of dry season annually. The rainy season starts around May and lasts till September while dry season starts in October and ends in April. The region has a single maximum rainfall regime which comes during the month of August with a mean annual rainfall of about 1100mm. The rains are usually torrential lasting for a few minutes or few hours and are characteristically relatively of large drop sizes. The average yearly rainy days is put at about 92 days (Hore, 1970).

The daily maximum temperature rises gradually from 33°C in which month attaining its major peak in April; with some days have temperatures as high as 40°C. The temperature drops rapidly to its lowest level in August with some days as low as 26°C. Zaria is located such that it is invaded by two distinct air masses; one from the north which is dry and continental in origin known as the Tropical Continental Air Mass (CTS). The other air mass is from the south, over the Atlantic Ocean which is moist, cool, and called Tropical Maritime Air Mass (MTS). The weather depends on the air mass which covers the area and its depth (Hore, 1970).

3.1.2.2 Geology of Zaria

The geology of the Zaria region is made up of crystalline metamorphic and igneous rocks of Precambrian to lower palaeozoic age occurring on the basement complex. A major part of the rocks is of high grade metamorphism mainly gneisses which suffered intense folding and granitization and have remained stable for millions of years. Others are migmatites, older granites and more recently metasediments (quartz, schist, laterites and aluminium). The rate and depth of weathering is quite irregular with variabilities but thorough, ranging from as deep as 60m to as shallow as 10m. The nature of parent material and long period of weathering under tropical conditions have produced a characteristic topography of peneplain, inselbergs and domes of resistant basement rocks. A combination of topography and geology more or less control the ground water occurrence in this area (Wright and McCurry, 1970).

3.1.2.3 Drainage System

The drainage system focuses on three major rivers; the Galma, Kubanni and Saye river basins. The Galma river and its tributaries are mostly ephemeral or seasonal in character and their flows are highly irregular (i.e. drying up from January to June) following rainfall events in streams such as Kabanni and saye. The Galma river area belongs to the northeastern part of Kaduna river basin which borders the Chad basin to the north. The Galma River is one of the main tributaries of Kaduna River. It has headwaters near the northwestern edge of the Jos Plateau and falls near the Magami village (Ali, 1995). The Drainage is commonly dendritic because there is no structural control on the drainage lines on the deeply weathered plains. The channel patterns of the drainage basin are of types, those with large number of un-branched first order tributaries with high stream frequencies and drainage densities such as Awai, Maramara and kubanni to East of Zaria (Urquhart, 1976).

The relief of Zaria region is a plain, extensive gentle rolling peneplain which extends from Sokoto to Lake Chad and northward from south of Kaduna to Tugueddi scarp near Agades (Niger Republic). This embraces most of the northern Nigeria and has been correlated with the mid tertiary African planation surfaces, recognized in other parts of the continent. The plain varies in height, reflecting both regional slopes to the south and a local relative relief of 30m-46m. The plain is intermittently dotted by rocks, inselbergs and lateritic iron stone-capped mesas, with the prominent landmark of Kufena (Thorp, 1970).

3.1.2.4 Soil

Zaria soils falls within the ferruginous tropical soils. The soils are deeply weathered with fine particles up to 50m deep (Jackson, 1958). A typical soil profile of the study area shows that the lower part of the underlying soil consists of mineral materials from the weathered gneisses and still has some pieces of quartz and mica. The upper layer is a mixture of some materials together with blown (wind-blown) particles. The profile also indicates an accumulation of clay between a depth of 36cm and 119cm (Jaiyeoba, 1986). According to Jaiyeoba (1986), below the horizon of clay accumulation, there exists another horizon which is of iron deposit. This is signified by the red or brown coloration; lower down is also found hard iron concentration. Though the soils of Zaria belong to the ferruginous group, those at the fadama (flood plains) belong to the hydromorphic type of soil which has high water retention capacity (Wright and McCurry, 1970).

3.1.2.5 Vegetation

The natural vegetation of the study area is the northern guinea savanna type. But the natural vegetation are absent within the vicinity of the gulley, resulting from the occurrence of the gulley itself due to poor vegetal cover, cleared for the purpose of cultivation, urbanization and construction of structures like the railway track. The land management practices have resulted in the evolution of thorny shrubs intersparsed with short annual grasses. The dominant shrub around the area is *Isoberlinia doka* with an average height of 20 metres. Other less frequent shrub species are *Butyrospermum spp*, *Piliostigma spp*, *Vitex spp*, *Terminalai spp* and *Dichrostachys spp* (Jackson, 1970).

The common grass communities around the study area are mostly *Andropogoneae* such as *Hyparrhnia spp*, *Andrpogon spp*, *Schizachyrium*, *Semi-berbe* and *Monocymbium ceresiiforme* and are almost completely absent during the long dry season. However, as soon as the rainy season begins grasses sprout and shrubs germinate very rapidly, no sooner had they become well established than the rain comes to an end again. Extensive grazing also contributes to the absence of grasses (Jackson, 1970). Tree plants include *Mangifera indica*, dotted everywhere, *Parkia clappertoniana* and several others that are useful to man. Despite cultivation activities going on, these are left standing. The vegetation is thick and greenish but dry and brownish during the wet and dry season respectively (Jackson, 1970).

The relationship of the physical characteristics of Zaria to the study is that waste materials (comprising plastics, sachet water bags, scrap metals, glasses, rags, paper, vegetal materials etc.) if left uncollected, chock drainages especially the non-biodegradable waste materials thereby preventing rain water from percolating or infiltrating through the soil and these results in stagnant water which takes days for it to completely drains down into the soil. Areas that are water logged combines with waste materials most times traffic flow, serves as a good breeding ground for disease vectors like mosquitoes, rodents etc. and also contribute to bad odour and diseases like cholera diarrhea among others. Waste if not properly managed can pollute water bodies and in turn affects animals and agricultural land, and aid soil erosion.

3.1.3 Population

The population of Zaria according to the 2006 census figure, is 698, 348 (NPC, 2009). This figure makes Zaria the second most populated urban centre in Kaduna State. This population is shared by the two local government areas, that is, Zaria and Sabon Gari as shown in Table 3.1. Due to the fact that official population assessment in Nigeria reflects administrative boundaries rather than settlements, this population figure also captures rural areas that are at the periphery but whose jurisdiction falls within Zaria and Sabon Gari Local Government Area Councils.

Table 3.1: Population of Zaria

Local government area	Sex				Total population	Total
	Male	**(%)**	**Female**	**(%)**		
Sabon Gari	149,111	41.4	142,247	42.0	291358	41.7
Zaria	210,900	58.6	196,090	58.0	406990	58.3
Total	360011	100.0	338337	100.0	698348	100.0

Source: NPC (2009).

Zaria is an important nodal point for both the railway and the road systems. It is connected to the northern and southern parts of Nigeria by road and railway. This nodal position in the national transportation system has attracted commercial, administrative and educational institutions to it. This causes a substantial expansion of Zaria. In this connection, there has been an increase in Zaria's population as a number of immigrants from other parts of the country are attracted to it. Thus, increasing the volume of solid waste generated in the study area; since population growth and increased urbanization results in a corresponding increase in the amount of solid waste generated.

3.1.4 Urban Structure of Zaria

The present day Zaria is formed by four distinct urban sectors- Zaria City, Tudun Wada, Sabon Gari and Samaru (Fig.2.1 and 3.1)

Zaria city, which is the headquarters of the Zazzau Emirate, lies in the south of Zaria. The original walled city retains much of the physical character of the traditional indigenous settlement of Muslim Hausa-Fulani population. The city still has a traditional character of perimeter wall, a complex maze of mud –walled compounds, and major roads secured by gates (*kofas*) leading to the Emir's palace, the Friday mosque, and the market area.

Tudun Wada is situated immediately north of the main city gate. It was the original strangers' quarters for non-natives of northern Nigerian origin. In recent times, however, Tudun Wada is inhabited by a more mixed population. Tudun Wada is characterized by a mixture of modern and traditional architecture with a street system in grid-iron pattern. It is in this quarter that most of Zaria's academic institutions are located. Several expansions have been made to Tudun Wada as it now extends to Gaskiya, and Tudun Jukun.

To the north of Tudun Wada lies Sabon Gari. Sabon Gari was created by colonial policy to accommodate strangers from the southern parts of the country. This is a recent quarters in Zaria and was built after the railway reached Zaria in 1911. It houses immigrants of mixed cultures and religions. Sabon Gari was laid out on grid- iron street pattern, which is indicative of an attempt at planning. The area is characterized by medium and low density residential plots. Later, areas like Muchia, Chikaji and Dogon Bauchi sectors were engulfed by development. Adjacent to Sabon Gari lies the Government Reservation Area (GRA). It is characterized by West European oriented urban design pattern. The roads are properly laid out, plots are mainly of low density and there are a lot of organized open spaces.

The Sabon Gari area was zoned for residential, commercial, industrial, health, education, and recreational uses. This district has now transformed to become a commercial and entertainment centre of Zaria. The GRA was originally reserved exclusively for the British administrators but indigenous officers now occupy the area. It has the Zaria club, the polo field, race course and the Golf club situated in it. After the GRA, moving northwards are a few indigenous settlements of Kwangila, Hanwa, and Dogarawa.

Samaru is in the northernmost section and is the most recent addition to Zaria Urban Area. It is a religiously and culturally mixed settlement. Samaru evolved from a small colonial farming settlement into a large community. Samaru village owes its growth to the influence of Ahmadu Bello University and the Institute for Agricultural Research. The settlement is inhabited mostly by people working in the University. The settlement has expanded overtime to include other settlements like Zango, Palladan, Layin Zomo and Bomo (Ukoje, 2011).

3.1.5 Socio-Cultural and Economic Characteristics

The composition of Zaria population is less heterogeneous than that of Kaduna or Kano. However, Sabon Gari and Samaru population are more heterogeneous in character. The sectors of the town are activity specific. The indigenous small-scale craft industry has been traditionally well developed. It is owned by a system of interdependent family enterprises. This is especially evident in the Zaria City, where small groups of tanners, leather works, dyers, potters and blacksmiths are found normally concentrated in a small cluster of adjacent compounds in the wards of the city. These crafts are handed down from one generation to another. Light industries are concentrated in Tudun Wada and Sabon Gari districts. In these districts, most of the firms and a number of the widest range of modern crafts and small industries are located. The modern crafts include tailoring, barber shop, silver smiths, carpentry etc. (Sokomba, 1980).

Education constitutes an important activity in Zaria and this gives a distinct character to the urban settlement. It adds to the cosmopolitan character of Zaria and the morphological diversity it has occasioned. The concentration of educational activities in Zaria has considerably diversified the composition of its inhabitants by bringing together people of different nationalities and ethnic groupings.

Most households live in compounds with an average of nine people per household and a compound size of twenty two people (Sani, 2006). The majority of households are low income earners. Most of the households' heads (about 46 percent) earns less than ₦10, 000 per month. Apart from the GRA that can be described as having a relatively high level of income, all the other neighborhoods can be classified as low-income areas (Ukoje, 2011). Many of the inhabitants are civil servants, factory workers, people working with private organizations, business men and women and their monthly income which on the average is about ₦ 10, 000 is quite encouraging hence, presenting a ready market for products which when consumed or used are disposed indiscriminately. The increase in consumption and affluence have greatly influence waste generation in the study area (Ukoje, 2011).

3.2 METHODOLOGY

This section discusses the various methods that were employed in generating data for the study. It focuses on the types of data needed, the sources of data, the sampling design, and the methods of data analysis. A reconnaissance survey was conducted to generate information on the following:

3.2.1 Types of data required

i. socio-economic and demographic characteristics of WMEs;

ii. cost of conveying recyclable and reusable materials to destinations;

iii. quantity of solid waste materials collected by informal enterprise;

iv. quantity of recyclable materials used daily by artisanal recyclers in the study area; and

v. income of middlemen, artisanal recyclers generated from recyclable materials.

3.2.2 Sources of Data

3.2.2.1 Primary source of data

Questionnaire and structured interviews as well as, informal discussions and observations were used to collect data from twelve localities in the study area. The selected localities include: Samaru, Palladan, Basawa, Gyllesu, Muchia, Chikaji, Wusasa, Dogarawa, Sabon-Gari, Tudun Wada, Gaskiya and Zaria city (see Figure 3.1). These are expected to give an understanding of the activity of waste management entrepreneurs (WMEs), the reasons for their actions and the intended outcomes of the actions. An iterative approach in the synthesis of the data was undertaken to discover similarities and linkages in the information collected. The field work was conducted within a period of four weeks (from second week of November to first week of December). Direct interactions were made with respondents to reveal additional vital information that was not part of questionnaire-interviews.

In addition to the interactive sessions, observation of the activities of waste management entrepreneurs (WMEs) was used to verify the facts of the respondents. Interviews were conducted in both English and local language Hausa- which is the widely spoken language in the study area. The chairman and a member of Zaria Scrap Metal Association (ZSMA) facilitated the administration of the questionnaire and interviews. The respondents were very eager to find out the benefits they could achieve from the study.

3.2.2.2 Secondary source of data

Additional information was obtained from available literature to enrich the theoretical conceptualization of the work. The available literatures include: related books, journals, published and unpublished texts, documents, magazines, conference articles, ministries of environment and related agencies. Other sources are from publications of the United Nations, World Bank, National Bureau of Statistics and related websites.

3.2.3 Sampling Technique and Sample Size

Based on the reconnaissance survey and the conviction that there were fewer artisanal recyclers but more number of scavengers and plastic bottle collectors, a proportionate sample size was decided. This is as a result of the difficulty in obtaining useful information as regards the sample size for the study from Zaria Scrap Metal Association (ZSMA). Consequently, a total of 252 respondents were interviewed using structured questions. The respondents comprised forty nine (49) scrap metal collectors, 75 plastic bottle collectors, 110 scavengers and 18 artisanal recyclers. Using these procedures a total of 252 persons were considered as an appropriate sample size.

Non-probability sampling techniques such as purposive and snowball sampling were used in identifying individuals to administer questionnaire to and to be interviewed. These sampling techniques were appropriate given their strength in identifying unique and informative cases. Snowball sampling was the preferred method for “identifying and sampling the cases in a network” of “difficult-to-find populations” (Neuman, 1997; Bernard, 2002). This was used in getting artisanal recyclers.

With the purposive sampling, personal judgment was used to select cases that will best meet the research questions and objectives (Saunders *et. al.*, 2003). The researcher selected informants who are knowledgeable about the issues being investigated, willing to talk and representative of the range of points of view (Rubin and Rubin, 1995). In line with Schutt's (2006) approach, areas with more respondents attracted more questionnaires. The reason for this decision is to avoid shortage in one area and surplus in another. The researcher was assisted by four field assistants. This was done by identifying convenient time when the middlemen, recyclers and scavengers could be met at their work place for the administration of the questionnaire.

3.2.4 Techniques of Data Analysis

Analysis and presentation of information from the questionnaire was carried out by means of tables, percentages and charts especially for objective (i) (ii) (iii) (iv) and (v) while multiple linear regression analysis was also used to achieve objective (v). To examine the relationships between incomes among various waste actors and quantity of waste materials sold (QTY), number of people employed (NPE), sales of products by artisanal recyclers (PAR), cost of conveying waste per truck (CCWPT) and cost of waste per 1000 Kg (CPT), the data were subjected to multiple linear regression analysis using the statistical package for social science (SPSS 17.0 version) as presented in equation 3.1

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ 3.1$$

where:

Y = Income of waste actors (IWAs)

X_1 = Cost of conveying waste per truck (CCWPT)

X_2 = Number of people employed (NPE)

X_3 = Cost of waste per 1000 Kg (CPT)

X_4 = Quantity of waste materials sold (QTY)

X_5 = Sales of products by artisanal recyclers (PAR)

n = 252

α is the intercept which is a constant and β_1, β_2, …, β_5 are the slope or coefficients for each of the variables. At α = 5% significance level the null hypothesis was tested.

CHAPTER FOUR: PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

4.1 SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

A total number of 252 solid waste collectors were involved in the study. Their socio-economic characteristics have inference on solid waste collection and were discussed under age, gender, educational and marital categories and religion. Other issues are income and ethnic composition.

4.1.1 Age of respondents

The study established that majority of the waste collectors about 46.4% within the twelve localities of Zaria were less than 20 years old. Those between 21-30 years account for 34.5% while the least is 1.2% which covers 60 years and above. About 10.3%, 5.6%, 2.0%, are between 31-40 years, 41-50 years, and 51 - 60 year respectively. While all age groups are represented, the majority are youths, accounting for nearly half of the sampled population (Table 4.1).

Table 4.1: Age of respondents

Age	**No. of respondents**	**Percentage (%)**
< 20	117	46.4
21-30	87	34.5
31-40	26	10.3
41-50	14	5.6
51-60	5	2.0
> 60	3	1.2
Total	**252**	**100**

Source: Field survey, 2012

4.1.2 Sex of respondents

The survey shows that 82.9% of the respondents who were males mostly involved in all waste activities (scrap metal and plastic bottle collection, scavenging and artisanal recycling). Furthermore, about 17.1% of the respondents were females that engaged in plastic bottle collection and cans collection. None of the women was involved in scrap metal collection and artisanal recycling.

4.1.3 Religion of respondents

The religion of majority of the respondents in Zaria is Islam. About 88.1% were Muslims while about 11.9% of the respondents are Christians. This is a reflection of the religio-cultural attribute of Zaria, indicating the dominance of Muslims in the informal economy by their size in the population composition.

4.1.4 Ethnic group of respondents

Ethnic group categorization in Table 4.2 revealed that Hausa/Fulani is the major ethnic group in waste to wealth activities, with 86.5%. The high proportion of these ethnic groups perhaps signifies their exposure to wealth benefits attached to waste. Southern Kaduna is next in terms of proportion in waste business which accounts for 6.7%. Others that are least and are not very familiar with the business include Igbo (3.6%), Yoruba (2.8%) and Igala (0.4%). Even when involved they are usually engaged in assorted plastic collection and reuse, they are rarely found in sections like scavenging, scrap metal/cans collection and artisanal recycling in Samaru, Palladan, Basawa, Gyllesu, Muchia, Chikaji, Wusasa, Dogarawa, Sabon-Gari, Tudun Wada, Gaskiya and Zaria city.

Table 4.2: Ethnic group of respondents

Ethnic groups	No. of respondents	Percentage (%)
Hausa/Fulani	218	86.5
Igbo	9	3.6
Yoruba	7	2.8
Southern Kaduna	17	6.7
Others	1	0.4
Total	**252**	**100**

Source: Field survey, 2012

4.1.5 Educational qualification of respondents

Figure 4.1 shows the educational qualification of the participants in informal waste management. It shows that individuals involved in waste activity generally have low levels of formal education. In fact, 31.7% of the respondents claimed that their highest level of education is Quranic education compared to 0.8% that has acquired tertiary education. Those with primary education accounts for 25.4%, while respondents with secondary education were 23.4%, about 18.7% of the respondents have no formal education.

This lack of formal education also predisposes them to making a living from these activities for survival. Generally, the low educational level of the respondents indicates that formal educational qualification is not a major determinant of being an actor in this type of business. Or rather that those with minimum educational qualification prefer the formal (white collar) employment in available educational and related institutions.

4.1.6 Marital status of respondents

Figure 4.2 shows the marital status of the respondents. It shows that about 131 (52.0%) were never married which dominate the (WMEs) activities in the study area. A total of 112 (44.4%) were married where by 13.9% were involved in polygamy and 32.1% said they were involved in a single union. Those that were widows accounted for about 3.6%. The marital categories when examined alongside the age reveal the youthful nature of those involved in waste re-use and recycling.

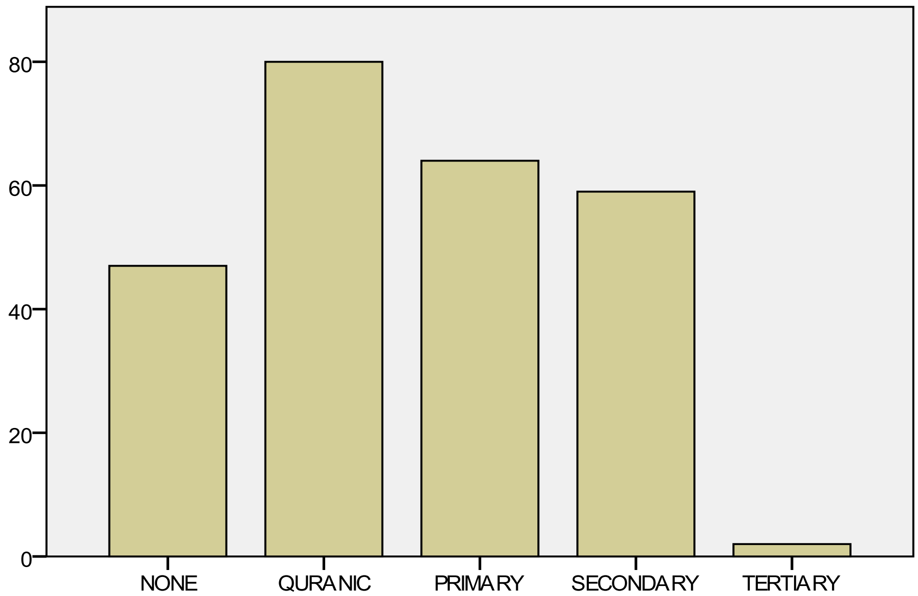

Figure 4.1: Educational qualification of respondents

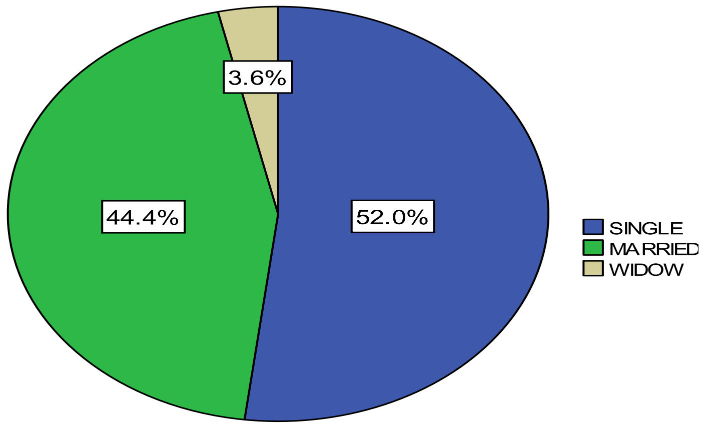

Figure 4.2: Marital status of respondents

4.2 WASTE COLLECTION, REUSE AND RECYCLING

4.2.1 Sources of waste

Table 4.3 shows that 71.8% of waste collectors collect from multiple sources comprising households, institutions, landfill/dumpsites, restaurants etc compared to single sourcing of usable materials. Among the single sources, however, 15.1%, 10.7% and 2.4% respectively source from institutions, restaurants and households. Using multiple sources by the scavengers, artisanal recyclers, plastic bottle and scrap metal collectors provide a variety and large quantity of recyclable materials which improve their income. It is important to note that, especially in institutions or households, scavengers purchase valuable waste from the owners; this is however based on weighing the recyclables to know the exact quantity (see Plate I and II). But in the words of some of the respondents, "*negotiation at times does exist depending on the quantity seen with the eye and not on measurement using weighing balance*".

The waste generated can be ascribed to the urban standard of living in the 12 localities sampled. Generally, manufactured products in iron, aluminium and plastic packaging are affordable and consumed by residents in the areas leading to waste materials.

Table 4.3: Source(s) of waste material

Source(s)	**No. of respondents**	**Percentage (%)**
Households	6	2.4
Restaurants	27	10.7
Institutions	38	15.1
Multiple sources	181	71.8
Total	**252**	**100**

Source: Field survey, 2012

Plate I: Young waste depot worker weighing scrap metals in Tudun Wada.
Source: Field survey, 2012

Plate II: Weighing of cans by artisanal recycler in Muchia
Source: Field work, 2012

4.2.2 Volume and characteristics of waste materials collected

Table 4.4 shows that cans and aluminium, scrap metal and assorted plastics, are the major materials that attract waste entrepreneurs in Zaria. Some respondents (especially scavengers) pick all the recyclables followed by assorted plastics; next scrap metal and least were those into cans and aluminium (i.e. the artisanal recyclers) (see Plates III, IV, V, VI and VII). All together, 110 (43.7%) of the respondents claim that they pick all forms of recyclable items while 75 (29.8%) claimed to pick only assorted plastic materials. Only 19.4% of respondents pick cans and scrap metals while the least is cans and aluminium by only 18 of the respondents.

Table 4.4: Waste materials collected

Materials	No. of respondents	Percentage (%)
Cans and Aluminium scrap	18	7.1
Cans and scrap metal	49	19.4
Assorted plastics	75	29.8
All of the above	110	43.7
Total	**252**	**100**

Source: Field survey, 2012

Plate III: Heap of cans to be used by Artisanal recycler in Samaru
Source: Field work, 2012

Plate IV: Packaged scrap metal waste at Tudun- Wada

Plate V: Packaged scrap metal waste at Sabon-Gari
Source: Field survey, 2012

Plate VI: Packaged can waste at Samaru
Source: Field survey, 2012

PlateVII: Reuseable plastics at Sabon-Gari
Source: Field survey, 2012

4.2.3 Destinations of retrieved waste materials

Table 4.5 revealed that as high as 83.7% dispose their materials within Zaria. These are mainly scavengers, plastic and scrap metal collectors. Moreover, some plastic collectors as stated in Table 4.7 and products from artisanal recyclers are spatially distributed or utilized both within and outside the study area.

The field investigation revealed that about11.1% of the respondents especially major dealers of scrap metals convey such goods to Lagos (see Plate VIII and IX). This may be due to the concentration of recycling plants and high price offered per tonne of the materials as compared to other locations with recycling plants. Also about 4.0% of assorted plastic and scrap collectors indicated that the waste materials are distributed to buyers in Kano. The least (1.2%) were some major scrap dealers that dispose their waste at both Kano and Lagos (see Figure, 4.3).

Table 4.5: Destinations of retrieved waste materials.

Destination(s)	No. of respondents	Percentage (%)
Zaria	211	83.7
Lagos	28	11.1
Kano	10	4.0
Kano and Lagos	3	1.2
Total	**252**	**100**

Source: Field survey, 2012

Plate VIII: Uploading a truck for transportation out of Zaria at Samaru

Plate IX: A recyclable materials loaded truck in Samaru going outside
Source: Field survey, 2012

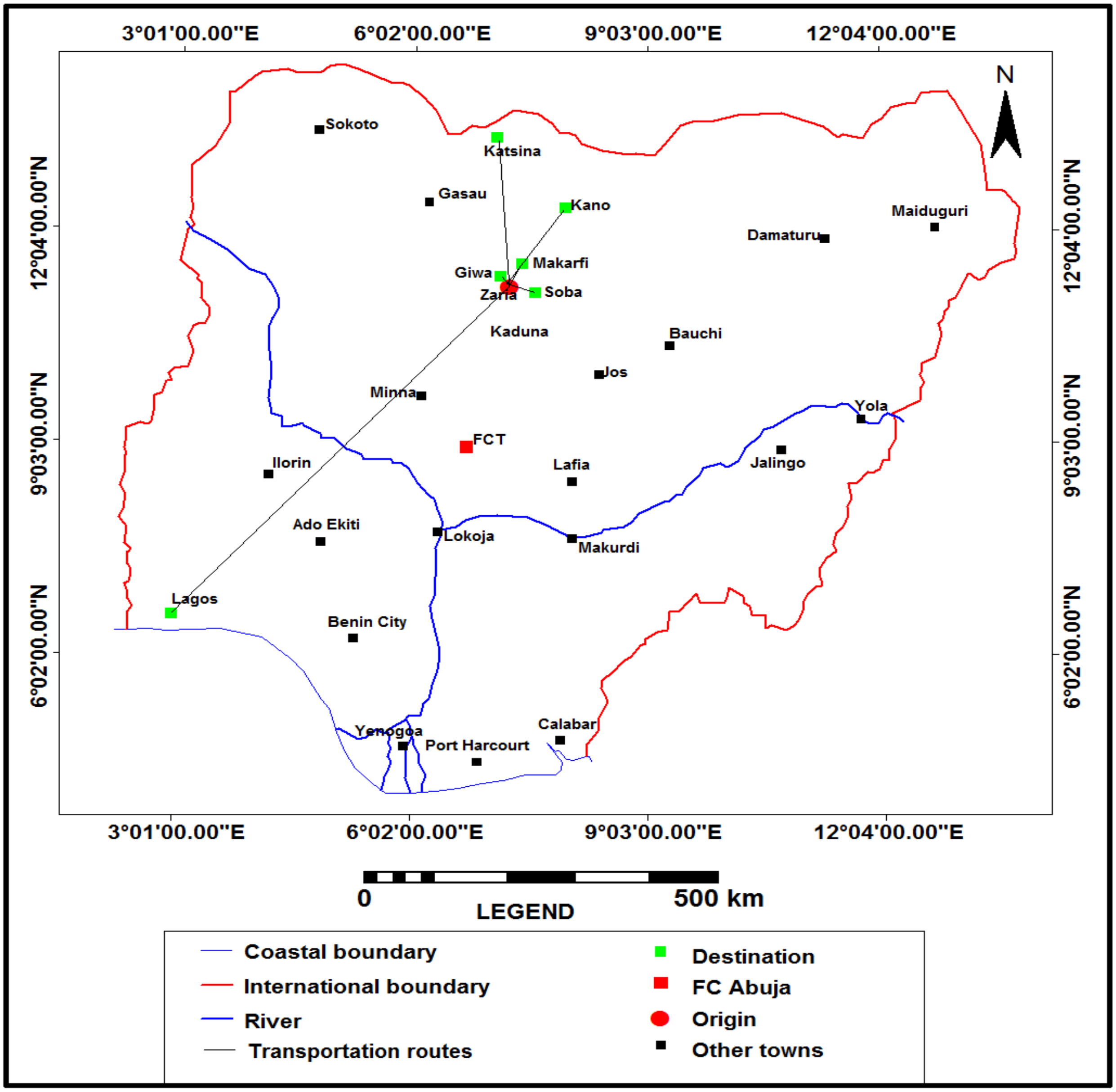

Figure 4.3: Location and direction of distribution of waste materials out of Zaria
Source: Field survey, 2012

4.2.4 Quantity of waste materials collected weekly by respondents

A close examination of Table 4.6 reveals that about 61.5% of the respondents collect less than 100 kg of valuable waste materials every week. This is actually in line with the quantity collected by majority of the waste pickers, plastic bottle collectors and some of the scrap metal collectors. In general, greater quantity of the materials still circulate within Zaria since most of the scavengers find it difficult transporting. Since there are no recycling plants, they sell to major dealers. In contrast, 23.4% comprising artisanal recyclers and some scrap metal collectors (major dealers) collects above 600 kg of waste per week. Field survey further revealed that some artisanal recyclers especially in Muchia utilize more than 800kg of (cans and aluminium scrap) in a week to produce pots and pans for sale. In addition, some of the major dealers in scrap metal claimed that they collect about 1000kg to 200000kg of scrap metal weekly. These are in Sabon Gari, Tudun-wada, Chikaji and Wusasa.

About, 5.2%, 4.0%, 3.6%, 2.4% of the respondents collect about 200kg, 500kg, 300kg, and 400kg per week of waste respectively. There are variations in the quantity of waste materials gathered between Samaru, Basawa, Palladan axis and Sabon Gari, Tudun Wada, Wusasa axis. The latter axis collects high quantity of waste than the former. This may be due to differences in population or proximity to the central business district of Zaria. Generally, large quantity of cans and plastics are usually collected during social functions like conferences, weddings etc.

Table 4.6: Quantity of waste materials collected weekly

Quantity (Kg)	No. of respondents	Percentage (%)
< 100	155	61.5
200	13	5.2
300	9	3.6
400	6	2.4
500	10	4.0
> 600	59	23.4
Total	**252**	**100**

Source: Field survey, 2012

4.2.5 Artisanal recyclers among respondents

The finding shows that about 7.1% of the respondents usually partake in recycling activities. It was clearly seen from the responses that most of the respondents were in one way or the other involved in activities that have to do with waste materials aside artisanal recycling. From this analysis, as high as 92.9% of sampled waste collectors in the study area were only engaged in activities like; reuse, scavenging, plastic and scrap metal collection.

Respondents that were involved in artisanal recycling were further asked about the products they produce from cans and scrap Aluminium. Only about 6.0% of the local recyclers indicated that they produce pots while a small percentage (1.2%) produces pots and frying pan (see Plates X and XI). About 92.9% constitute the category that never responded since they don’t participate in recycling.

4.2.6 Assorted plastic collection and its utilization

From the findings, about 73.4% of the respondents collect assorted plastics ranging from plastics for bottling water, or other assorted drinks; for either sale to people involved in reuse or both (see Plate VII). From the analysis, about 26.6% of the respondents in the twelve localities were not engaged in plastic bottles collection.

Plate X: Products made by artisanal recyclers from cans and alluminium waste at Samaru
Source: Field work, 2012

Plate XI: Products made by artisanal recyclers from cans and alluminium waste at Muchia
Source: Field work, 2012

Table 4.7 shows that a relatively high proportion (56.7%) of respondents disposes the assorted plastics to those involved in reuse like, bottling of locally made drinks (*Zobo and Kunu*), traditional herbs and honey both within and outside Zaria. The collectors surveyed expressed that most of the plastics are utilized locally but at times people from neighbouring State and Local Government areas such as Katsina and Makarfi, Giwa and Soba obtain these products. The field observations further revealed that some of the respondents sell the retrieved materials within Zaria and transport others to Kano to other reusers (see Figure 4.3, for the location and direction diagram of waste materials distribution from Zaria).

From this analysis, about 7.9%, 5.6%, 3.2% of the respondents claimed to dispose the material to people producing locally made drinks, traditional herbs and honey respectively.

Table 4.7: Major users of assorted plastics in the study area

Consumers	**No. of respondents**	**Percentage (%)**
Honey	8	3.2
Traditional herbs	14	5.6
Locally made drinks (*Zobo and Kunu*)	20	7.9
No response	67	26.6
All of the above	143	56.7
Total	**252**	**100**

Source: Field survey, 2012

4.2.7 Plastic bottle collections and re-use activities

About 15.5% of the respondents reuse and sell plastic bottles; about 9.1%, 4.8%, 1.6% were engage in bottling *Kunu and Zobo*, traditional herbs, and natural honey respectively. While a greater percentage of the respondents don't reuse assorted plastics and this accounted for about 84.5%.

4.3 SOCIO-ECONOMIC BENEFIT OF WASTE MANAGEMENT TO WMEs

4.3.1 Income of respondents

The distribution of the monthly income among respondents is shown in Table 4.8. The income category as presented in Table 4.8 established that about 43.3% of the respondents in all categories earn above ₦16, 000 monthly which is at par with the minimum wage for civil servants in the study area.

The field survey buttressed the fact that about ten (10) dealers earn up to about ₦200, 000 in a month. The table further reveals differences in the income among respondents such that the lower income groups; 26.6% of the respondents earn less than ₦5000; 9.1% earn between ₦8, 000-₦10, 000. 8.3% of the respondents claimed they earn between ₦5, 000-₦7, 000, while 6.7%, 6.0% earn between ₦11, 000-₦13, 000 and between ₦14, 000- ₦16, 000 respectively. The result indicates that waste collectors are, relatively speaking, wealthy people and, thus, waste collection can be taken as a lucrative business. Also the result invariably means that waste activities bring about moderate income earning by Nigerian standard compared to the formal sector. In the words of some of the respondents, "*the business that can compete with waste collection is actually crude oil business*". Inaddition, all the artisanal recyclers 7.1% indicated that they generate over ₦30, 000. 00 weekly from the products they produce from recyclables. This translates to about ₦120, 000. 00 net monthly profit.

Furthermore, when other occupations were inquired, only about 24.6% were engaged in other occupation like petty trading, restaurant operation, security service, casual/industrial work, farming etc. while 75.4% were not engaged in other occupations. This is a clear indication that their income is strictly as a result of waste activity and little or nothing is added from other source(s) or occupation (see Plate XII and XIII).

Table 4.8: Income of respondents

Income	No. of respondents	Percentage (%)
< ₦5, 000	67	26.6
₦5, 000- ₦7, 000	21	8.3
₦8, 000-₦10, 000	23	9.1
₦11, 000-₦13, 000	17	6.7
₦ 14,000- ₦ 16, 000	15	6.0
> ₦ 16, 000	109	43.3
Total	**252**	**100**

Source: Field survey, 2012

Plate XII: Scavengers in Samaru on waste picking
Source: Field work, 2012

Plate XIII: Recyclables of a scavenger at Wusasa
Source: Field survey, 2012

4.3.2 Cost of assorted waste materials

As shown in Table 4.9, about 5.6% of the respondents who engages in scrap metal collection and artisanal recycling (that collect scrap alluminium and cans) especially in Samaru, Palladan, Basawa etc buy 1kg of scrap metal between ₦20-₦25 as compared to collectors in Sabon-Gari, Tudun-Wada, Wusasa, Gaskiya etc. where same materials are worth between ₦30-₦35 these accounts for about 22.2%. Also about 72.2% did not provide answers because they are either involved in plastic collection or scavengers who only pick waste materials but don’t buy.

Table 4.9: Cost of 1kg of scrap metal

Cost of 1kg of scrap metal	No. of respondents	Percentage (%)
₦ 20 – ₦ 25	14	5.6
₦ 30- ₦35	56	22.2
No response	182	72.2
Total	**252**	**100**

Source: Field survey, 2012

4.3.3 Cost of a dozen of assorted plastics

As shown in Table 4.10 about 56.3% of the respondents said a dozen of assorted plastics is worth ₦30 while about 17.1% of the respondents especially major dealers of assorted plastics revealed that a dozen is worth ₦50 and that they buy a dozen from scavengers and other plastic collectors at ₦30. About 26.6% of the respondents do not partake in this type of waste activity.

Table 4.10: Cost of a dozen of assorted plastics

Cost of a dozen of assorted plastics	No. of respondents	Percentage (%)
₦ 30	142	56.3
₦50	43	17.1
No response	67	26.6
Total	**252**	**100**

Source: Field survey, 2012

4.3.4 Cost of conveying assorted waste materials

Cost is a very vital item to consider in any business that has to do with conveying of goods from one destination point to the other. Distance in some cases reduces profit margins in any business involving long distance travel. Table 4.11 revealed that 87.3% of the respondents claimed that they are not involved in transporting the materials to other destinations except to major dealers as earlier stated. Absent of recycling plant and high cost actually discourages most entrepreneurs from participating in individual distribution to points outside Zaria. In addition, the cost of conveying recyclables to recycling places as claimed by 8.7% of the respondents who partake in the movement of waste materials to various points was between ₦100000-₦120000. 00 per 30 tonne load truck capacity, while about 2.0% pay between ₦121000. 00 - ₦141000. 00, ₦142000.00 and above per standard truck each.

Table 4.11: Cost of conveying assorted waste materials

Cost per truck (with capacity 30 tonne)	**No. of respondents**	**Percentage (%)**
>₦142000	5	2.0
₦121000-₦141000	5	2.0
₦100000-₦120000	22	8.7
No response	220	87.3
Total	**252**	**100**

Source: Field survey, 2012

4.3.5 Cost of 1 tonne of waste material in recycling industries

Table 4.12 shows that about 86.9% of the respondents don't know the cost of 1 tonne of recyclables in recycling industries. About 9.9% of the respondents were of the view that a tonne of recyclables is worth between ₦42000 and ₦47000 while others (2.0%) disclosed that the recycling industries buy at between ₦30000 and ₦35000. Only 0.8% of the respondents claimed that a tonne is sold between ₦36000-₦41000 while only 0.4% collector claimed that the price is over ₦47000. 00.

Table 4.12: Cost of 1 tonne of waste material in recycling industries

Cost per 1 tonne	**No. of respondents**	**Percentage (%)**
>₦47000	1	0.4
₦42000-₦47000	25	9.9
₦36000-₦41000	2	0.8
₦30000-₦35000	5	2.0
No response	219	86.9
Total	**252**	**100**

Source: Field survey, 2012

4.3.6 Waste management enterprises and job creation

Waste activities in Zaria provide jobs and livelihood to vulnerable groups (widows, retirees, young etc.) especially those with low level of formal education. Table 4.13 emphasizes the role of WMEs in terms of the number of people it creates job for in the study area. It is revealed that about 30% of respondents are employers of labour. Specifically 13.5% have more than 6 employees. Infact, some of them employ as high as seventeen persons, especially those involved in scrap business.

About 6% employs 2 people while 5.6% and 4.4% employ 3-4, 4-5 persons. The remaining 70.5% do not have people working for them but are self employed. This includes scavengers and some plastic collectors. The findings corroborate Nzeadibe's (2009) statement that waste picking provides a chance to vulnerable groups such as widows to earn an independent income. It thus contributes towards the attainment of MDG related to job creation. Obviously, other livelihood satisfaction and socioeconomic wellbeing that are associated with employment comes with engaging in waste re-use and recycling.

Table 4.13: Waste management enterprises and job creation

Number of employees	No. of respondents	Percentage (%)
4-5	11	4.4
3-4	14	5.6
1-2	15	6.0
6 and above	34	13.5
None	178	70.5
Total	**252**	**100**

Source: Field survey, 2012

4.4 CHALLENGES IN WASTE MANAGEMENT ACTIVITIES

All the respondents claimed that the government has not in any way come to their aid in terms of provision of a functional recycling plant in Zaria; trucks that will convey the valuable materials to the required destination at a subsidized rate; protectors especially to scavengers or even pay every individual involved in waste management for keeping the environment clean.

Also, since there are no harmful substances released to the environment as a result of local recycling process by artisanal recyclers in the study area; this implies that artisanal recycling is actually a practice that is environmental friendly.

4.5 WASTE MANAGEMENT AND THE STATE OF THE ENVIRONMENT

Managing solid waste of different sources has always been a difficult task for government in most urban areas of both developed and developing countries of the world. In developing countries especially, solid waste is a problem they were unable to solve or control to the barest minimum. Poor funding is one of the main reasons for poor collection and disposal of refuse. Lack of funds has forced most environmental protection agencies in the country to hire vehicles and maintain few staff on a permanent basis Enugu State Environment Sanitation Agency (ESESA, 1998). This is not different from what is obtained from the environmental protection agencies in Zaria.

4.5.1 Awareness of environmental benefits of waste management among respondents

The survey revealed that as high as 70.2% of the respondents said they were aware of helping the government to safe guard the environment compared to about 29.8% of the respondents who don't have the knowledge completely.

This is in line with Girling (2005) who noted that the best way to achieve sustainable waste management is to reduce the amount of waste produced. Where waste is unavoidable a sustainable approach is to encourage reuse and recycling of products to prevent them from getting into the waste stream. Similarly, the findings of Anthony (2009) revealed that recycling projects are affected by the availability of industry to receive and process recycled materials. However, there is a ready market for recyclables in Zaria and environs; therefore investing in recycling and provision of recycling plant will go a long way in reducing the volume of waste lying on the street or going to landfills.

4.5.2 Knowledge of waste as a threat to the environment

Table 4.14 further revealed that majority of about 78.2% of the respondents were knowledgeable of the fact that waste (especially solid waste) which they attach value to if left on the environment without collection will become a serious threat not only to the environment but also human beings, plant/animals, properties etc. Whereas, 55 (21.8%) of the respondents were of the view that they are not aware of municipal solid waste being a threat to the environment.

Field investigation further revealed that as high as 33.3% of the respondents were knowledgeable of the threat which can be in form of litter, 20.6% constitute respondents that were aware of all the possible threats (litter, disease outbreak, reduction of environmental aesthetics, flood). About 11.1% of the respondents were only aware of the possible consequences to be litter and disease outbreak, 6.7% disease outbreak only, 4.8% reduces environmental aesthetics, and lastly 1.6% flood.

Table 4.14: Knowledge of waste as a threat to the environment

Threat	No. of respondents	Percentage (%)
Flood	4	1.6
Reduces environmental aesthetics	12	4.8
Disease outbreak	17	6.7
Litter and disease outbreak	28	11.1
Litter	84	33.3
All of the above	52	20.6
No response	55	21.8
Total	**252**	**100**

Source: Field survey, 2012

4.5.3 Multiple linear regression analysis of benefits from waste management activities

Table 4.15 presents the multiple linear regression results for actors' income (wealth) as dependent variable while Cost of conveying waste per truck (CCWPT), Number of people employed (NPE), Cost of waste per 1000 Kg (CPT), Quantity of waste materials sold (QTY), and Sales of products by artisanal recyclers (PAR) are separate independent variables. It can be observed that there is a significant linear relationship between income of waste actors (IWAs) and CCWPT, NPE, CPT, QTY, PAR; since the F-value of 36.314 is highly significant with p-value of 0.0001 which is less than α = 1% and 5% significance level. Also, the table presents the coefficients of the independent variables and a t-test to evaluate each independent variable's contribution to the model. The multiple regression model from the study can be written as;

$$IWAs = 2.126 + 0.135\ (CCWPT) + 0.343\ (NPE) - 0.123\ (CPT) + 0.360\ (QTY) - 0.157\ (PAR) \quad (4.1)$$

The R^2 and adjusted R^2 values (coefficient of determination and adjusted coefficient of determination) for the model is above 40%. This simply means that only 40% of the total variation of IWAs is explained by the independent variables. The t-test result on the other hand, from the table revealed that CCWPT, CPT and PAR are not significant since their p-values of 0.560, 0.600 and 0.493 respectively are greater than α = 5% significance level. This implies that CCWPT, CPT and PAR have no significant contribution to IWAs. The reason is simple as earlier stated in Table 4.9 that only a few (major dealers) transport scraps outside Zaria while majority of the waste workers sell their valuables to them which will be transported to locations with recycling industries. However, the effect of CCWPT is positive to the income of all the actors (IWAs). It is suggested that for survival, recyclables must be sold to major dealers from scavengers and other weak waste collectors and must be taken to recycling industries outside

Zaria where the commodity are needed coupled with the high cost of transportation. Whereas, CPT and PAR have negative effect on IWAs (especially those involved in scrap metal business) which means that a 1% CPT increase leads to 0.123% decrease in IWAs, likewise a 1% PAR increase leads to 0.157% decrease in IWAs.

Furthermore, NPE and QTY still from the t-test result revealed that the variables are significant since their p-values of 0.0001 and 0.0001 respectively are less than $\alpha = 5\%$ significance level. It implies that NPE and QTY have significant contributions to IWAs. However, the effect of both NPE and QTY are positive to IWAs. This invariably means that a 1% NPE increase will lead to 0.343% increase in IWAs. It is applicable to a 1% QTY increase will also results to 0.360% increase in IWAs. As an explanatory and predictive tool, the multiple linear regression analysis reveals that the conditions that support the benefits accruable to waste re-use and recycling actors in Zaria (and by extension other traditional cities in northern Nigeria) can be sustained through a careful consideration of the variables explored in this study.

Table 4.15: Multiple linear regression results for waste actors' income

Variables	**Coefficient**	**Standard error**	**t-statistic**	**p-value**
Constant	2.126	1.268	1.676	0.095
CCWPT	0.135	0.231	0.583	0.560
NPE	0.343	0.096	3.567	0.0001
CPT	-0.123	0.234	-0.525	0.600
QTY	0.360	0.058	6.194	0.0001
PAR	-0.157	0.228	-0.686	0.493
F = 36.314				
P-value = 0.0001				
R^2 = 0.425				
Adjusted R^2 = 0.413				

Source: Author's computation using SPSS 17.0

where:

IWAs = Income of waste actors

CCWPT = Cost of conveying waste per standard truck in Naira

NPE = Number of people employed

CPT = Cost of waste per 1000 Kg in Naira

QTY = Quantity of waste materials sold in Naira

PAR = Products by artisanal recyclers

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The aim of the study is to evaluate the potential for municipal solid waste re-use/recycling as waste management strategies in Zaria metropolis to create wealth and promote a sustainable environment. The objectives of this research are to: examine the socio-economic and demographic characteristics of waste management entrepreneurs; identify the sources and destinations of recyclable municipal solid waste; analyse the quantity of waste materials (metal scraps, plastics and cans) recovered, reused and transported for recycling; identify the type of uses recyclable materials are put into in the study area; and examine the socioeconomic benefit of waste re-use and recycling. A total of 252 scrap metal/plastic collectors, scavengers and artisanal recyclers' were studied using purposive and snowball sampling techniques. Tables, percentages, charts and multiple linear regression techniques were used for the analysis.

The study established that majority of the waste collectors within the twelve localities of Zaria were less than 20 years old. The implication is that the trade is more attractive to the very young ones. As expected, the majority of the people involved in the trade, as indicated by the survey results are of Hausa/Fulani ethnic composition with 86.5%. In fact, 31.7% of the respondents claimed that their highest level of education is Quranic education compared to 0.8% that has acquired tertiary education. Generally, the low educational level of the respondents indicates that formal educational qualification is not a major determinant of being an actor in this type of business. Only about 24.6% were engaged in other occupation like petty trading, restaurant operation, security service, casual/industrial work, farming etc. while 75.4% were not engaged in other occupations.

Cans and aluminium, scrap metal, assorted plastics, are the major materials that attract waste entrepreneurs in Zaria. Waste collectors' utilize multiple sources, including individual houses, institutions, landfill/dumpsites, restaurants etc compared to single sourcing of usable materials. Greater quantity of the recyclable materials still circulate within Zaria since most of the scavengers find it difficult transporting and absent of recycling plants, they sell to major dealers. About11.1% of major dealers of scrap metals and plastics convey such goods to Lagos and Kano. The collectors surveyed expressed that most of the plastics are also utilized locally and people from neighbouring State and Local Government areas such as Katsina and Makarfi, Giwa and Soba obtain these products.

The study notes that majority of the waste actors about 61.5% collect less than 100 kg of valuable waste materials every week. In contrast, 23.4% comprising artisanal recyclers and some scrap metal collectors (major dealers) collects above 600 kg of waste per week. Products produced by artisanal recyclers from cans and scrap Aluminium includes majorly pots and frying pan. A relatively high proportion (56.7%) of plastic collectors disposes the assorted plastics to those involved in reuse like, bottling of locally made drinks (*Zobo and Kunu*), traditional herbs and honey. Also some reuse and sell plastic bottles. The survey indicates that the average monthly income generated especially among some of the actors from scrap metal/plastic bottle collection, scavenging and artisanal recycling was discovered to be above ₦16, 000. 00 which is at par with the minimum wage for civil servants in the study area, about ten (10) scrap metal dealers earn up to about ₦200, 000 in a month. Also their income is strictly as a result of waste activity and not from other source(s) or occupation. A 1kg of scrap metal cost between ₦30-₦35 in Sabon-Gari, Tudun-Wada, Wusasa, Gaskiya etc. and between ₦20-₦25 in Samaru, Palladan, Basawa etc while a dozen of plastic bottles cost between ₦30 and ₦50. Major dealers revealed that they pay mostly between ₦100000 to ₦120000 per standard truck in the movement of recyclables to recycling places outside Zaria and that a tonne of recyclables in recycling industries is worth between ₦42000-₦47000.

Solid waste activities in Zaria provide jobs and livelihood to vulnerable groups (widows, retirees, young etc.) especially those with low level of formal education. Some WMEs (scrap metal collectors) employ as high as seventeen persons; while some in waste business don't have people working for them but are self employed especially scavengers and plastic collectors. Most waste actors were aware of waste as a threat to the environment like litter, disease outbreak, reduces environmental aesthetics, flood.

The challenges militating against solid waste activities in Zaria are categorized into: lack of a functional recycling plant; provision and subside on trucks that convey valuable materials to the required destination; lack of protectors and payment especially to scavengers or every individual involved in waste management from government for keeping the environment clean.

5.2 CONCLUSION

By adopting the wealth aspect from waste or treating solid wastes as resources, in terms of waste management strategy has effectively become not only a service but an instrument for alleviating poverty. Government should not only conceive waste management as a means of service delivery but a war against poverty and poor living environment. The future prospect of scrap metal/plastic collection, scavenging and artisanal recycling is envisaged to be prosperous and can offer livelihood opportunities for poor people if the process of collection remains unaltered. However, price fluctuation and the cost of conveying especially scrap metals to recycling plants outside the study area have negative influences on the motivation for the job and the realization of good incomes adequate enough to meet improved standards of living for members that are still new in the business.

5.3 RECOMMENDATIONS

The study has shown the characteristics of solid waste re-use/recycling as waste management strategy as well as the potentials to create wealth and promote a sustainable waste management in Zaria metropolis. Based on such findings, recommendations were developed to promote solid waste re-use/recycling situation in Zaria metropolis.

5.3.1 Specific recommendations

A holistic and people-focused approach in empowering the unemployed to make choices for their livelihoods should be the key focused of intervention. Within this framework, the collaboration of all stakeholders such as WMEs, municipal solid waste management agencies, government agencies such as the ministries of trade, labour and state security to dialogue and design policies and regulations that will address issues of scrap metal/plastic price, price fluctuations and cost of conveying the materials from collection points to recycling plant and also make provision for a functional recycling plant in Zaria. This will strongly improve the actors income.

The implementation of the policies and regulations from ISWM should be strictly adhered to. The policies and regulations should take into cognizance the importance of all stakeholders and harmonize their difference so that the exploitation of a category of stakeholder (e.g. scavenger) by the other (for instance major waste dealers) is minimized.

It is suggested that solid waste activity being an informal sector should be transformed into a more formal sector which will in turn bring about better organization of the sector, hence making it more attractive thus, paving ways for lots of job opportunities for a good number of both unskilled and skilled people residing in Zaria. This can be achieved through involvement of non-governmental organization (NGO) to provide appropriate public awareness, tools and educational programmes concerning the benefits of solid waste management.

The WMEs should be encouraged to form strong and functional association with educated and influential leaders that will take their case to appropriate government authority. Lack of diversification was observed from the results of the field work, that majority of the respondents were restricted to waste activity and not diversifying into other activities. Diversification if encouraged will add extra income and promote more employment opportunities.

Alternatively, public and private participation (PPP) arrangement should be encouraged to collaborate with WMEs thereby, generating more job opportunities, with a wage adequate to meet improved socio-economic conditions of living for WMEs where issues of social security, work accidents insurance and the provision of working tools, equipments and protective clothing will be well taken care of.

The development of the capacity of the unemployed to appreciate opportunities from waste management that will meet the socio-economic needs of their living conditions should be a fundamental objective of poverty eradication and human development. Government and non-governmental organizations should take the leading role in the formulation and implementation of multi-dimensional policies and the empowerment of the jobless so that their development in terms of capacity building will sustainably be achieved.

5.3.2 The institutional framework for waste management in Zaria

Field investigation revealed that Kaduna State Environmental Protection Authority (KEPA) is a state agency with a zonal office in Zaria where relevant information was brought. KEPA was established in 2006 and it is a state agency by 1999 constitution of Kaduna state. It was disclosed that all waste management issues are under the authority of local government councils; the state government only provide policies and guidelines for the local government councils to adopt. However, the state government can only intervene when the volume of waste in Zaria and its environs is beyond the capacity of the local government authority to handle. In Zaria, since the inception of KEPA, the state government only intervened twice in October, 2010 when there was an outbreak of cholera.

Regarding the types of waste, the agency does oversee the affairs of both solid waste and effluent from some of the few industries in the study area. It was discovered that charges depend on whether the waste is biodegradable or non-biodegradable though the minimum charge per tonne of both degradable and non-biodegradable waste is ₦10, 000 for collection and disposal.

With respect to disposal, there are 4 not officially designated landfills in Zaria. Two of them are, along Jos road. There is also, a disposal point along Zaria bye pass, while the other, is along Kano express way (Sakadadi road).

Landfills in Zaria are not enough and the environmental implications as revealed by the agency’s spoke person are that waste are indiscriminately disposed to create unsanitary outlook and other effects like environmental degradation, outbreak of diseases like diarrhea, cholera etc and that landfill which is the only means of disposal are very close to residential areas and are not properly managed.

Environmental health unit under Sabon Gari Local Government Council (Kaduna state) has been in existence since 1992 and were solely into collection of solid waste from major dump sites in Zaria. The Department is funded by government and they collect solid waste 3 times annually from the community without charging them. The unit's spoke person further revealed that an organization like Al-amin Refuse Collection and Disposal is a profit-oriented Non Governmental Organization that charges the community as they collect their waste. The organization carries out this activity weekly and the charge depends on the volume of solid waste; the least charge is ₦ 2,000- ₦ 5,000 Naira weekly.

Solid wastes when collected by this unit are finally disposed in the 4 not officially designated landfills in Zaria as earlier stated by KEPA zonal office in Zaria. Notable environmental implication include; constitute breeding ground for rodents and insects, bad odor, water pollution and same implications as revealed by KEPA zonal office in Zaria.

As demonstrated from the work that solid waste recycling and re-use was actually a vital source of income. The actors in recycling and re-use activities solely depend on waste pickers (scavengers) for a greater percentage of most of the waste valuables they utilize and in turn the wealth they generate. There is a need to formally recognize the role of waste scavengers notable among which are; they operate on a daily basis unlike environmental health unit workers under Sabon Gari local government area that operate only 3 times annually.

Zaria local government area and KEPA's operation as regards waste collection are also not regular; increasing the aesthetics of the environment by picking the huge volume of most of the waste disposed indiscriminately on the environment; reduce the breeding ground for mosquitoes, rodents and other vectors that causes diseases to man; reduce the prevalence of air and water pollution among others.

This is a clear indication that solid waste pickers, artisanal recyclers and actor's involved in re-use and recycling activities contribute more in terms of waste collection than the government owned agencies in the study area. Their contribution to safe guarding the environment is good enough for support and be incorporated into the state environmental protection agency since they fall within a well institutional framework which the agency is part of.

Recommendations for further research are as follows:

i. Morbidity and ill-health implication of waste scavenging in Zaria, Nigeria.
ii. Waste to Wealth from '*Tinka'* and Itinerant waste sellers and environmental sustainability in Zaria, Nigeria.

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APPENDIX

DEPARTMENT OF GEOGRAPHY, AHMADU BELLO UNIVERSITY, ZARIA

Dear respondent,

The purpose of this questionnaire is to obtain information on waste management and environmental sustainability in Zaria metropolis, Kaduna State. Your answers will be confidential and strictly for academic use. I sincerely request your cooperation in completing this questionnaire. Please tick the appropriate option.

QC…………..

Location code…………..

SECTION A: DEMOGRAPHIC AND SOCIOECONOMIC INFORMATION

1. What is your age? ....
2. Sex (a) Male ( ) (b) Female ( )

3. What is your ethnic group? (a) Hausa/Fulani ( ) (b) Igbo ( ) (c) Yoruba ( ) (d) Southern Kaduna ( ) (e) Others (specify) ……………..

4. What is your religion? (a) Islam ( ) (b) Christianity ( ) (c) Traditional ( ) (d) Others (specify)……………..

5. What is your highest educational qualification? (a) None ( ) (b) Quranic ( ) (c) Primary ( ) (d) Secondary ( ) (e) Tertiary ( ) (f) Others (specify) ……………….

6. Are you engaged in other occupation? (a) YES ( ) (b) NO ( )

7. If yes, what type of occupation? (a) Farming ( ) (b) Security service ( ) (c) Petty trading ( ) (d) Casual/industrial worker ( ) (e) Restaurant operation ( )

8. What is your monthly income? (a) < ₦5000 ( ) (b) ₦5000-₦7000 ( ) (c) ₦8000-₦10000 ( ) (d) ₦11000-₦13000 ( ) (e) ₦14000-₦ 16000 ( ) (f) > ₦ 16000 ( )

9. What is your marital status? (a) Single ( ) (b) Married ( ) (c) Widow ( )

10. Type of marital union? (a) Monogamy ( ) (b) Polygamy ( ) (c) Others (specify) …………

11.Source(s) of waste materials (a) Households ( ) (b) Restaurants ( ) (c) Institutions ( ) (d) Multiple sources ( )

12. What type of waste material do you collect? (a) Cans and Aluminium scraps ( ) (b) Cans and scrap metal ( ) (c) Assorted plastics ( ) (d) All of the above ( )

13. What quantity of the above waste do you collect every week? (a) < 100Kg ( ) (b) 200Kg ( ) (c) 300Kg ( ) (d) 400 ( ) (e) 500 ( ) (f) > 600 ( )

14. Do you recycle the waste material? (a) YES ( ) (b) NO ( )

15. If YES what product do you transform the material into? Tick as many as applicable. (a) Pots ( ) (b) Pots and Frying pan ( ) (c) No response ( )

16. Do you collect plastic bottles? (a) YES ( ) (b) NO ( )

17. What type of plastic bottle? (a) Water ( ) (b) Red oil ( ) (c) Engine oil ( ) (d) Groundnut oil ( ) (e) Liquid detergent ( ) (f) Other's (specify)…………………..

18. If YES, who do you dispose to (a) Honey sellers ( ) (b) Traditional herbs sellers ( ) (c) Locally made drinks sellers (Zobo and Kunu) ( ) (d) No response ( ) (e) All of the above ( )
19. Do you reuse plastic bottles? (a) YES ( ) (b) NO ( )
20. If YES what form of reuse practice (a) Bottling locally made drink (KUNU & ZOBO) ( ) (b) Bottling honey ( ) (c) Bottling traditional herbs ( ) (d) No response ( )
21. Where are your destination point(s) (Recycling & Reuse) (a) Zaria ( ) (b) Kano ( ) (c) Lagos ( ) (d) Kano and Lagos ( )
22. Who do you buy waste from (a) Adult (b) Under aged (c) Teenagers (d) Scavengers (e) Business men and women (f) All of the above (g) Others (specify)……………………….
23. How much is 1kg worth of scrap metal? (a) ₦20-₦25 ( ) (b) ₦30-₦35 ( ) (c) No response ( )
24. How much is a dozen of assorted plastic waste worth? (a) ₦30 ( ) (b) ₦50 ( ) (c) No response ( )
25. Where do you store your waste after collection? (a) Open space ( ) (b) Building with roof top ( ) (c) Building without roof top ( ) (d) Zinc structure with roof top ( ) (e) Zinc structure without roof top ( ) (f) Others (specify)………………………
26. How many people are gainfully employed in your enterprise? (a) None ( ) (b) 1-2 ( ) (c) 3-4 ( ) (d) 4-5 ( ) (e) 6 and above ( )
27. How much are they paid monthly? (a) < ₦500 ( ) (b) ₦500-₦700 ( ) (c) ₦800-₦1200 ( ) (d) ₦1300-₦1700 ( ) (e) > ₦1800 ( )
28. What is the age range of your employees? (a) > 10 years (b) 11-15 years ( ) (c) 16-20 years ( ) (d) 21-25 years ( ) (e) 26-30years ( ) (f) > 35 ( )

29. How much do you pay per truck of waste material from collection point to destination point? (a) ₦100000- ₦120000 ( ) (b) ₦ 121000 – ₦ 141000 ( ) (c) ₦ 142000 and above ( ) (d) No response ( )
30. Does the government come to your aid in any way? (a) YES ( ) (b) NO ( )
31. If yes, how? (a) Provide trucks ( ) (b) Provide protective ( ) (c) Recycling plant ( ) (d) Pay you for keeping the environment clean ( ) (e) Others (specify)…………………………….
32. How much do the recycling industries buy 1000 Kg of waste material? (a) ₦30000- ₦35000 ( ) (b) ₦ 36000- ₦ 41000 ( ) (c) ₦ 42000- ₦ 47000 ( ) (d) > ₦ 47000 ( ) (e) No response ( )

SECTION B: INFORMATION ON THE STATE OF THE ENVIRONMENT

33. Do you know you're helping the government to safe guard the environment? (a) YES ( ) (b) NO ( )
34. Do you know that waste is a threat to the environment? (a) YES ( ) (b) NO ( )
35. If yes, how? (a) It is a form of litter ( ) (b) It reduces environmental aesthetics ( ) (c) It brings about outbreak of diseases ( ) (d) It brings about flood ( ) (e) Litter and disease outbreak ( ) (f) All of the above ( ) (g) No response ( )
36. Is there any form of harmful substances presented to the environment at the end of recycling? (a) YES ( ) (b) NO ( )
37. If yes, what are they? (a) Harmful gases ( ) (b) Particles of metal ( ) (c) Litter ( ) (d) All of the above ( ) (e) Others (specify)………………………….

SECTION C: INFORMATION ON GOVERNMENT INSTITUTION

38. What is the span of your existence?

39. What sort of waste do you collect?

40. How much do you charge the community for collecting their waste?

41. Where is the final disposal point of waste collected?

42. What are the environmental implications of your disposal system?