ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF SOLID WASTE MANAGEMENT AMONG HOUSEHOLDS IN KATSINA STATE, NIGERIA

BY

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DECLARATION

I declare that the work in this dissertation entitled "**ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF SOLID WASTE MANAGEMENT AMONG HOUSEHOLDS IN KATSINA STATE, NIGERIA**" has been carried out by me in the Department of Human Kinetics and Health Education under the supervision of Profs. (Mrs) M.A. Suleiman and V. Dashe. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this research work has been submitted for another degree or diploma in this or any other institution.

Abdurrahman Abe SAIDU	----------	----------
Name of Student	Signature	Date

CERTIFICATION

This dissertation entitled "**ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF SOLID WASTE MANAGEMENT AMONG HOUSEHOLDS IN KATSINA STATE, NIGERIA**" by Abdurrahman Abe SAIDU meets the regulations governing the award of degree of Masters of Education in Health Education of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literacy presentation.

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Chairman, Supervisory Committee

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DEDICATION

This dissertation is dedicated to my parents Alh.Saidu Abe, Hajia Halima Yusuf and also to the households in Katsina State, Nigeria.

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ABSTRACT

This study was conducted to assess knowledge, attitude and practice of solid waste management among households in Katsina State, Nigeria. Ex-post facto research design was used. Seven hundred and twenty (720) respondents were sampled from a population of 3,250,960 households in Katsina State, Nigeria. The respondents were drawn through multistage sampling technique, which consisted of stratified, simple random, and proportionate sampling techniques. A close ended questionnaire was used to obtain responses from the respondents. Seven hundred and eleven (711); copies of questionnaires were returned. The data collected was analyzed using descriptive statistics of frequency, percentages, means and standard deviations were used to describe the demographic characteristics of the respondents and to answer the research questions respectively. For the purpose of the study, research hypothesis were tested at 0.05 level of significance using one sample t- test and Pearson product moment correlation (PPMC). The findings of the study revealed that the knowledge, attitude and practice of solid waste management among households in Katsina State were significant,(P=0.000). Also significant relationship existed between knowledge and practice of solid waste management among households in Katsina State,(P=0.020<0.620) and significant relationship existed between knowledge and attitude of solid waste management among households in Katsina State,(P=0.010<0.751). On the basis of the findings of the study, it was concluded that households in Katsina State have adequate knowledge of solid waste management and that with this knowledge the attitude and practice correlated with one another. However, it was, recommended that health educators/environmental health officers should organize and facilitate seminars, workshops and conferences that will educate households more on solid waste management. Government should provide trucks, incinerators, wheel barrows and other equipment that can be use to improve waste management practice in Katsina state of Nigeria.

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OPERATIONAL DEFINITION OF TERM

KNOWLEDGE: Is the awareness of Households on solid waste management.

ATTITUDE: Is the behavior of Households on solid waste management.

PRACTICE: Refers to an action of Households on solid waste management.

MANAGEMENT: Is a process whereby Households collect their west and deposit properly.

RECYCLE: Is the modern way of combining waste into useful.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Waste management is one of the most visible urban services whose effectiveness and sustainability serve as an indicator for good local governance, sound municipal management and successful urban reforms. Waste management, therefore, is a very good indicator of performance of a municipality. Waste management is the process by which unwanted materials are being treated either through recycling or by complete destruction or burning of waste materials. Waste management in urban centers of Africa has for a long time been centralized with the use of imported refuse truck that collects wastes from sources or transfer point and delivers to designated waste dumps (Rotich, Zhao & Dung, 2006). Municipal Solid Waste Management (MSWM) system in Nigeria has changed from the colonial days in the 40s, 50s and early 60s when it was efficient because of the lower urban population and adequate resources to the current status that displays inefficiencies (Okumu & Nyenje 2011).The centralized waste management system has evolved into the current management mixtures that included centralized as well as the involvement of the private sector (Okot-Okumu & Nyenje 2011)

This calls for efficient collection system to avoid health, aesthetics and environmental impacts. The global trend of increased use of electrical and electronic goods is also evident in Nigeria where E-waste is becoming a significant threat to the environment and human health in Nigerian urban centers (Blaser& Schluep, 2012).

Waste sources are households (residential), commercial premises, markets, institutions, industries and health care facilities. Residential areas or households are the major contributor of wastes followed by markets and commercial areas respectively (Okot-Okumu & Nyenje 2011). Densely populated urban zones (e.g. slums) have low

income markets with waste generation estimated between 0.22 and 0.3kg/cap/day. Solid waste generation by the higher income markets is-estimated between 0.66 and 0.9 kg/cap/day on average (Kaseva,& Mbuligwe, 2005) Overall waste generation rate for Nigeria urban centers vary on average between 0.26 (low income) and 0.78 (high income)kg/cap/day (Rotich, et at., 2006; Scheinberg, 2011). Low income urban communities generate lower waste volumes because they buy little and are less wasteful in consumption. In contrast the higher income groups have higher disposable income and purchase larger volumes of consumable goods, that have high waste portions and also practice a more wasteful consumption pattern (Scheinberg, & Anchutz, 2007).This observation is consistent with what has been reported by other authors (Hina, Zia,& Devadas, 2007). Low income urban community spend most of their disposable income for purchase of food items most part of which are consumed and little disposed, while the higher income groups purchase a variety of goods some with associated wastes in form of non-consumables (e.g. packaging, containers, etc.).

When solid wastes are disposed of by water, it is referred to as sewage. The pipes that channel sewage from building and apartments are called sewers, while the networks of sewers in the community are called sewerage. Much water is required for sewage disposal, which is made up of 99.9% water and 0.1% organic and inorganic matter, (West Africa Examinations Board 1991). According to Akpofure, (2009); Omodu, (2007), and Miller (1992), 97% of earth's volume of water is found in oceans and seas. The remaining 3%, only, is fresh water, out of which 2.997% is locked up as ice glaciers in the poles, or as ground waters, too deep and expensive to harness. It means that only 0.0003% of earth's water is available to humans, in lakes, soil moisture, exploitable ground water, atmospheric water, streams and rivers. In other words, if the world's water were only 100 liters, our usable amount of fresh water would only have

amounted to 0.003 liter, which is just a half teaspoonful, for all mankind (Miller, 1999). This is the reason that fecal disposal by water is a difficult task, especially in rural and semi-urban communities.

Little is known of waste from urban agriculture that has emerged and this together ' with poor sanitation in the semi-urban areas pose high risk to human health (Asomani, Boateng,& Haight, 1999; Okot-Okumu, 2008). Disposal of waste in household is largely carried out using storage containers (e.g. sacks polythene bags and boxes) which is mostly used by the poorer urban community arc dumped with the wastes. There is no sorting as such, but people separate components of wastes considered of value such as vegetables and food leftover used at source or sold and sometimes given free (for animal feeds), plastic bags (reuse), bottles- plastic/glass (reuse and sale), tins (reuse and sale) and scrap metals (for sale) are separated by some people from waste that is usually stored and mixed. Sorted/separated wastes are either reused at source or sold to itinerant buyers who afterwards sell them to middlemen who supply recycling industries. Waste separation also takes place at transfer stations (e.g. bunkers, skips, road verges) on transit to the landfill and at the landfill or dump sites (Miller, 2010).

The generated wastes are transported to transfer points (Skips, bunkers, standby trailers, open lots and mostly by the waste generators) e.g. (households, commercial '.premises, market traders) themselves or hired (informal) labor, before collection by urban council workers or private operators. Industries, large institutions (e.g. educational, hospitals), shopping malls, large markets have their own transfer stations served by skips, bunkers, trailers and other waste containment facilities. Three main methods of wastes collection can be identified as the informal primary or pre-collection phase mainly from households to community collection points (e.g. skips, bunkers or

open roadside) mostly by households or hired labor. The secondary phase collection is from community transfer points to final disposal sites or landfills and is mostly by formal institutions like urban councils and private operators. Private operators mostly collect wastes directly from generating sources (door to door). Private operators collect waste at negotiated fees with the individual clients (Miller,2010).Industries and shopping malls in most cases contract private waste collectors to pick wastes from their premises, while community markets and hospitals still rely mainly on urban council collection. Other collection modes take the form of a "summon to "bring" system, where a truck is parked at a location and a horn (hooting) summons people to deliver wastes to the truck. The introduction of private operators has increased solid waste collection levels compared to when it was dependent entirely on the urban councils (Oberlin, 2011; Okot-Okumu,& Nyanje, 2011). However most of these reported collection efforts only apply to wastes that have reached community collection points (Transfer points). This means that a higher percentage of urban solid waste does not reach the legal disposal points but ends up in the environment. Open dumping is the most common waste disposal methods in urban areas (Oberlin, 2011;Okot-Okumu,&Nyenje, 2011). Where skips and waste bunkers are too far, the communities dump wastes indiscriminately and some disposal points are often overflowing with uncollected wastes.

The use of skips has been terminated in many parts of northern Nigeria since 2002 (Kusu, 2007). Skips were found to be linked to lack of cleanliness and most urban residents were dissatisfied with its use. The current operating systems in Nigeria are open ground disposal and in the remaining skips. Katsina state is one of the 36 states in Nigeria and carved from former Kaduna state on 23 september1987 located on $12^0$15'N $7^0$30E Coordinate in the North waste geopolitical Zone. The management of solid waste

is the mandate of ministry of environment and co-ordinate by the state environmental protection agency (SEPA). For the Households the state has reiterated the monthly environmental Sanitation conducted last Saturdays of every month (2015). Most of those households participated in the exercise not for their benefit but for the fact that it is a directive from the state government. The solid waste disposal method used is mostly the dumping method used is mostly the dumping method which takes long time be evacuated, creating more hazard to the environment. Communities without access to transfer stations resort to open disposal methods which include burning, burying, using of wastes as animal feeds and indiscriminate disposal. There is rampant littering caused by the indiscriminate disposal of wastes in storm drainage channels, road verges and open lots. They carelessly disposed wastes block storm water drains causing floods and also cause health hazards and poor aesthetics. Hence the purpose of this study is to assess knowledge attitude and practice of solid waste management among household in Katsina State, Nigeria.

1.2 Statement of the Problem

Solid waste management has emerged as one of the greatest challenges facing states and local government environmental protection agencies in Nigeria. The volume of solid wastes being generated continues to increase at a faster rate than the ability of the agencies to improve on the financial and technical resources needed to parallel this growth. Solid waste management in Nigeria may, however, be characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal 'of solid wastes. Most developing countries, including Nigeria have solid waste management problems different from those found in industrialized countries in areas of composition, density, political, and economic framework, waste amount,

access to waste for collection, awareness, and attitude. The wastes are heavier, wetter and more corrosive 'in developing cities than developed cities (Ogwueleka, 2009).

Solid waste management is therefore, critical for all levels of management and control. New kinds of waste are always being introduced into the solid waste stream due to changing consumption patterns and rapid population increase. Consumer products have become a very important part of human life because of advances in the market industry and lifestyles over the last three decades. This has led to an increase in the use of products which have now become important part of human lives (More, 2006). This growth is significant because it has made life in homes, and markets uneasy, complicated, and unattractive. Though there are a number of private recyclers they are inadequate and their demand for waste falls short of the waste supply because waste hardly reaches transfer point but rather littered the environment. Also, there are inadequate collection programmers to ensure that most of the wastes are recycled. Finally, there are not enough legislation to properly regulate the handling and processing of these wastes. All these explain why much of the waste in the state may end up in streets, gutters, and indiscriminate dumping rather than in landfills and incinerators.

The researcher observed that failure of proper waste disposal in Katsina state leads to ill health to the community, air pollution, water pollution and land pollution and it served as a reservoir of infections, malaria, cholera, typhoid fever, etc. It is against this back ground that the researcher became interested in conducting a research on assessment of knowledge, attitude and practice on solid waste management among households in Katsina state, Nigeria.

1.3 Purpose of the Study

The main purpose of this study is to Assess Knowledge, Attitude and Practice of Solid Waste Management Among Households in Katsina state, Nigeria. The specific purpose is to assess;

1. Knowledge of solid waste management among households in Katsina state, Nigeria
2. Attitude towards solid waste management among household in Katsina state, Nigeria
3. The practice of solid waste management among households in Katsina state, Nigeria
4. The relationship between knowledge and practice of solid waste management among households in Katsina state, Nigeria.
5. The relationship between knowledge and attitude of solid waste management among households in Katsina state, Nigeria.

1.4 Research Questions

This study is proposed to answer the following specific research questions

1. What is the knowledge of members of households about solid waste management in Katsina state, Nigeria?
2. What is the attitude of households towards on solid waste management in Katsina state, Nigeria?
3. What are the practices of households on solid waste management in Katsina state, Nigeria?

4. Is there any relationship between knowledge and attitude of solid waste management based on gender among households in Katsina state?

5. Is there any relationship between knowledge and practice of solid waste management based on gender among households in Katsina state?

1.5 Hypotheses

On the basis of the research questions of the study, the following hypotheses were formulated to guide the study.

1.5.1 Major Hypothesis

Knowledge, attitude and practice of solid waste management among households in Katsina state is not significant.

1.5.2 Sub- Hypotheses

1. The knowledge of solid waste management among households in Katsina State is not significant.
2. The attitude of solid waste management among the households in Katsina State is not significant.
3. The practice of solid waste management among households in Katsina State is not significant.
4. There is no significant relationship between knowledge and practice of solid waste management among households in Katsina State.
5. There is no significant relationship between knowledge and attitude of solid waste management among households in Katsina State.

1.6 Basic Assumptions

On the basis of research questions the following basic assumptions were made for the purpose of this study that;

1. Households have adequate knowledge of solid waste management in Katsina state, Nigeria
2. Households have positive attitude towards solid waste management in Katsina state, Nigeria
3. Households practice adequate solid waste management in Katsina state, Nigeria
4. Households practice good disposal of solid waste management in Katsina state, Nigeria

1.7 Significance of the Study

This study, if successfully completed, is hoped to be of significance to government, Health educators, Households, readers and researchers in related areas:

For the government, of this study could be useful in updating the policy on solid waste management so that health educators could enlighten the community on how to clean their environment in order to avoid occurring of diseases within the communities, also provide the government at both state and local levels the need to ensure that the solid waste management is given urgent and prompt attention. For the fact that practice of solid waste management would be published in this study.

The households in Katsina state would benefit from the outcome of this research, as it would change their behavior to practice the correct way of solid waste management at all time. More so, the study would provide basic and vital information on solid waste management among households in Katsina state.

For health educators, this study would contribute to the field of environmental health Education, as it would enable health educators organize seminar based on solid waste management issues which will enlighten the people of Katsina state and beyond.

The outcome of this study should serve as a source of literature for readers and researchers who want to conduct a research on any field related to the topic in question.

1.8 Delimitations of the Study

This study was purposely conducted to assess knowledge, attitude and practice of solid waste management among households in Katsina state, Nigeria. In order to achieve this purpose; the study was delimited to:

1. Knowledge of solid waste management among households in Katsina state, Nigeria.
2. Attitude towards solid waste management among households in Katsina state, Nigeria.
3. Practice of solid waste management among households in Katsina state, Nigeria.
4. The relationship between knowledge and attitude of solid waste management among households in Katsina state, Nigeria.
5. The relationship between knowledge and practice of solid waste management among households in Katsina state, Nigeria.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, the review of related literature on Assessment of knowledge, attitude and practice of solid waste management among household in Katsina state will be made under the following sub-headings**:**

2.2 Conceptual Framework.

2.2.1 Theoretical Framework.

2.2.2 Solid Waste Management

2.2.2 Classification of Solid Wastes

2.3 Solid Waste Management in Nigeria

2.3.1 Collection of Solid Waste

2.3.1 Disposal of Solid Waste

2.3.3 Recycling of Solid Waste

2.4 Knowledge, Attitude and Practice of Solid Waste Management among Households.

2.4.1 Knowledge of Solid Waste Management among Households.

2.4.2 Attitude towards Solid Waste Management among Households.

2.4.3 Practice of Solid Waste Management among Households.

2.4.4 Influence of Demographic Characteristics on Solid Waste Management on Solid Waste Management among Households.

2.5. Environmental Effectiveness

2.5.1 Governance Networks

2.5.2 Four Determinants of Environmental Effectiveness

2.6 Solid Waste Transfer and Transport

2.6.1 Solid Waste Processing and Recovery

2.6.2 Solid Waste Disposal

2.7 Problems Facing Solid Waste Management in Katsina State

2.8 Empirical Studies

2.2 Conceptual Framework

Waste is a term used for unwanted materials. These are substances or objects which are disposed of, or are intended to be disposed of, or are required to be disposed of, by the provision of national law. Wastes are materials that are not prime products (that is, products produced for the market) for which the initial users have no further use in terms of his/her own purposes of production, transformation or consumption and of which he/she wants to dispose . From the foregoing one can say that waste includes physical things that are of no use to the human beings who are in the immediate environment where such physical things are located. The human beings may or may not be the original owners of the physical things. The physical things in question may or may not have been previously useful to the human beings in its present environment. Waste management is the generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of social waste. The steps in waste management include waste generation, waste storage, waste collection and waste disposal. This explanation actually means that waste management starts from the very point in time the item ceases to be useful to the human being in its immediate environment. Household waste generation is closely linked to population, urbanization and affluence. This is because the more the human beings are, the more the items that they will no longer deem useful are. Disposal of waste is considered one of the main problems faced in the world today and so, it is very important to know the different ways of disposing the waste materials produced in the home. The choice of method of disposal depends on such factors like: the physical characteristics of the place, the quantity and quality of the waste to be disposed and the cost and the culture of the community. The various methods of waste disposal include landfills method/controlled

tipping, incinerations, recycling, composting, barging, use of mechanical destructor, indiscriminate open dumping and burying.

The significance of knowledge, attitudes and practice studies in assessing waste management is highlighted by the fact that studies provide a diagrammatic tool to determine the problem and solution. Therefore literature relating to knowledge, attitudes and practice was deemed relevant for review. A to knowledge, attitudes and practice study measures the knowledge, attitude and part of a community. As Kaliyaperumal (2007) observed when beginning the process of creating awareness in any given community, it is necessary first to assess the environment in which awareness creation will take place. Conducting knowledge, attitude and practice study can best do this. Knowledge, attitudes and practice study tells us what people know about certain things, how they feel and also how they behave. The knowledge possessed by a community refers to their understanding of any given topic on waste management in this case. Attitude refers to their feelings towards this subject, as well any preconceived ideas that they have towards it. Practice refers to the ways in which they demonstrate their knowledge and attitude through their action. Understanding the levels of knowledge, attitude and practice will enable a more efficient process of awareness creation as it will allow the programs to be tailored more appropriately to the needs of the community.

2.2.1 Theoretical Framework of Solid Waste Management

From time immemorial, humans and animals have used the resources of the earth to support life and dispose of wastes. In those days, the disposal of human and other wastes did not pose any spectacular problem as the population was limited and the area of land available for the assimilation of such waste was unlimited. However, today,

utmost importance is being given across the globe to this burgeoning problem of solid wastes. Rapid population growth and uncontrolled industrial development are seriously degrading the urban and semi-urban environment in many of the world's developing countries, placing enormous strain on natural resources and obstructing efficient and sustainable development.

2.2.2 Solid Waste Management

Solid waste management is one of the major environmental concerns in the world. Human activities and changes in lifestyles and consumption patterns have resulted in an increase in solid waste generation rates. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each. A typical waste management system comprises collection, transportation, pre-treatment, processing, and final abatement of residues. Various types of waste can be collected separately. Early researcher mentioned as the waste management is one of the public infrastructures that are based on a specific type of physical infrastructure to provide the goods or services, and in this respect it resembles the electricity, natural gas, and water sector (Dijkema, Reuter, Verhoef, 2000).

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial, producers. Management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator. When recycling began to be recognized as essential for both environmental and resource management reasons, recycling rates for household wastes in most developed countries in the 1980s were in the low single figures by percent. Modern western waste

management systems have rebuilt recycling rates over the last 20 years (Wilson, Araba, Chinwah, Cheeseman, 2008). Modern waste management systems, which many developing country cities aspire to, are all characterized by high recycling rates of clean, source separated materials.

Most technologies for waste management are mature and have been successfully implemented for decades in many countries. In Turkey, Solid Waste Control Regulation came into force in order to manage solid waste in 1991. The regulation has been continuously updated. Considering the Directive of Waste Frame EEC and the other directives of the European Union as part of the requirements of the integration process into the EU, the Department has started the preparations for the Regulation of Waste Frame and the draft of the Regulation has been presented for consideration. Finally, the waste management is conducted according to the Turkish Solid Waste Management that was adopted in 2008 (Republic of Turkey Ministry of Environment and Forestry, 2008). In the Regulation, the procedures about the classification of the wastes, collection, transportation, and temporary storage of the wastes within the institutions and the transportation of them to the final disposal area were explained. In the last part of the Regulation, the method of the disposal of the wastes was mentioned.

New developments in the field of waste management must be included into the system. Large quantities of this waste cannot be eliminated. However, the environmental impact can be reduced by making more sustainable use of this waste. This is known as the “Waste Hierarchy” (Batayneh, Marie, & Asi, 2007). The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The hierarchy of disposal options, which categorizes environmental impacts into six levels, from low to high; namely, reduce, reuse, recycle, compost, incinerate and

landfill (Siddique, Khatib, & Kaur, 2008). The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste. Waste collection methods vary widely between different countries and regions. Domestic waste collection services are often provided by local government authorities, or by private industry. Some areas, especially those in less developed countries, do not have a formal waste-collection system.

A. Characteristics of Waste

When it comes to hazardous waste disposal and management, understanding the waste your organization generates is imperative. Hazardous waste is heavily regulated, and thus cannot just be tossed out with your everyday trash. To know if you're handling hazardous waste, the first step is to assess its characteristics.

When categorizing hazardous waste, the EPA breaks it down by four characteristics:

- ignitability, or something flammable
- corrosively, or something that can rust or decompose
- reactivity, or something explosive
- toxicity, or something poisonous(Nuortio, Kytöjoki, Niska, & Bräysy, 2016)

These high level categories each have their own characteristics that further help you as a generator define with what you are dealing.

I. **Ignitability**–point less than 60 °C (140 °F). Examples include waste oils and used solvents. Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash

There are three types of ignitable forms:

- Liquids with a flash point–the lowest temperature at which fumes above waste ignite–of 60 degrees Celsius or 140 degrees Fahrenheit. Examples include alcohol, gasoline, and acetone.
- Solids that spontaneously combust.
- Oxidizers and compressed gasses (Aliyu, 2017)

I. Corrosively

Corrosive substances, such as hydrochloric acid, nitric acid, and sulfuric acid, have the ability eat through containers, causing the leakage of harmful materials. A corrosive is anything liquid with a pH of less than or equal to 2 or greater than or equal to 12.5, or has the ability to corrode steel. Everyday example of corrosives includes battery acid and rust removers (Aliu, 2017).

II. Reactivity

Given their instability, reactive wastes can be very dangerous. The EPA recognizes that there are too many conditions and situations to identify all types of reactive materials. However, they use the following as guidelines to assist generators:

- unstable, and routinely experiences violent change without detonating
- potential for explosive mixture or violent reaction when combined with water
- toxic gasses are released when mixed with water (Aliu, 2017)

III. Toxicity

Poisonous materials pose a threat to our groundwater, which can have long term effects to human health and the environment. This is different from the first three

characteristic groups, which the EPA views as containing immediate and firsthand dangers. There are 60 contaminants on the toxicity characteristics list. These contaminants are identified solely through a test method called Toxicity Characteristic Leaching Procedure or TCLP (Hoornweg, & Bhada-Tata, 2012).

A. Solid Waste Management Methods

Classification and assignment of different waste materials to classes cannot be easily achieved by conventional parameters. Some new techniques have been proposed and developed by researchers. Nowadays not all the wastes are classified under the same classical category, requiring the same procedure of elimination. Especially in the industries in which the types of wastes are so varied it is very difficult and impractical to set up and operate a different management system for different types of wastes (Buyukbektas, & Varinca, 2008). Thus has emerged the necessity of a, management system which would eliminate all types of wastes. Table 1 has presented a selection of promising waste treatment processes.

An integrated approach is required in an attempt to manage such large quantities of a diverse, contaminated mixture of wastes in an energy efficient and environmentally benign manner. This would require examining critically various steps in the life of the wastes such as the raw materials for their manufacture, the manufacturing processes, design and fabrication of the finished products, possible reuse of those items, and the proper disposal of the wastes, in totality. Such an integrated waste management concept comprises: (i) source reduction; (ii) reuse; (iii) recycling; (iv) land fill and gas-to energy (v) waste-to energy conversion.

1. Landfill

A landfill is not a normal environmental condition, though, nor is it intended to be. Instead, a landfill is more like a tightly sealed storage container. A landfill is

designed to inhibit degradation to protect the environment from harmful contamination. Deprived of air and water, even organic wastes like paper and grass clippings degrade very slowly in a landfill. Municipal Solid Waste Landfills (MSWLs) are places where heterogeneous mixtures of municipal and industrial wastes are disposed. Mechanical properties of MSW such as strength and compressibility depend on composition of waste, mechanical properties of components of the material deposited, water content and decomposition (Edincliler, Baykal, Erdik, & Mowrtage, 2007).

Disposing of waste in a landfill involves burying waste to dispose of it, and this remains a common practice in most countries. Landfills were often established in disused quarries, mining voids or borrow pits. A properly-designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly-designed or poorly-managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin (especially, noxious little animals or insects, collectively, as squirrels, rats, mice, flies, lice, bugs, etc), and generation of liquid leachate.

Landfill leachates contain a large number of compounds, some of which can be expected to create a threat to health and nature if released into the natural environment. For this purpose, Öman and Junestedt (Oman, & Junestedt, 2008), have been studied screened samples from 12 Swedish municipal landfill sites for 400 parameters and compounds which expected to be present in landfill leachate. More than 90 organic and metal organic compounds and 50 inorganic elements were detected, some of which seem to have not been detected before. Compounds detected include halogenated aliphatic compounds, benzene and alkylated benzenes, phenol and alkylated phenols, ethoxylates, polycyclic aromatic compounds, ophthalmic esters, chlorinated benzenes, chlorinated phenols, PCB, chlorinated dioxins and chlorinated furans, bromated flame-

retardants, pesticides, organic tin, methyl mercury and heavy metals. According to Oman, et. al, (2008), the presence of this large number of hazardous compounds in landfill leachates should have a significant impact on future landfill risk assessments and the development of leachate treatment methods.

Today's landfills are very different from the open dumps of the past. For one thing, new landfills are situated where clay deposits and other land features act as natural buffers between the landfills and the surrounding environment. Second, the bottom and sides of modern landfills are lined with layers of clay or plastic to keep the liquid waste, called leach ate, from escaping into the soil. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin.

Another common by product of landfills is gases. Landfill gas is a renewable energy source. Methane (CH_4) and carbon dioxide (CO_2) are major gases, forming from the anaerobic degradation of degradable domestic solid wastes. Landfill gases generally contain 45-60% CH4 and 40-60% CO_2 (Ozcan, Borat, & Bayat, 2005). These gases can create odor problems, kill surface vegetation, and is a greenhouse gas (GHG). Some of these compounds may cause corrosion or other damage to engines if they are not removed from the gas before utilization.

Landfills are an important source of atmospheric CH4 due to methanogenic activity under anaerobic conditions (Houghton, Ding, Griggs, Noguer, van der Linden, Dai, Maskell, Johnson, (2011). Landfill CH_4 recovery and optimized wastewater treatment can directly reduce GHG emissions. So far, studies and applications on upgrading landfill gas are relatively few, while the upgrading of biogases from sewage and bio waste digesters is rapidly increasing in some countries. For example, in Reykjavik (Iceland), landfill gas upgrading was started in 2000 with water scrubber

technology (Rasi, Lantela, Veijanen, & Rintala, 2008). In 2003, East Kentucky Power Cooperative began recovering methane gas from three landfills. The utility uses the landfill gas to generate 8.8 MW of electricity, enough power 7500-8000 homes.

According to Magrinho, Didelet, & Semiao, (2016) land filling is the last choice method in the hierarchy of waste management. However, even with sanitary land filling being the most common method of solid waste management, there was no landfill gas energy recovery. With the scarcity of space for land filling and due to its ever increasing cost, waste utilization has become an attractive alternative to disposal.

2. Bio-renewable gaseous fuels

Liquid (bio-ethanol and biodiesel) and gaseous (biogas and bio-hydrogen) bio-fuels have become more attractive recently because of its environmental benefits. In recent years, many studies have investigated the economic and environmental impacts of the bio-fuels, especially bio-ethanol and biodiesel (Balat, 2008; Balat, 2009a; Balat, 2009b; Balat, 2007; Demirbas, 2008a; 2008b; 2009). Liquid bio-fuels are important because they replace petroleum fuels. There are many benefits for the environment, economy and consumers in using bio-fuels. Bio-fuels production costs can vary widely by feedstock, conversion process, scale of production and region. Bio-fuels production costs can vary widely by feedstock, conversion process, scale of production and region. On an energy basis, ethanol is currently more expensive to produce than gasoline in all regions considered (Demirbas, 2008b; 2008c; 2008d; 2008e; 2008f; Demirbas, 2009c; Hacisaligoglu, 2009; Demirbas, & Demirbas, 2009).

Biogas can be obtained from several sources. It is obtained from decomposing organic material. Biogas is composed by methane (CH_4), carbon dioxide (CO_2), air, ammonia, carbon monoxide, hydrogen, sulfur gases, nitrogen and oxygen. Among its components, methane is the most important one, particularly for the combustion process

in vehicle engines (Kuwahara, Berni, and Bajay, 1999). CH_4 and CO_2 make up around 90% of the gas volume produced. The main constituents of landfill gas are methane and carbon dioxide, both of which are major contributors to global warming. Because of the widely varying nature of the contents of landfill sites the constituents of landfill gases vary widely.

Landfill leachate treatment has received significant attention in recent years, especially in municipal areas (Uygur, 2004). The generation of municipal solid wastes (MSW) has increased in parallel to rapid industrialization. Approximately 16% of all discarded MSW is incinerated (EPA. 1994); the remainder is disposed of in landfills. Effective management of these wastes has become a major social and environmental concern (Erses, & Onay, 2003). Disposal of MSW in sanitary landfills is usually associated with soil, surface water and groundwater contamination when the landfill is not properly constructed. The flow rate and composition of leachate vary from site to site, seasonally at each site and depending on the age of the landfill. Young leachate normally contains high amounts of volatile fatty acids (Timur, & Ozturk, 1999). MSW statistics and management practices including waste recovery and recycling initiatives have been evaluated (Metin, Erozturk, & Neyim, 2003). The organic MSW was chemically and biologically characterized, in order to study its behavior during anaerobic digestion, and its pH, biogas production, alkalinity, and volatile fatty acid production was determined by Plaza, Robredo, Pacheco, & Toledo, (1996). Anaerobic digestion of the organic food fraction of MSW, on its own or co-digested with primary sewage sludge, produces high quality biogas, suitable as renewable energy (Kiely, Tayfur, Dolan, & Tanji, 1997). The processing of MSW (i.e. landfill, incineration, aerobic composting) secures many advantages and limitations (Braber, 1995). The

greenhouse gas emissions can be reduced by the uncontrolled releasing of methane from improperly disposed organic waste in a large landfill (Al-Dabbas, 1998).

Decomposition in landfills occurs in a series of stages, each of which is characterized by the increase or decrease of specific bacterial populations and the formation and utilization of certain metabolic products. The first stage of decomposition, which usually lasts less than a week, is characterized by the removal of oxygen from the waste by aerobic bacteria (Augenstein, & Pacey, 1991). In the second stage, which has been termed the anaerobic acid stage, a diverse population of hydrolytic and fermentative bacteria hydrolyzes polymers, such as cellulose, hemicelluloses, proteins, and lipids, into soluble sugars, amino acids, long-chain carboxylic acids, and glycerol (Micales, 1997). The main components of landfill gas are by-products of the decomposition of organic material, usually in the form of domestic waste, by the action of naturally occurring bacteria under anaerobic conditions.

Methods developed for treatment of landfill leachates can be classified as physical, chemical and biological which are usually used in combinations in order to improve the treatment efficiency. Biological treatment methods used for the leachate treatment can be classified as aerobic, anaerobic and anoxic processes which are widely used for the removal of biodegradable compounds (Kargi, & Pamukoglu, 2004). Biological treatment of landfill leach ate usually results in low nutrient removals because of high chemical oxygen demand (COD), high ammonium-N content and the presence of toxic compounds such as heavy metals (Uygur, 2004). Landfill leach ate obtained from the solid waste landfill area contained high COD and ammonium ions which resulted in low COD and ammonium removals by direct biological treatment (Kargi, et, al. 2004).

Several anaerobic and aerobic treatment systems have been studied in landfill leachate (Ozturk, Altinbas, Koyuncu, Arikan, & Gomec-Yangin, 2003). Leachates contain non-biodegradable substrates which are not removed by biological treatment alone and an increase of leachate input may cause reduction in substrate removal (Cecen, Erdincler, & Kilic, 2003). Raw landfill leachate was subjected to pre-treatment by coagulation-flocculation and air stripping of ammonia before biological treatment (Kargi, & Pamukogl, 2004). In order to improve biological treatability of the leachate, coagulation-flocculation and air stripping of ammonia were used as pre-treatment (Kargi, et, al. 2004). Natural zeolite and bentonite can be utilized as a novel landfill liner material (Kayabali, 1997).

3. Incineration

Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash. As stated by Yang, Nam, & Choi, (2007) a solid waste incinerator is a type of facility which is designed, built, and operated at specified design conditions. A typical incinerator processes wastes that have been collected as input material, and achieves its goal, i.e., treatment of waste material and as secondary benefit recovers heat energy from the combustion process.

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants. Solid waste incineration generates solid residues, such as bottom ash and air pollution control residues. Besides a

high content of inorganic compounds, incineration residues also contain abundant carbon compounds deriving from incomplete combustion, unburned organic matter and carbon compounds formed during the incineration process (Ecke, & Svensson, 2008). In addition, the incineration of fossil carbon results in minor emissions of CO_2.

Incineration is common in countries such as Japan where land is scarcer, as these facilities generally do not require as much area as landfills. In Japan, where open space is very limited for construction of waste management infrastructure, very high rates of both recycling and incineration are practiced and are expected to continue into the future.

Waste-to-energy (WTE) or energy-from-waste (EFW) is broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam and/or electricity. Combustion in an incinerator is not always perfect and there have been concerns about micro-pollutants in gaseous emissions from incinerator stacks. Particular concern has focused on some very persistent organics such as Dioxins which may be created within the incinerator and which may have serious environmental consequences in the area immediately around the incinerator. Gullett, Dunn, Bae, and Raghunathan, (1998), reported the discovery of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) from waste combustion sources and the increased under-standing of the toxic effects of these chemicals have prompted extensive study over the last 10 or so years on how these trace compounds are formed in combustion systems.

Incineration for waste to (WTE) has been widely implemented in many European countries for decades. In 2002, European Union WTE plants generated 41 million GJ of electrical energy and 110 million GJ of thermal energy. Incineration and industrial co-combustion for WTE provide significant renewable energy benefits and fossil fuel

offsets. Currently, over 130 million tones of waste per year are incinerated at over 600 plants (Themelis, 2003). Thermal processes with advanced emission controls are proven technology but more costly than controlled land filling with landfill gas recovery; however, thermal processes may become more viable as energy prices increase. Because landfills produce CH_4 for decades, incineration, composting and other strategies that reduce land filled waste are complementary mitigation measures to landfill gas recovery in the short- to medium-term (Bogner, Ahmed, Diaz, Faaij, Gao, Hashimoto, Mareckova, Pipatti, & Zhang, 2007).

2.2.2 Classification of Solid Wastes

According to Adebayo (2004) waste can be classified according to their source and basically from the origin of generation with a of obtaining efficient method of storage, collection. Treatment and management, such as

Solid Waste

Solid waste can be defined as non liquid material that no longer has any value to the person who is responsible for it. The words rubbish, garbage, trash, and refuse are often used as synonyms when talking about solid waste (Da Zhu et al.). Any solid material in the material flow pattern that is rejected by society is called solid waste. So, solid wastes are the organic or inorganic waste materials produced by various activities of the society, which have lost their value to the first user. It is generated by domestic, commercial, industrial, healthcare.

Municipal Solid Waste

The term ‘municipal solid waste’ refers to solid waste from houses, streets and public places, shops, offices, and hospitals. The management of these types of waste is most often the responsibility of Municipal or other Governmental authorities. Although solid waste from industrial processes is generally not considered municipal waste, it

nevertheless needs to be taken into account when dealing with solid waste, because it often ends up in the MSW stream. Street refuse, a major ingredient of MSW, contains a mixture of refuse from many sources, because streets are used as dumping grounds by all generators of waste. Where sanitation facilities are lacking and a large animal population roams the streets, street refuse contains a lot of human faecal matter and manure. Streets are also often used for extensive dumping of construction and demolition debris-attracting further dumping of solid waste. (Da Zhu et al.). Municipal Solid Waste (MSW), also called urban solid waste, is a waste type that includes predominantly household waste (domestic waste) with, sometimes, the addition of commercial wastes, construction and demolition debris, sanitation residue, and waste from streets collected by a Municipality within a given area. They are in either solid or semisolid form and generally exclude industrial hazardous wastes. So, any types of solid wastes generated in Municipal limits are municipal solid wastes

2.2.3 Classification of Solid Wastes

1. Residential

Residential waste refers to wastes from dwellings, apartments, Municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. This garbage is generated mainly from residential and commercial complexes. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing.

The continuous indiscriminate management of municipal solid waste is accelerating and is linked to poverty, poor governance, urbanization, population growth, poor standards of living and low level of environmental awareness (Adewuyi, Komine,Yashura, Murakami, 2009). Inadequate management of environmental

knowledge Most of these wastes are generated from domestic sources and arc most characteristics of household solid waste (Ayotamano & Gobo 2004). The persisting problems of municipal solid waste management in Nigeria prompt the need for communicating innovations and knowledge to achieve desire transformation in overcoming socio-economic and environmental challenges. The need to migrate environmental pollution is crucial due to its direct impacts on human, plants and animals the increasing contribution to climate change. Furthermore, energy conversation, energy generation, resource and material recovery from waste through improves municipal solid waste management is possible by deploying best solutions (Ogu, 2008)

Different approaches and interventions have been developed in die pat for tackling municipal waste concerns with little or no progress. Managing municipal waste efficiently requires intensification and application knowledge management tools that guarantee sustainable environment and socio economic growth. '"Municipal solid waste management is an important part of urban infrastructure that ensures the environment and human health" (Aliyu, 2010). consists of leftover food, vegetable peels, plastic, clothes, ashes, etc.

2. Industrial

Industrial wastes mainly consist of process wastes, Industrial and hospital waste is considered hazardous as they may contain toxic substances. Certain types of household waste are also hazardous. Hazardous wastes could be highly toxic to humans, animals, and plants; are corrosive, highly inflammable, or explosive; and react when exposed to certain things e.g. gases**.** According to (Aribisala, 2004*),* hazardous waste contain toxic substance which could be highly toxic to human, animal and plant; they are corrosive, high inflammable, or explosive and react when exposed to certain thing

like gases, household waste that can be categorized as hazardous include old batteries, shoe polish, paint tins, old medicines and medicine boles, hospital wastes contaminated by chemical (formaldehyde and phenols) used in hospitals is considered hazardous. In the industrial sector, the major generators of hazardous waste are chemicals, paper, pesticides dyes, refining and rubber goods, ashes, demolition and construction wastes, hazardous wastes, etc., due to industrial activities.

3. Commercial

Commercial wastes consist of leftover food, glasses, metals, ashes, etc. generated from stores, restaurants, markets, hotels, motels, auto repair shops, medical facilities, etc.

4. Institutional

Institutional waste consists of paper, plastic, glasses, etc., generated from educational administrative and public buildings such as schools, colleges, offices, prisons, etc.

5. Municipal

Municipal waste includes dust, leaf matter, building debris, treatment plant residual sludge, etc., generated from various municipal activities like construction and demolition, street cleaning, landscaping, etc.

2.2.3. Biomedical solid waste- Infections Waste

Biomedical waste is any kind of waste containing infectious (or potentially infectious) materials (Ezirim & Agbo, 2018). It may also include waste associated with the generation of biomedical waste that visually appears to be of medical or laboratory origin (e.g., packaging, unused bandages, infusion kits, etc.), as well research laboratory waste containing bio molecules or organisms that are mainly restricted from environmental release.

Biomedical waste may be solid or liquid. Examples of infectious waste include discarded blood, sharps, unwanted microbiological cultures and stocks, identifiable body parts (including those as a result of amputation), other human or animal tissue, used bandages and dressings, discarded gloves, other medical supplies that may have been in contact with blood and body fluids, and laboratory waste that exhibits the characteristics described above. Waste sharps include potentially contaminated used (and unused discarded) needles, scalpels, lancets and other devices capable of penetrating skin. Environmental Protection Agency (EPA, 2013)

According to Hoornweg (2000), infectious waste such as hospital waste are generated during diagnosis treatment or immunization of human beings or animal or during research activities, theses may include sharps, soiled waste disposables and anatomical wastes, disposables and medicine, chemical wastes which could be in form of disposable syringes, swabs, bandages, body fluids, human excrete.

2.3 Solid Waste Management in Nigeria

By and large, the uncontrolled dumping of refuse in both acceptable and unacceptable locations, the stock piling of different forms of solid waste much inefficiency characterize Municipal Solid waste management (MSWM) services in several West African cities including Nigeria. This often times results in air and water pollution as well as air and water borne diseases, yet no drastic efforts is directed in improving these services.

Problems associated with utilities such as water, electricity and communication services are treated with greater urgency. Nevertheless, the problems associated with solid waste have not been handled in a similar manner Rohrs et al.(2009), identified that in addition to the low level of infrastructure in developing countries management is perceived to be less important than the provision of other municipal services. "Solid

waste management is one of the public infrastructure that is based specific type of physical infrastructure to provide the goods or services, and in the respect it resembles the electricity natural gas, and water sector (Dijkema et al 2000),

Generally conditions of solid waste management in Nigeria are similar to those in many developing countries within the tropical climates. Based on an estimated population of 18 million (2005) and an average daily waste generation per capita of0.45kg, Nigeria generates annually about 2.0million tons of solid waste. Several other studies have been carried out within the country, yet archiving and access to records leaves much to be desired. In many other rapidly growth cities, the issue of solid waste is a major source of concern owing to the inefficiency observed in the sanitation management provided by poorly resourced regulatory authorities Solid waste limited only to local authorities, who are much slower in adjusting to the demands of residential areas, industries, institutions and even streets and market places despite the various charges levied by the city council.

2.3.1 Collection of Solid Waste

Waste collection is the collection of solid waste from point of production (residential, industrial commercial, institutional) to the point of treatment or disposal (Hoornweg, & Bhada-Tata, 2012). Municipal solid waste is collected in several ways:

1. **House-to-House:** Waste collectors visit each individual house to collect garbage. The user generally pays a fee for this service.

2. **Community Bins:** Users bring their garbage to community bins that are placed at fixed points in a neighborhood or locality. MSW is picked up by the municipality, or its designate, according to a set schedule.

3. **Curbside Pick-Up:** Users leave their garbage directly outside their homes according to a garbage pick-up schedule set with the local authorities (secondary house-to house collectors not typical).

4. **Self Delivered:** Generators deliver the waste directly to disposal sites or transfer stations, or hire third-party operators (or the municipality).

5. **Contracted or Delegated Service:** Businesses hire firms (or municipality with municipal facilities) who arrange collection schedules and charges with customers. Municipalities often license private operators and may designate collection areas to encourage collection efficiencies(Hoornweg, & Bhada-Tata, 2012)

In developed and normal societies, waste management simply means the collection, keeping, treatment and disposal of waste in such a way as to render then harmless to human and animal life-the ecology and environment generally. It could also be said to be the organized and systematic dumping and channeling of waste through or into landfills or pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguard. Proper waste management will result in the abatement or total elimination of pollution. The collection of waste is a highly visible and important municipal service that involves large expenditures (Nuortio, Kytöjoki, Niska, & Bräysy, 2016). Nuortio, et. al, (2016) emphasized that waste collection problems are, however, one of the most difficult operational problems to solve.

2.3.2 Disposal of Solid Waste

Aliu, (2017) emphasized that, in Nigeria, managing waste disposal has become a major concern despite several attempts by successive governments and private organizations in that direction. That is why it is a common sight across the country

today to see heaps of festering waste dumps in almost every nooks and crannies. Residential apartments, markets, waterways, highways, streets and undeveloped plots of land have been turned to waste dumps for many households. No wonder many say that in Nigeria, waste increases in a geometrical progression and collection and disposal is at an arithmetical progression.

It is obvious that some factors are responsible for poor waste disposal management. These include lack of adequate funding, excessive population, and lack of comprehensive legal framework and enforcement of the existing regulations (Aliu, 2017). Others include low investment in infrastructure, inadequate human capacity for administrative and technical issues, and wrong attitude of the public towards solid waste disposal, poor planning, low data management and uncontrolled urbanization, uncoordinated institutional functions, low academic research and industry linkages and lack of the needed political will on the part of the leaders. Until these challenges are properly, boldly and diligently addressed by relevant authorities and individuals, managing waste disposal will remain a nightmare and recurring decimal in Nigeria (Aliu, 2017).

There are many methods available in disposal of waste. For the purpose of this study we will look at some of the most commonly used methods:

A. Landfills

Throwing daily waste/garbage in the landfills is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land. Landfills are commonly found in developing countries. There is a process used that eliminates the odors and dangers of waste before it is

placed into the ground. While it is true this is the most popular form of waste disposal, it is certainly far from the only procedure and one that may also bring with it an assortment of space (Aliu, 2017).

This method is becoming less these days although, thanks to the lack of space available and the strong presence of methane and other landfill gases, both of which can cause numerous contamination problems. Landfills give rise to air and water pollution which severely affects the environment and can prove fatal to the lives of humans and animals (Aliu, 2017).

Incineration/Combustion

Incineration or combustion is a type disposal method in which municipal solid wastes are burned at high temperatures so as as to convert them into residue and gaseous products. The biggest advantage of this type of method is that it can reduce the volume of solid waste to 20 to 30 percent of the original volume, decreases the space they take up and reduce the stress on landfills. This process is also known as thermal treatment where solid waste materials are converted by Incinerators into heat, gas, steam and ash. Incineration is something that is very in countries where landfill space is no longer available, which includes Japan (Achor, & Nwafor, 2014).

B. Recovery and Recycling

Resource recovery is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials (Achor, & Nwafor, 2014). Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use (Aliu, 2017).

C. Plasma gasification

Plasma gasification is another form of waste management. Plasma is a primarily an electrically charged or a highly ionized gas. Lighting is one type of plasma which produces temperatures that exceed 12,600 °F. With this method of waste disposal, a vessel uses characteristic plasma torches operating at +10,000 °F which is creating a gasification zone till 3,000 °F for the conversion of solid or liquid wastes into a syngas.During the treatment solid waste by plasma gasification, the waste's molecular bonds are broken down as result of the intense heat in the vessels and the elemental components. Thanks to this process, destruction of waste and dangerous materials is found. This form of waste disposal provides renewable energy and an assortment of other fantastic benefits (Aliu, 2017).

D. Composting

Composting is a easy and natural bio-degradation process that takes organic wastes i.e. remains of plants and garden and kitchen waste and turns into nutrient rich food for your plants. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it. Composting is one of the best method of waste disposal as it can turn unsafe organic

products into safe compost. On the other side, it is slow process and takes lot of space (Aliu, 2017).

2.4 Knowledge of Solid Waste Management Among Households

The knowledge of households is mainly interested in receiving effective and dependable waste collection service within their immediate vicinity. Households give priority to water supply and electricity. Although households are the main contributors to waste generation, it may well be useful to know how this may change with economic development. A positive relationship between income levels and waste generation at the household level has been established (Nabegu 2008, Rotich et al. 2006). At the same time, waste generation is conditioned to an important degree by people's attitudes towards waste especially their patterns of material use and waste handling, their interest in waste reduction and minimization, the degree to which they separate wastes and the extent to which they refrain from indiscriminate dumping and littering (Zurbrugg 2007). People's attitudes influence not only the characteristics of waste generation, but also the effective demand for waste collection services. Attitudes have been positively influenced through awareness-building campaigns on the negative impacts of inadequate waste collection with regard to public health and environmental conditions, and the value of effective disposal. Such campaigns should also inform people of their responsibilities as waste generators and of their rights as citizens to waste management services. While attitudes towards solid waste may be positively influenced by public information and educational measures, improved waste handling patterns can hardly be maintained in the absence of practical waste disposal options.

Awareness-building measures should therefore be coordinated with improvements in waste collection services, whether public or community managed. Similarly, people's waste generation and disposal patterns are influenced by those of their neighbors (Mehta and Satyamarayaran 2006). Thus, besides general awareness, improved local waste management depends upon the availability of practical options for waste collection and a consensus among neighbors that improvements are both important and possible. Programmers to disseminate knowledge and to improve behavior patterns and attitudes regarding waste management, are therefore critical. For such programmers to succeed such programmed must be based on sound understanding of the social and cultural characteristics of the communities.

2.4.2 Attitudes towards Solid Waste Management Among Households

Negative attitudes towards solid waste management bring about barriers to performing activities concerning waste management. This was evident in the study which was conducted by Tuckers (2003), on attitudes and behavioral change in households waste management behaviors. The findings were that negative perceptions about waste management activities are common discriminate of behavior in household waste management. The study further revealed that attitudes can differ between those who have recently taken up the activities of waste management and those who have not, and between those who formerly participated but have dropped out and those still continuing to participate. The results also revealed that there may be two distinct classes of antecedent attitudes: Convenience, factors such as time and effort, which may play little part in initiation but can reinforce persistence, and attitudes of predisposition such as perceptions of Vermin and fly problems, waste requirements and aesthetics, which can inhibit initiation. The study also reviewed that initial experience quickly sets attitudes that are stably maintained into the longer terms unless subsequent specific

adverse experience an encountered, when attitudes may weaker and drop out might occur.

It is true that attitudes contribute to the accumulation of solid waste in most parts of the city. Most of the people know that it is not health to have waste in their house no wonder they throw it outside their houses. But it is only that they have “I don’t care attitude”. The best is to change the mindset of the people by making them understand that waste mainly is the responsibility of everyone in any given society. On the global scale, human beings have become dominant in the ecosystem. This has been possible because of their large numbers and their ability to modify systems as well as extract and transform natural materials into their use. Also Sridhar et al (2006) reveal that human beings have been slower to respond than nature can, and only in recent decades have they acknowledged die need to cop die examples of nature (bio-mimicry) to avoid accumulation of solid waste and the challenges of solid waste management historically(Wikipedia.com 27 Nov2006). Explained that waste is any substance or object which the holder discards or intends to discard or is required it, discard. Also, Wikipedia.com (2014); identified solid management as the generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes. All human activities give rise to residual materials which may not be of immediate use and thereby constitute waste which is ultimately released to the environment. Solid waste can be categorized based on its source of generation and production. Thus, solid waste can be broadly grouped into domestic, commercial, and industrial waste. Henderson (2002), refer solid waste management to the act to maintain acceptable environmental quality, sound public health and creation of aesthetic value, solid waste management as to do with administration of institution charge with the responsibility of evacuating of solid waste from there smokes of generation through

storage, collection, transportation, recovery and treatment processes to disposal. Dede, (2006), categorized solid waste based on its composition such as organic and biodegradable waste, solid waste, liquid waste, gaseous waste, and regulated medical waste.

Asomani (2007), asserted that there is a growing domestic solid waste management problem in most developing countries, which is gradually approach crises level. This trend has gone unchecked for so many years that now: the situation appears to be intractable. In Nigeria, the domestic solid waste management problems (especially by overflowing dustbins, mountains of open refuse dumps at virtually even street corner; their attendant problems (especially where burning also occurs) and the existence of improperly operated landfills which are often rodent infested with potentials for surface and ground water pollution. So far, most of the solutions proffered 10 solve the problem have at best been short term in scope and have tended to view the problem as a localized household or area wide problem rather than a regional one. Therefore Akintola (2011) stated that Nature has the capacity to dispense, degrade, absorb or otherwise, dispose of in the atmosphere, waterways, oceans, sea and soil. However, according to Dede (2006), thereconcern about those residues including the domestic wastes that may poison or damage the environment, adversely affecting species in the biosphere and destabilizing ecological balance. Solutions aimed at addressing domestic waste problems should target the benefits of health conservation, aesthetic and recreation as well as the past organization of refuse management. The modem Nigerian urban domestic solid waste is characterized by polythene (plastic) materials. garbage, bottles, cans, papers or foil wrappings and throwaways of all sons from the household.

The volumes of these wastes are increasing rapidly because of the constant desire of consumers to discard the old and acquire new items, completely disregarding the concept of recycling and this is a big problem to management. The rate at which domestic solid wastes are being generated is great nowadays and only an organized solid waste management can handle it without any problem (Emily, 2004). Environment Sanitation Edit of (1983). Refuse disposal and the recovery of solid wastematerials are the responsibilities of the local government authorities.

They are therefore, responsible for the collection, transportation, treatment and final management domestic waste (FMHH 2009), before this time, domestic solid waste management had been the responsibility of the state extra ministerial. Par aster, like the Kaduna State Environmental Protection Agency. On the national .scale, this responsibility is vested on the Federal Environmental Protection Agency, established on the 30 of December. 1988 (Aniemeka. 2011) the management of solid waste constitutes one of the most immediate and serious environmental problems lacing most towns in Nigeria. The conventional solid waste management approach based on collection and management has failed to provide efficient and effective results. A World Health Organization (WHO) Report (2006), has identified solid waste as one of the biggest challenges to the health of the people residing in Lagos. The report revealed that lagos has been beset with the difficulties of clearing over 10,000 tons of solid waste generated daily.

The lack of effective solid waste management service is becoming problem. According to the report, the growth in the population of Lagos from 5.7 million in 1991 to about 9 million in 2005 has made it difficult for the Slate Government tofind a solution to Lagos waste problems. The Lagos Solid waste management Authority corroborated the report and further stated that indiscriminate dumping is an added

complication. Emily (2004) asserted that when solid waste is not collected unsanitary conditions develop and pose environmental and human health risks. The prevalence of parasites, tetanus, malaria, hookworm. Cholera and diarrhea in cities in Nigeria is attributed to the unsanitary condition in these cities (Oyediran, 2004).

Oyediran, (2004) posits that insanitary management of solid waste promotes fecal-oral transmitteddiseases through fecal contamination of the hands, food and water, he further stated that,solid waste dumps provide breeding grounds for mosquitoes, rats and other waste generating amongst others: yellow fever, Lassa fever, and trachoma mortality in Nigeria.

Despite the efforts made by various levels of government to sanitize the environment, it is still filthy and has an adverse effect on the wellbeing of residents; most parts of the Lagos metropolis are hardly free of the waste menace since the PSP operators took over refuse clearing. Besides the health problem, solid waste blocks the drainage system and creates severe flooding on the streets especially during the raining season when farm produce leaves litters the environment (Ilevbare, 2011). Solid waste could be defined as non liquid and nongaseous products of human activities, regarded as being useless. It can take the forms of refuse, garbage and sludge. The World Health Organization, WHO (2001) also defines waste as "something, which the owner no longer wants at a given time and place and which has no current or perceived market value". One of the few status in Nigeria, that attempts to define waste is the Lagos State Environmental Sanitation Edict (1985), which in Section 32, define waste as (a) waste of all description (b) any substance, which constitutes scrap materials or an effluent or the other, unwanted surplus substance arising from the application of any process. However, psychological factors such as self-monitoring and locus of control should not

be underscored as crucial factors in predicting attitude towards solid waste management.

According to Mischel (2006), such psychological variables would interact to influence human attitude and behavior. Locus of control is grounded in Expectancy – Value Theory, which describes human behavior as determined by the likelihood of an event or outcome occurring contingent upon the behavior in question and the value placed on the event or outcome. Hwang, Kim and Jeng (2000) refer to locus of control as an individual's belief in whether or not he or she has the ability to bring about change through his or her behavior. Studies have shown that locus of control is associated with environmental issues. Hines , Hungerford and Tomera (2007) concluded that an internal locus of control is positively related to environmental behavior while Cleverland, Kalanas and Laroche (2012) found that the development of a novel construct , internal locus of control captures consumers' multifaceted attitudes pertaining responsibility towards and ability to affect environmental outcomes. Lennox and Wolfe (2004) restricted the concept of self-monitoring to the ability to modify self presentation and sensitivity to the expressive behavior of others.

The Self- Monitoring Theory refers to the process through which people regulate their own behavior in order to "look good" so that they will be perceived by others in a favorable manner. Researchers have indicates that the way an individual presents him/her self in situations and adjusting his/her performance to create the desired impression can be a crucial factor in predicting a positive attitude towards environmental issues , for example, Ilevbare (2011) examined the influence of self-monitoring on residents self – reported attitude towards solid waste management in Lagos metropolis and the finding established that people who seek to present themselves in positive light to the public are more concerned with the way they manage

solid waste and also Green-Demers, Pelletier, and Menard (2007) examined the relationship between self-determination, the perceived difficulty of performing various pro-environmental behaviors, self-reported recycling behavior, purchase of environmentally friendly consumer products, and efforts to gain knowledge about environmental problems. They found that consistent with the theory, self-determination was positively related to the frequency of pro-environmental behavior.

However, several authors have provided evidence, suggesting that self-identity dimensions can be a useful addiction to the Theory of Planned behavior within the domain of repeated behaviors such as recycling. To compare the predictive power of a new model of self-expressive behavior with the TPB, a study was conducted in which, besides the classic variables of the TPB model (such as attitudes, subjective norms and perceived control), similarity between personal identity and identity typical recyclers was also taken into account. Two hundred and thirty subjects were recruited to study behavioral intentions concerning household recycling in relation to the variables mentioned above. Data analysis, based on structural equation modeling, shows that personal identity contributes significantly 2004).

2.4.3 Practice of Solid Waste among Households

Phillips, &David, (2010) stated that households with less education are more likely to generate waste because of the need to get an income. Perhaps, everyone would be exposed to environmental education. The current way of disposing solid waste in Katsina is by using open space or gutter as their way of disposing solid waste. There is need to emphasize the protection of the environment at all levels in the communities. The kindergarten could be the foundation for environmental education. Emphasis should also be placed on increasing environmental awareness and a sense of responsibility among the residents particularly in handling waste. Policymakers could

consider offering tax concessions to industries involved in developing reusable products that will reduce solid wastes intended for disposal. This would encourage informal recycling activities by giving recognition and facilities to recyclers. In Uganda, the itinerant buyers and local artisan groups provide an avenue for recycling of old and disposable items.

They are involved in producing low cost household and farm tools which have a big market among the low income population. Their contribution in reducing waste cannot be ignored. The government should encourage and support these local artisans in their work by offering them (Ekere, Mugisha and Drake, 2009). The problems of waste management have continued to beleaguer the entire universe especially Nigeria as presented by ABUJA CITISERVE (2004). According to Adeniran (2005) and Babatunde et al., (2013) with annually generated solid waste in Nigeria been more than 25 million tonnes of 0.66 kg/cap/day in urban areas and 0.44 kg/cap/day in rural areas, we are certainly heading to a crises stage if unmanaged.

Solid waste comes from residential, institutional, commercial, agricultural or even industrial discards while municipal solid waste has emerged as one of greatest generated hazards (Benjamin, Emmanuel & Gideon,(2014); ABUJA-CITISERVE, The Management of municipal solid waste consist of practices involving waste generation, collection, sorting, storage, transport, transfer, processing and disposal which can lead to environmental pollution like land degradation, vector breeding ground, offensive odors, emissions of toxic gases and groundwater contamination if not managed effectively in urban areas as noted by Farasat et al., (2015) and even the formation of lactates which contains heavy metals, microorganisms and radioactive elements especially in dumped open landfills (Olusegun, 2013).

Thus municipal waste disposal as reported by Iyanda, Titilope & Olaniyi (2014) have reached a crucial point in major towns and cities in Nigeria including katsina urban. With strategies like public private partnership, Vincent (2000) observed that the private sector participation in waste management is becoming visible as the public sector is enabling the private sector in provision of public services. But willing lines of householders to pay for waste generated is still declining since payment is based on location and type of living area rather than volume of waste generated (Longe, Longe & Ukpebor, 2009) and as a result private firms restrict their activities to middle and high income neighborhoods (Yekeen & Sanusi 2010). But Ohakwe, Nnorom and Iwunze(2011)note that public predication in waste management programs determine the success of such programs, although studies by Millicent and Ibrahim,(2013) have shown disparity in household satisfaction with waste collection services.

However, can public enlightenment on waste disposal improve people's attitude and participation as Afangideh, Joseph and Atu, (2012) noted. There is also the problem of existing dust bins and their serving neighborhoods and its associated problems. Moreover studies have shown that the intimidating and confrontational beaurecratic routine of environmental sanitation exercises in Nigeria causes low participation and no stakeholders' involvement (Achor & Nwafor, 2014).furthermore household perception that children, women and youths should be disposing the waste generated in the homes could be a challenge (Ramatta, Dennis & Philip, 2014; Joseph, 2014) since open dumping in open sites remain their familiar method of disposing waste in katsina Urban (Eze, Orebiyi, Henri & Onyenwe, 2014). Thus the study will investigate if the "use and dump anywhere" attitude of Owerri urban dwellers as regard waste sorting (Joseph, 2014) is actually do to lack of knowledge as the major limiting factor preventing individuals from waste recycling otherwise that the major management method of

disposal of waste in katsina urban are either burning, composting, and burying (Ohaka, Ozor & Ohaka, 2013), and if educating the citizenry on proper waste disposal practices would influence their practices and perception of waste disposal (Adaogu et al., 2015)practice of some Katina household in sometime is looked like One area in which this strain has become obvious is in waste management where the existing system appears to be incapable of coping with the mountain load of waste generated and heaped on almost every street corner.

Solid waste production has grown beyond 16 million tone per annum in Lagos state in direct response to rising consumerism, technology and population growth (Ibiyemi, 2010). As time passes the only certainty is that accumulation of waste will outstrip its control. Throughout the western world, there are no longer enough convenient holes in the grounds into which to tip unwanted matter. The third world, having refused to become the "dustbin" of the western world, also lacks appropriate storage facilities, treatment technologies, and good methods of disposal for its waste (Gourlay,2002). Not discounting the above factors, other factors might have compounded the problem. People's apathetic and lackadaisical attitudes towards matters relating to personal hygiene and environmental cleanliness, of which waste management in general is its focal point, should not be over looked (George, 2010).

An average citizen has the mindset that the issue of solid waste disposal should be the sole responsibility of the government to collect the amount of wastes they generated in their households and dump them in designated sites. Katsina State Government in their own initiatives came up with the idea of the Private Sector Participation (PSP) in waste management and asked the registered PSP operators to get compactors, telling them that henceforth, evacuation of waste from household to

dumpsite in open trucks would no longer be tolerated. Waste management education is a critical and necessary element in the management of waste.

Lack of knowledge brings about poor waste management practices. This was evident in Jurczak's (2008) study where he observed that generally, generation of total municipal solid waste had signifying about poor waste management practices. This was evident where he observed that generally, generation of total municipal solid waste had significantly increased in Poland due to poor management of waste which in turn was due to lack of knowledge. According to Jurczark (2008) lack of proper knowledge by the tenants resulted into irresponsible management of waste. Jurczark (2008) further indicated that in order to increase public knowledge towards waste management, professional workers such as teachers of the subjects related to environmental issues should deliver educational programs mainly within the formal education system. Joos *et al* (2005) pointed out that lack of improvement in waste management was to due to the fact that all forms of promotional and educational programs on sound waste management over the country had not been successful.

The problem to (Joos *et al* 2005), was the absence of acceptance and active participation by the public in the rational waste management. In addition the public did not participate in the segregation and recycling as well as in planning and implementation of the waste management activities. According to Uvio, (2004) integrated waste management systems follow a general hierarchy of waste management which includes source of reduction, recycling or revising, compositing, incineration and land filling. For each of the processes, there is a dependence upon how effective each preceding elements has been. The most favorable is reduction which suggests using less to begin with and revising more, thereby saving material production, resource cost and energy. Educational programs on waste management are an imperative in any given

society. Education is a recipe for any sound waste management practice. This study therefore will be significantly in that it will seek to assess the knowledge, attitude and practices among the household of Katsina residents towards waste management.

2.4.4 Influence of Demographic Characteristics on Solid Waste Management among Households

Solid waste is unwanted remains, residues discarded and material or by products which are no longer required by the initial user. These materials are by-products of human activities such as process of preparation, manufacture, packing, repacking, unpacking, construction, renovation of structures and mining operations. Almost any substance that is discarded is designated as waste, but it may be considered as a potential resource. Virtually everything also in the "waste stream" has residual value for someone or some business in the community. Waste can serve as valuable resources as ground cover to reduce erosion, fertilizer to nourish the crops and the source of energy (Rabie T, Curtis V 2006) The management of waste should focus on how to find the value and redirect it back to the community. But unfortunately, our collecting and dumping process mix and crush everything together; and make separation an expensive and sometimes impossible task to properly manage wastes (Atlabachew G, Learners 2007). The proper management of solid wastes generated from individual house, institutions such as hospitals, health centers; from public eating and drinking establishments (hotels, restaurants etc.); from business and working places is a very important part of environmental health service in a community. If these wastes are not disposed in a proper way, they create breeding places for insects such as flies, mosquitoes etc; they provide food and harborages for rats. These insects and rats are health risk in that they are potential disease transmitters. In addition to health problems rats also imposes an economic problem (Abebaw D 2008)

2.5 Environmental Effectiveness

The conventional approach of regime theorists in the study of international relations, where the focus is on how an institution functions, seems similar to that of the main research stream studies on waste. Kütting (2009), proposed the framework of environmental effectiveness to examine the effectiveness of international environmental agreements, after criticizing this conventional approach of regime theorists. The main interest of regime theorists is on the institutional performance (i.e., institutional effectiveness) of the agreements. In her researches, however, a meaningful point was raised that institutional efficiency does not solve environmental problems that these international environmental agreements are designed for. An agreement could fall short of its goals, even if it has satisfactory institutional effectiveness, because environmental necessities can be put aside.

Most studies on waste management are similarly focused on the execution of waste management; that is to say, why the management was introduced, how the management is implemented, who is engaged in it, and what the management accomplishes (Davies, 2008; Karousakis, 2009; Minervini, 2013; Karre, 2013; Corvellec and Hultman,(2013). There is also a tendency to employ the comparative method to show the differences in performance, development, outcomes and obstacles in waste governance, between different countries (Campos, 2013; Taherzadeh and Rajendran, 2015). There are many more studies paying attention to the function of waste management, than there are looking into its 'efficiency' in preventing negative impacts done to the environment by waste. Accordingly, current research cannot adequately answer the following questions, because they require a critical perspective on the environmental effectiveness of the present-day waste treatment situation: Is recycling the best method to treat waste from an environmental perspective? Is energy

recovery a truly circular way to utilize resources? Why is it so difficult to advance reuse and waste prevention methods in, given that the two are considered the most desirable methods in the waste management hierarchy, There are a few meaningful studies that explore the limitations of the current waste management system.

These studies claim that waste management should commit to changing the current performance towards more environmentally desirable methods, such as reuse and waste prevention (Fagan, 2003).For example, Bell and Sweating argue that the current waste policy in Bristol, UK, put more economic burdens on households while it is in favor of business actors (Bell and Sweeting, 2013). They contend that the reason for the unfair policy stems from a policy framework that prefers recycling over waste reduction. It seems, however, difficult to find research that examines how effective waste management is in solving environmental problems regarding waste, and how far waste management has advanced to achieve more control over waste and environmental problems. Thus, the concept of environmental effectiveness can be a useful tool to examine the effectiveness of waste management in the bigger picture, as determined by the four factors (e.g., economic structures, time, science, and regulatory structures) it is made up of. In addition, this enables to figure out how the waste management reflects and uses these four determinants in the management process, in order to create a more environmentally effective approach in waste management.

2.5.1 Governance networks

Significant changes occur, altering the role of local governments that are traditionally responsible for waste disposal. Diverse actors, including global entities, national and local governments, private actors, and civil organizations are engaged in the production, transport and treatment of waste that influence the environmental, social, economic and political conditions of a nation (Davies, 2008; Bulkeley et al.,

2006). Thus, waste governance does matter, since "waste issues are present in the discussion involving different spheres of governance (public, private and civil society sectors) at a variety scales from the local to the global (Davies, 2008). In this situation, Davies mentions the benefit of waste governance analyses, saying, Waste governance analyses would seek to understand how decisions are made in relations to waste matter, (2008). Decisions or policies are outcomes of complex interactions between actors and agencies in the decision making processes of waste governance. Based these explanations, this thesis applies the governance network analysis to examine waste governance as a regulatory structure.

The first reason for this choice, is that waste governance is not accomplished by a single actor, but rather over networks of cooperating actors across professions and differing levels of government, (Fagan, 2004; Davies, 2008). This form of waste governance occurs in most European countries, and this includes Norway. The analysis of multilevel governance could also be utilized to explain the present state of waste governance (Bulkeley et al., 2006), since the implementation of waste management in a European region is heavily affected and shaped by EU directives and national laws. Although multilevel governance emphasizes the different degree of levels ranging from international to regional level when analyzing waste governance, the approach of governance networks seems more suitable to explain the current waste governance that is formed and carried out based on discussion and cooperation amongst the different actors in the network (Davies, 2008)

The second reason is that governance network analysis can be a useful for discovering the hidden story of the policy-making processes between actors in waste governance. Theorists adapting the network approach assume that it takes a process of negotiations, conflicts, and cooperation to come up with improved waste policies and

strategies (Fagan, 2004). Thus, the analysis of governance networks enables an understanding of the following aspects: what waste governance is composed of; what kinds of networks belong to it; how these networks shape waste policies and public practices on waste issues; and who manages this governance, and how.

2.5.2 Four Determinants of Environmental Effectiveness

In order to take an account of environmental effectiveness, it is necessary to study four determinants of environmental effectiveness, which operate inside and outside of an institution (Kütting 2009). The four determinants are regulatory structure, time, economic structure, and science. The concept of environmental effectiveness "explores four areas which are vitally important for understanding the relationship between environmental degradation and its regulation, (2000). Based on Kütting's assertion, it is possible to figure out how these four determinants define the relationship between waste management, environmental problems, and social structures, which are:

a) Regulatory structure

b) Time

c) Economic structure

d) Science

a) Regulatory structure

Kütting describes the regulatory structure as "the center of institutional effectiveness (2000a)" which is a traditional concern of regime theorists. Thus, it focuses on administrative feasibility rather than environmental necessity. Kütting (2000a) explains why the regulatory structure is more concerned with administrative feasibility, giving the following three reasons. The first reason is that policy makers in a regulatory structure are government officials who do not represent the environment, but rather a government. The second reason is that these policy makers work within a rigid

and fragmented administrative structure, so they cannot grasp the whole picture of environmental degradation and the potential impacts of their operation. Lastly, environmental policy-making is subject to administrative time frames rather than environmental needs.

Applying these features of regulatory structure to waste management in this thesis, waste governance can be examined with the help of the following questions: What does solid waste governance consists of? Which actors are engaged in it, and what are their roles? What kinds of obstacles occur in waste governance? How do these obstacles hinder the environmental effectiveness in waste management by, for example, discouraging reuse and waste prevention methods? This line of questioning will clarify whether waste governance prioritizes administrative feasibility over environmental necessity, or not. Also, it will be possible to figure out how this form of network governance enables or obstructs the environmental effectiveness of present-day solid waste management. As mentioned in section 2.1.2, this research assumes that the waste governance of solid waste management is implemented with networked cooperation. Thus, strengths and weakness of waste governance, will be explained when it comes to enhancing environmental effectiveness in waste management.

b)Time

Kütting (2000) regards ‘time’ as an important determinant of environmental effectiveness due to its two unique features. The first one is ‘irreversibility’ of time. It is almost impossible to recover the environment once it has already been severely destroyed. The second one is ‘rhythm city’ of time, which is a pretty new concept. The rhythm city of time can be categorized into two types: linear and circular. Kütting (2000) believes that linear rhythm city symbolizes the fundamental principle of modern society, which she describes as ‘mechanistic system’. She explains ‘mechanistic

systems' which are human-made, and are best described by the phenomenon of the throw-away society which replaces individual parts but does not reuse them (Kütting, 2000b). She believes these throw-away practices are enabled because the mechanistic system has established assumptions of "dividing an object into parts that can studied individually and can be replaced easily (ibid)" On the contrary to linear rhythm city, circular rhythm city represents the principle of the environment, which is reflected in 'organic system.' The organic systems (the environment) "are based on the recycling resources and emphasize re-use and renewal, thus creating a constant energy cycle (ibid)." In her point of view, environmental degradation occurs because of the incompatibility between a mechanical system (man-made modern society) and an organic system (the environment). The mechanical system representing linear rhythm city is so used to consuming and wasting lots of resources, which results in severe environmental degradation.

The features of time, explained by Kütting, provide interesting points for examining waste management. First of all, when it comes to the irreversible feature of time, waste management should put an effort to stop aggravating environmental degradation within a given period, understanding the irreversibility of environmental problem. Thus, it is necessary to discover how the participants in waste management recognize this irreversibility and what they will do to prevent further environmental (and irreversible) degradation caused by waste. In addition to this, it is also required to identify the factors that impede launching new policies and programs that aim for better strategies in waste management. With regard to the rhythm city of time, it is necessary to figure out how solid waste management reflects the circular rhythm city of time in waste policy.Waste treatment methods in the waste hierarchy can be categorized by representing either linear or circular features. Waste disposal methods such as land

filling and incinerating without energy recovery can be regarded as methods reflecting linear rhythm city, since the value of waste will dissipate in landfill sites or incinerators. On the contrary to these two methods, recycling and reuse practices can be understood as reflections of circular rhythm city, because waste is reused by replacing virgin materials partly or entirely. Energy recovery, which sits at the middle of the hierarchy between disposal and recycling methods, reflects the circular principle to some degree, since this method uses waste as resource to generate energy for district heating and electricity, although the value of the waste will be extinguished in the energy plant. Therefore, by discovering which treatment methods the waste management focuses on, it will be revealed how the waste management is attempting to prevent further environmental degradation by pursuing compatibility between contrasting rhythms, linear and circular, which represent the modern society (mechanic system) and the environment (organic system), respectively.

b) Economic structure

Kütting (2000a, 2001b), saw economic structures as a major determinant of environmental effectiveness, because economic structures generally determine social organization, and these structures also decide the angle how the environment and environmental issues are perceived in a society. For instance, Kütting (2001b) uses the example of ‘green technology’ to explain how technology is seen in modern society. She argues that green technology is perceived as a desirable method to overcome environmental degradation and to sustain the economic growth at the same time. This is because the current society has such a strong belief in the possibility of infinite progress and economic growth. At the institutional level, Kütting (2000a, 2000b, 2001a) insists that the regulatory structure reflects the economic factors, thus negotiations or agreements are greatly influenced by economic considerations and feasibilities. This is

because most regulations for the environment impose a cost on economic activity and people. This analysis of Kütting is well demonstrated in the relationship between waste management and economic structures. First of all, the current economic structure is characterized by mass production, and consumption linked to giant amount of waste generation. It is easy and cheap to buy products and throw them away. Thus, it is necessary to investigate the relationship between the present economic structure and waste generation, and from there find possible solutions. Secondly, by considering the economic factors at institutional level, we can see how the economic factors restrict the current waste management from developing better waste management plans. For example, due to the high cost of introducing a new waste treatment system, a company might hesitate to implement it, even if the system is more environmentally friendly. In short, economic concern is sometimes prioritized over environmental necessity. Therefore, understanding the economic structure is paramount in diagnosing the problems regarding waste generation, and in seeking solutions by understanding the financial barriers to implementing and enhancing the current waste management.

d) Science

Kütting explains that "science is taken to mean the activity, and its results, carried out by a professional group of people in universities or other research institutions trying to find laws and correlations in their study of phenomena occurring in the physical environment by simulating these in a laboratory environment (2009: 12)." Thus, Kütting (2009) believes that science is a crucial determinant of effectiveness, since policy makers rely on science to understand environmental problems, and to seek possible solutions for them. The other important point of science is that "science is a social activity that cannot be isolated from other social activities," (Kütting, 2009: 13). Accordingly, "scientific processes strongly reflect social, political, and economic

processes that occur simultaneously with the scientific research related to an environmental issue. When it comes to waste management, science is an important factor, as Kütting has insisted above. Science offers knowledge and enables to forecast negative impacts originating from waste on the environment. Thus, this enlightens policy makers and citizens about the negative effects of waste. Also, science brings about technological advances in waste treatment that are more environmentally friendly. Science mobilizes people's attention to an environmental issue, but public attention can encourage or discourage scientific research on the environmental issue as well. If more people are concerned with a certain environmental issue, more researchers will do their studies on the matter. Furthermore, the policy makers and private companies may provide more financial support to the studies the explore issues that they are related more closely to. By considering the science determinant in waste management, this thesis will show how scientific factors have helped to improve solid waste management.

2.6 Solid Waste Transfer and Transport

There are only few solid waste management stations for solid waste. These are mostly in the low income and highly populated areas. The Solid management department has officers assigned to various zones, street, drains public toilets, etc. These officers oversee the work of the contractors. One prominent transfer station is located in the main market to serve the market and its environs .sin is a densely populated area with high waste generation.

Since it is a critical waste generation and dumping area. 10 laborers from waste management department have been permanently assigned the place. However seems inadequate considering the volumes of waste generated. The depart is equipped with a side loader truck, a pay loader and a compactor which is used due to the constraints of fueling, Nevertheless, most communities have quite good access roads hence door-to-

door pick up should not have been a challenge solid waste management department's own resource constraints. In low in: communities characterized by limited access to refuse collection trucks or carts, door –to-door collection services is not economically feasible, and only a communal con bell system is viable (Cointreau-Levine 2004).

2.6.1 Solid Waste Processing and Recovery

Johannessen and Boyer,(2008) observed that the design and waste management technologies and practices that aim at maximum the valuable products from waste, as well as minimizing the environmental effects little or no consideration in the Africa region. When few individuals, scavengers and or sachet water producers large volumes of plastic waste, there are a couple of plastics processing plants solid waste for recycle. Metals recovered from the waste are sold by the scavengers -scraps and either fed into the steel works companies in the country or export foreign exchange,

A visit to the dumpsite revealed that, there are organized groups of scavenge. Who comb through the dump to recover mostly plastics, metals and glass. Solid waste pickers are involved in a small-scale recovery and reuse operation (Palezynski, 2002). Johannessen and Boyer (2008) also noticed that while there are potential productive uses of landfill gas for instance, most landfills in Africa do not practice gas recovery except one landfill in South Africa where active pumping and flaring of landfill gas is practiced. These observations are no different from observations in Nigeria that few landfills in operation are poorly managed and gas recover is not practiced.

The concept of Waste -to -Wealth literally means moving waste from a platform of exhausted utility to valuable and desirable level. Its transformation: in engineering, requires some form of energy, and in economics, it requires factor of production. The latent issue here is that waste in itself can never be wealth otherwise generator will

never discard it. Likewise, wealth is created and process of creating wealth has some cost implications that the market forces construe as the price. This means that not all wastes are potentially of secondary benefits. In all, the slogan waste-to-wealth connotes that waste management operations must transcend delivery of service to provision of goods or value like energy or proper disposal of waste.

2.6.2 Solid Waste Disposal

It is estimated that throughout Nigeria only about 10% of solid wastes generation are properly disposed. Open refuse dumps are most commonly located perimeter of major urban centers in open lots, wetland areas, or next 10 surface water sources (WEIL fact Sheet-Nov 2005).At the national and municipal levels, "Nigeria had not taken steps to constructed operate, or maintain sanitary landfills until very recently. Johannessen and Boyer, (2008).as at the lime of their study, observed that the majority of Nigeria open were the means of solid waste management as is the case in Katsina state. Though not one of the three major cities in the country, a landfill site currently nearing completion is being constructed at out sketch of Katsina town for solid waste management. department of the Metropolitan Assembly. The single excavator for use on the site broke down a couple of years ago and is therefore be projected that in a few years to come the may lose us capacity to accommodate and assimilate waste efficiently. The inadequate information on quantification and characterization of waste; health, social, economic and environmental impact of municipal solid waste management is a common occurrence in the community.

2.7. Problems Facing Solid Waste Management in Katsina state

The problem militating municipal solid waste management in arc diverse and numerous; and according to Agumwaba (2000) these problems are related so economical, technological, psychological and political aspects in Nigeria. The problems

vary from poor funding, poor legislation and implementation of policy. Limited infrastructures and professionals, level of awareness, poor recovery and recycling programmed, and disposal technique (Dauda, 2003),one of the major problems constraining die solid waste management sector (Ogu. 2000), In capability of purchasing new solid waste collection trucks, limited staffs, poor vehicle maintenance, unsubsidized waste storage containers.

2.8 Empirical Studies

Awopetu1,Coker, and Awopetu,(2012) conducted a research in Benue State. The study focused on residents' knowledge of solid waste reduction, reuse and recycling (3Rs), as sustainable solid waste management options in Makurdi metropolis, a rapidly growing urban city in the North central (middle belt region) of Nigeria. The area surveyed covered low (zone I), medium (zone II) and high- density (zone III). Data used for this study were collected by the use of literature search, administration of questionnaire to respondents (n=560). Analyses of the data revealed that > 72% of the respondents in the three environmental zones are aware of the fact that solid waste can be reused, reduced and recycled. The trouble is, merely knowing something is not, by itself, sufficient to generate beneficial outcomes. There is a need for the residents to be educated or informed on how solid waste can be reused and reduced from source.

The Government needs to put uninterrupted electricity supply in place as a basic ingredient for small medium and large scale industry. The market for recyclable products should also be strengthened**. A**ccording to J. Senthil ,S. Vadivel (2015) Dept. of Geography Government Arts College (A), Kumbakonam, Tamil Nadu, India This study mainly focuses the people attitude and awareness about the solid waste disposal. The questionnaire survey method and possibly covering the socio-economic,

demographic and environmental variables that are largely determined the behavioral pattern of household solid waste management. Objectives: a) to simplify the socio-economic and demographic characteristics of respondent's participation in solid waste disposal, b) to explain the public awareness towards to household waste disposal, c) to analyze the attitude of people regarding household solid waste disposal and d) to identify the statistical association and significance between the selected variables. Sample: 183 males and 117 females (300) respondents were observed for the present study and their age was between 18 and 60 years. Methodology: The SPSS software is used derive Karl Pearson Correlation analysis is used for easy interpretation and interrelationship between variables. Conclusion: More than half of them are using small dustbin to put household wastes. One forth, half, and one fourth of them are disposing waste daily once, twice and thrice respectively.

They are disposing three and six kilograms of bio-degradable and non-degradable waste/week. Three fourth of the respondents are opinioned that they are satisfied with the works of municipality sweepers. According articles of science journal Margaret Banga Makerere University may (2011)This article investigates households' knowledge, attitudes and practices on the separation and recycling of solid waste in Kampala, Uganda. A survey was administered to 500 households randomly sampled from Kampala. The results indicate that, although the public is aware of solid waste separation and recycling practices, it has not participated in such initiatives.

The results also indicate that participation in solid waste separation activities depends on the level of awareness of recycling activities in the area, household income, educational level and gender. It is, therefore, argued that increasing accessibility to recycling facilities is the best means of promoting positive attitudes to solid waste separation activities. One of the effective strategies identified by households that can be

initiated by policymakers in government and urban authorities to increase the rate of participation in separation activities and eventually encourage them to participate in recycling activities is to provide easily accessible recyclable collection centers in all residential areas in urban Kampala.Research reported by Nkwoada A, Alisa Christopher, Duru Ijeoma((2014) Federal University of Technology Owerri,School of Physical Sciences, Department of Chemistry waste disposal have reached a crucial point in major urban areas in Nigeria especially Owerri urban and householder's readiness to participate in waste management are still declining moreover the problems of indiscriminate dumping of refuse at central places and open dumping and burning at private residents continue to persist. A structured questionnaire was provided to residents of Owerri urban areas addressing lack of knowledge and attitude as a factor in waste recycling, methods of waste disposal, participation and practice using analysis that identified 24 active waste dump/disposal sites. ANOVA at 0.95% value of F calculated was 0.25 and less than the value of F critical at value of 4.25 which shows that the burning and burying of waste was unaffected by usage of bins within any location but rather a habit acquired over the years.

Also F calculated in column of ANOVA was less than F critical and showed that different zones exhibit different disposal habits and their levels of participation are affected by levels of quality of surrounding environment, popular trend, sex, age and income. SCHOM participants revealed a trend in volume of waste generated among householders to be Metals<Glasses<Garden waste<Papers<plastics<Kitchen Litter. Analysis showed that Owerri urban residents had high level of awareness in waste sorting and it should be introduced because the public is more likely to participate in recycling programs when they contribute to the designing of such programs. Olabimitan Benjamin, A (2014) Department of Psychology , Lagos State University,

Oyo , Lagos, Nigeria The study examined the interaction influence between self-monitoring and locus of control on attitude towards solid waste management among residents in Lagos metropolis of Nigeria. The study adopted the survey design.

The study population consisted of residents in Lagos State. The study sample consisted of 375 residents in two local government areas of Lagos State. Three psychological measures namely: Self - Monitoring Scale (SMS), Locus of Control Scale (LOCS) and Attitude towards Solid Waste Management Scale (ATSWMS) were used to collect data. The data collected were analyzed using appropriate descriptive and inferential statistics. The results showed a significant interaction influence of self - monitoring and locus of control on attitude towards solid waste management of residents ($F(1,371) = 7.056, p < 0.05$).This indicates that psychological factors are very important precursor in the self-reported positive attitude towards solid waste management practices in the study area. The study has implication for policymakers and stakeholders to put into consideration the psychological attributes of residents in the design and formulation of intervention programmed and strategies in changing people's negative orientation and belief in the observation of a desirable solid waste management practices. Keywords: Self-Monitoring, Locus of control, Interaction, Attitude towards Solid Waste management.

From the past few decades, Solid Waste Management (SWM) has emerged out as a serious matter of global concern because rapid increase in population and overexploitation of non-renewable resources generated huge piles of waste materials that are far beyond the carrying capacity of the earth and posing serious threats to environment and health. However, it is always challenging to combat the rising amount of solid waste issue before assessing the awareness status of the people. Therefore, the present study was conducted to assess the attitudes, perception and awareness status

regarding SWM practices of the people of Lahore. SWM is essential for sustainable development hence required intensive research nowadays. Respondents of three different income levels (high, middle and low) of Lahore City were analyzed through questionnaire survey, conducted through door to door and face to face interviews, of 300 households.

The survey revealed that contemporary SWM practices have been improved but still unsatisfactory. Source separation and recycling were hardly practice and people habitually sweep their places while throwing the waste components in the streets or nearby plots. The three income levels contributed about 564kg/day of solid waste, among which low income areas contributed 171kg/day, middle income areas 194kg/day and higher income areas 199kg/day and the quantity of waste increased as the number of family members increased. Generally the composition of solid waste includes fruits and vegetables 65.2%, plastic 20.2%, paper 10.9%, glass 0.3%, textile 3.3% and others 0.1% respectively. Although, 78.5% people were willing to pay for recycling, HIA generated more waste and more satisfied than others, however, trend of reuse of old items and waste collection varied from higher to lower income level.

Krishnal (2015) Solid waste has become a critical issue with increasing population creating a negative impact on environment. This study examined the knowledge, attitudes and practices in solid waste segregation and management in Eravur Urban Council. Proportionate sampling was done and from five Grama Niladhari divisions a total of 100 households were studied. It was found that average quantity of solid waste generated by households was 2.61 kg/day. Food wastes topped the list where every household generated 2.06kg of food waste per day.

Food wastes were disposed by several methods such as disposal in urban council truck (30.35%), fed to animals (29.46%) and buried in their home (25.89%).Yard

wastes, plastics, paper, metals and glass wastes were mostly disposed by households through the existing Urban Council collection service. Only 0.93% of the household reused the paper. Eravur-01B households generated the highest average quantity (3.17kg/ household /day) of solid waste among all five GN divisions in the Eravur Urban Council. It was also found that 82% of the household heads believed that the burning of waste makes health risk. 98% of the household heads concerned about disease (Eg: Dengue, Malaria) that were related to improper storage and disposal method of waste. About 84% of the household were concerned about the service that provided by Urban Council.

Public education and teaching in school about waste management took the big responsibility to control the waste blooming in Eravur Urban Council area. 18% of the household heads were not worried about the waste disposal because of their personal issues like unemployment and high cost of living etc. It is recommended that the households must be educated with proper solid waste management practices and the government must intensify its proper solid waste management education to increase the awareness and knowledge level of households on the collection service.

Abebe, (2017) Ethiopia Waste is defined as unwanted remains, residues discarded and material or by products which are no longer required by the initial user. These materials are by-products of human activities such as process of preparation, manufacture, packing, repacking, unpacking, construction, renovation of structures and mining operations. Almost any substance that is discarded is designated as waste, but it may also be considered as a potential resource. Virtually everything in the “waste stream” has residual value for someone or some business in the community. Waste can serve as valuable resources as ground cover to reduce erosion, fertilizer to nourish the

crops. KAP studies investigate the knowledge attitude and practice of respondents on the particular subject of interest. KAP studies tell us what people know about certain things, how they feel, and how they behave. The knowledge possessed by a community refers to their understanding of waste generation, description and recycling in this context.

Attitude refers to their feeling toward waste separation, collection as well as recycling. Practice refers to the way in which they demonstrate their knowledge and attitude throw their actions.

2.9 Summary

Knowledge of households is mainly interested in receiving effective and dependable waste collection service within their immediate vicinity. Households give priority to water supply and electricity. Although households are the main contributors to waste generation, it may well be useful to know how this may change with economic development.

Attitudes of solid waste management among household brings barriers to performing activities waste generation and waste management practice of Households toward solid waste depend upon to their education so that generated waste because of the need to get an income. Perhaps, everyone will be exposed to environmental education. The current way of disposing solid waste in katsina is by using open space or gutter as their way of disposing solid waste. There is need to emphasize the protection of the environment at all levels of the communities. Then are only few solid waste management stations for solid waste. These are mostly in the low income and highly populated areas. The Solid wastes management department has officers assigned to various zones, street, drains public toilets, etc. These officers oversee the work of the contractors.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The purpose of this research was to assess knowledge, attitudes and practice of solid waste management among households in Katsina state, Nigeria .To achieve the purpose of this study research design, population, sample and sampling technique, research instrument, procedure for data collection and procedure for data analysis are presented and described in this chapter.

3.2 Research Design

As the purpose of this study was to gather already existing information on knowledge, attitude, and practice on solid waste management from households in Katsina state, an expost-facto research design was used for this study. Ex-post facto design was found suitable for this investigation. The design is used because the information needed is already in existence with the respondents and does not require any form of manipulation of the independent variables by the researcher. The research design is also deem appropriate because it tend toward data gathering and permit inferences and generalization of the finding of the study to the populations (Nworgu, 2011). Furthermore, ex-post facto research design is ideal for conducting a social research when it is not possible or acceptable to manipulate the characteristics of human participants.

3.3 Population of the Study

The population of this study comprised of all households in Katsina state. According to the 2017survey by the Katsina state Ministry of Housing there are 3,250,960 households.

3.4 Sample and Sampling Technique

The sample size for this study was 720. According to Krejcie and Morgan(1970) in a population of 1,200,000, and above, a sample size of 387 is adequate, but the researcher intends to make it 720 as this size was adequate in representing the population. The sampling procedure for this study is a multi-stage sampling technique. The stratified sampling procedure was used to stratify the state into the three already existing senatorial zones of the state which is; Katsina, funtua and Daura senatorial zone respectively. The simple random sampling technique was used to select five (5) local governments from each senatorial zone. Three containers was used, one representing each senatorial zone. The name of local governments was written on a piece of paper, folded and dropped into a corresponding container. The researcher then shook the container and asked the three research assistants to pick a piece of paper at a time. Until the total numbers of LGAs needed were selected. Proportionate sampling technique was used to arrive at the number of respondent per local government area as indicated in table 3.1. A simple random sampling technique was used to select two (2) wards from each LGA as described above. A systematic random sampling technique was used to select the households from the wards, starting from the ward head house then every 5^{th} house was selected until the total number of houses was selected. Hence, for the purpose of households used for this study, only households with odds numbers were used as sample for this study.

Table 3.1: Number of respondents sampled proportionately in each LGA

Sen. Zones	L G A	No. of household	Proportionate	SampleSize
Katsina	Batagarawa	52128	52128/619004×720	61
	Charanchi	31369	31369/619004×720	36
	Kurfi	51128	51128/619004×720	60
	Katsina	64429	64429/619004×720	75
	Rimi	29065	29065/619004×720	34
Funtua	Bakori	37526	37526/619004×720	44
	Danja	31169	31169/619004×720	36
	Funtua	57960	57960/619004×720	67
	Faskari	30987	30987/619004×720	36
	Malumfashi	49388	49388/619004×720	57
Daura	Baure	36529	36529/619004×720	42
	Daura	52978	52978/619004×720	63
	Dutsi	24300	24300/619004×720	28
	Mashi	30590	30590/619004×720	36
	Sandamu	39458	39458/619004×720	46
TOTAL		**619004**		**720**

3.5 Instrument

To achieve the purpose of this study, a researcher-developed questionnaire was used to assess knowledge, attitude and practice of solid waste management among households in Katsina State.

The questionnaire was divided into four (4) sections (A-D) Section A was on demographic characteristics of the respondents comprising five (5) items. Section B consisted of ten (10) items on knowledge of solid waste management among households in Katsina state. Section C contained ten (10) items on attitude towards solid waste management among households in Katsina state. Section D consisted of ten (10) items on practice of solid waste management among households in Katsina state. Hence, a total of thirty five(35) items constituted the questionnaire.

In section B, C and D four (4) point Likert scale was used as follows:

Strongly agree	(SA)	-	4
Agree	(A)	-	3
Disagree	(D)	-	2
Strongly disagree	(SD)	-	1

3.6 Validity of the Instrument

To ascertain the face and content validity of the research instrument, the questionnaire was vetted by 5 professionals from the Department of Human Kinetics and Health Education, Ahmadu Bello University Zaria. The observations and comments raised by the experts were incorporated in the final copy of the questionnaire and used for data collection from the respondents.

3.7 Procedure for Data Collection

An introductory letter was obtained from the Chairman Supervisory Committee in the Department of Human Kinetics and Health Education, Ahmadu Bello University Zaria to the Katsina State Housing Authority. Three research assistants were instructed on how to read, interpret, administer and retrieve the copies of questionnaire from the respondents in their various houses. The household head served as the first respondent. However in the absence of household head the most elderly person was used as the respondent. In the case where the household head neither the elderly person was not around, one additional week will be given as appointment to return and administer the Questionnaire. . In each local government area, the researcher and his three (3) research assistants administered the questionnaire to the respondents on Tuesdays and Thursdays, these are the based on systematic sampling technique earlier

used to sample the respondents. This procedure was carried out until all the copies of the questionnaire were administered to the 720 respondents. The researcher and his research assistants retrieved the filled questionnaire on the spot. The procedure for data collection lasted for six weeks.

3.8 Procedure for Data Analysis

The data collected was analyzed using descriptive statistics of frequency, percentages to describe the demographic information of the respondents, mean and standard deviation was used to answer the research questions on knowledge, attitude and practice of solid waste management among households in Katsina State. A constant mean of 2.5 was used to ascertain agreement or non agreement of respondents on questionnaire items. Inferential statistics of one sample t-test was used to test the formulated hypothesis one, two and three, while PPMC was used to test hypotheses four and five. All hypotheses were tested at 0.05 level of significance

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This study is an assessed knowledge, attitude and practice of solid waste management among households in Katsina State of Nigeria. The research design used for this study was an ex-post factor research design, which is a non- experimental design. To achieve the purpose of this study, seven hundred and twenty (720) were selected by using systematic random sampling. Odd numbers were used to select the respondents. A total of seven hundred and twenty (720) copies of the questionnaires were distributed and seven hundred and eleven 711(98.8%) copies of the questionnaire were dully filled and returned. However, 9 (1.2%) copies of the questionnaire were not used as these were not adequately filled. The analyses were presented in three sections, the first section on the demographic characteristics frequencies and percentages. These include gender, age, and level of education, marital status and occupation of the respondents. The second section contained research questions which were answered using means and standard deviation. Any mean score of response that was cumulative mean of all the item means in each section is computed and compared with a 2.5 and above reflected acceptance of that item. However, standard decision mean of 2.5000. If the cumulative mean is higher than the standard mean, it means there is a general agreement with the question but if otherwise, it denotes a general disagreement with the question. The standard/decision mean is computed based on the 4-Liker scale options of the study, thus (4+3+2+1)/4=2.500 The third section used inferential statistics of t-test was used to test the hypotheses. The major hypotheses and the first three sub hypotheses were tested for significant with the one sample t- test statistics. Sub hypotheses four and five were tested with the Pearson Product Moment Correlation

(PPMC) to determine relationship between the two variables. All the hypotheses were tested at 0.05 alpha level of significance.

4.2 Results

Table 4.2:1 Frequencies of Respondents according to their Demographic Characteristics

Variable	Frequency	Percent
1. Gender		
Male	458	64.4
Female	253	35.6
Total	**711**	**100.0**
2. Age		
18-27	47	6.6
28-37	137	19.3
38-47	224	31.5
Total	**711**	**100.0**
3. Marital tatus		
Married	463	65.1
Single	221	31.1
Divorce	27	3.8
Total	**711**	**100.0**
4. Occupation		
civil servant	239	33.6
Business	214	30.1
Farmer	172	24.2
Trader	86	12.1
Total	**711**	**100.0**
5.Level of ducation		
Primary ertificate	207	29.1
Secondary rtificate	317	44.6
Tertiary rtificate	187	26.3
Total	**711**	**100.0**

On the respondents gender, a total of 458 (64.4%) are males as against 253 (35.6%) who are female

On the ages of the respondents it showed that while 47 (6.6%)are between 18-27 years, 137 (19.3%) falls within ages 28-37 years as against 224 (31.5%) who are between 38-47 years while 174 or (24.5%) are between 48-57 years and the rest 129 (18.1%) are more than 57 years

A total of 463 representing (65.1%) of the respondents are married as against 221 (31.1%) that are single and the rest 27 (3.8%) that are divorced

On respondents occupation, 239 (33.6%) are civil servants while 214 or (30.1%) are businessmen or women as against 172 (24.2%) who are farmers and the rest 86 or 12.1% that are traders

Their level of education showed that while 207 (29.1%) possessed primary certificates 317 (44.6%) secondary certificates and the rest 187 (26.3%) possessed tertiary certificates respectively.

4.2 Research Questions

Question One: What is the knowledge of members of households about solid waste management in Katsina state, Nigeria?

Table 4.2.2:

s/no	Item	Mean	SD
1	I am aware that people have a proper knowledge on solid waste management	3.231	1.532
2	I am aware that transported often fall indiscriminately on the road making the environmental unhygienic.	3.468	1.423
3	I know that trucks are used for of waste.	3.847	1.433
4	I am aware that proper solid waste management is the responsibility of every member of the households.	3.696	1.345
5	I know that government provide dumping side for domestic used,	3.622	1.320
6	I am aware that use of truck will helps in evacuating of solid waste.	3.754	1.234
7	I know that to control any solid wastes in the environment, open dumping system can be used.	3.685	1.356
8	I am aware that sewer system is a method of solid waste management.	3.474	1.435
9	I know that solid wastes are burnt at my house.	3.869	1.533
10	I know that solid waste can be recycling to useable materials	3.643	1.326
	Cumulative mean	3.629	1.394

According to Table 4.2.1 above, the knowledge of members of households about solid waste management in Katsina state, Nigeria is relatively high. This is because their cumulative or general mean of 3.6289 is above the 2.50 standard/decision mean. Specifically they are of the strong opinion that that trucks are used for transportation of waste with a mean of 3.847 as details showed that while a total of 652.strongly agreed with this view, 29 others agreed as against , 10 that disagreed and the rest 20 strongly disagreed with this view. In the same vein most are of the knowledge that knows that solid waste is burnt at my house. As this had a very high mean agreement of 3.869 with details showing that while 676 were in strong agreement, 6 agreed as against 11 that disagreed and the rest 18 strongly disagreed with this view. They are also of the high knowledge that solid waste can be recycled to useable materials as this had a high mean agreement level of 3.643.

In summary, The knowledge of members of households about solid waste management in Katsina state, Nigeria is relatively high, especially their knowledge that solid waste are burnt at their houses, trucks are used for transportation of waste and that solid waste can be recycled to useable materials

Question Two: What is the attitude of households towards on solid waste management in Katsina state, Nigeria?

s/no	Item	Mean	SD
1	I feel that waste collected is disposed into water bodies.	3.824	1.578
2	I feel that waste materials are dumped at the designated station.	3.737	1.467
3	I feel waste products are often dumped into gutters.	3.677	1.387
4	I feel waste products are dumped indiscriminately in the open space.	3.347	1.367
5	I feel that waste products are accumulating on dump site.	3.568	1.234
6	I feel waste products end up in open dump road side.	3.719	1.567
7	I feel that the sanitary staff inspectors should be available.	3.876	1.589
8	I feel the sanitary inspectors prohibiting indiscriminate dumping of waste are effective.	3.135	1.023
9	I feel that there are designated areas for dumping of waste for the households.	3.669	1.432
10	I feel that recyclable materials are seen as unfit for use and can pose health threat	3.166	1.456
	Cumulative mean	**3.572**	**1.41**

According to Table 4.2.2 above, the attitude of members of households about solid waste management in Katsina state, Nigeria is positively high. This is because their cumulative or general mean of 3.5718 is above the 2.50 standard/decision mean. Specifically they are of the strong opinion that they feel that waste collected is disposed into water bodies, as this view attracted their highest mean agreement of 3.824 with details showing that while 649 were in strong agreement, 28 were in agreement as

against,5 that disagreed and the rest 29 strongly disagreed with this view. Also, Majority also feel that the sanitary staff inspectors should be available as this attracted a very high mean agreement level of 3.876 as details showed that while 669 were in strong agreement, 18 agreed as against 8 that disagreed and the rest 18 strongly disagreed. Addition, most feel that that waste materials are dumped at the designated station as this view had the third highest mean agreement level of 3.737 as a total of 606 were in strong agreement while 58 were in agreement as against 12 that disagree and the rest 35 strongly disagreed. In summary, the attitude of members of households about solid waste management in Katsina state, Nigeria is positively high, especially as most feel that waste collected is disposed into water bodies, also Majority also feel that the sanitary staff inspectors should be available and most feel that that waste materials are dumped at the designated station

Question Three: What is the Practices of households towards on solid waste management in Katsina state, Nigeria?

s/no	Item	Mean	SD
1	I practice recycling of solid waste than open dumping system of solid waste management.	3.828	1.587
2	I pay government to evacuate solid waste generated.	2.918	1.432
3	I dump at site designated for dumping solid waste which is always burnt.	3.364	1.234
4	Government has provided dumping containers which I use.	2.979	1.121
5	I dump solid waste inside gutter.	3.439	1.345
6	I dump solid waste on open space inside water way.	3.440	1.346
7	I use open space for defecation.	3.502	1.786
8	I use cart pushers to dump the solid waste generated.	3.571	1.452
9	I use dustbin to store solid wastes.	3.720	1.672
10	I clean my environment on weekly basis.	3.504	1.431
	Cumulative mean	**3.427**	**1.441**

Table 4.2.3 above shows that the Practices level of households towards on solid waste management in Katsina state, Nigeria, is positively high. This is as; their cumulative mean agreement level of 3.4265 is higher than the 2.50 standard/decision mean. Specifically, most of them practice recycling of solid waste than open dumping system of solid waste management, as a total of 652 were in strong agreement while 23 were in agreement with this view as against 9 that disagreed and the remaining 27 strongly disagreed with this view. Another important practice is that most use dustbin to store solid wastes as this view attracted the second highest mean agreement level of 3.720 as details showed that while 626 were in strong agreement, 28 were in agreement with this view as against 21 that disagreed and the rest 36 in strong disagreement.

Another very noticeable practice is the use of cart pushers to dump the solid waste generated, as this item had the third highest mean agreement level of 3.571 as details showed that while 590 were in strong agreement, 29 were in agreement as against 27 that disagreed and the rest 65 strongly disagreed with this view. In summary, the Practices level of households towards on solid waste management in Katsina state, Nigeria, is positively high, as , most of them practice recycling of solid waste than open dumping system of solid waste management, while most also **most** use dustbin to store solid wastes and the use of cart pushers to dump the solid waste generated.

Research Question Four: Is there any relationship between knowledge and practice of solid waste management based on gender among households in Katsina state?

Table 4.2.4: Co relational statistics on relationship between knowledge and practice of solid waste management based on gender among households in Katsina state?

Variables	N	Mean	STd.dev	Df	P
Knowledge	711	36.4233	3.37463		
				710	0.02
Practice	711	33.3897	4.28944		

The Correlation statistics revealed that proportional relationship exist between knowledge and practice of solid waste management among households in Katsina State at a p value of 0.02 The relationship between knowledge and practice of solid waste management is directly proportional, that is, the higher their knowledge of solid waste management, the higher and better their practices towards solid waste management and vice versa

Question Five: Is there any relationship between knowledge and attitude of solid waste management based on gender among households in Katsina state?

Table 4.2.5: Correlation statistics between knowledge and attitude of solid waste management based on gender among households in Katsina state

Variables	N	Mean	STd.dev	Df	P
Knowledge	711	36.4233	3.37463	710	0.00
Attitude	711	35.9531	3.86660		

Table 4.2.5 shows that proportional relationship exist between knowledge and Attitude of solid waste management among households in Katsina State at p value of 0.00. The relationship between knowledge and Attitude of solid waste management is directly proportional, that is, the higher their knowledge of solid waste management, the higher and better their Attitude towards solid waste management and vice versa.

4.3 Hypotheses Testing

Sub hypothesis one: The null hypothesis state that the knowledge of solid waste management among households in Katsina State is not significant

Table 4.3.1: One sample t-test analysis on knowledge of solid waste management among households in Katsina State

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean	Differences	Df	t Computed	t Critical	p
KNOWLEDGE	711	36.4233	3.37463	.12656	36.42335	710	287.798	1.96	0.002

P< 0.05, t calculated > t critical at df 710

The one sample t-test analysis showes that the knowledge of solid waste management among households in Katsina State was significant. This is because the calculated p value of 0.02 is lower than the 0.05 alpha level of significance, and the computed t value of 287.798 is higher than the 1.96 t critical value at df 710. Their mean knowledge of solid waste management among households is 36.423 with a standard deviation of 3.37463. This shows that the knowledge of solid waste management among households in Katsina State is high. Therefore the null hypothesis which states that the knowledge of solid waste management among households in Katsina State is not significant was thereby rejected.

Hypothesis Two: the null hypothesis state that the attitude of solid waste management among the households in Katsina State is not significant

Table 4.3.2: One sample t-test analysis on attitude of solid waste management among the households in Katsina State

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean	Differences	Df	t computed	t critical	p
ATTITUDE	711	35.9531	3.86660	.26494	35.9531	710	135.70	1.96	0.001

P< 0.05, t calculated > t critical at df 710

The one sample t-test analysis shows that the attitude of solid waste management among households in Katsina State was significant. This is because the calculated p value of 0.001 is lower than the 0.05 alpha level of significance, and the computed t value of 135.70 is higher than the 1.96 t critical value at df 710. Their mean attitude of solid waste management among households is 35.9531 with a standard deviation of 3.86660. This shows that the attitude of solid waste management among households in Katsina State is high. Therefore the null hypothesis which states that the attitude of solid waste management among households in Katsina State is not significant was thereby rejected.

Hypothesis Three: the null hypothesis state that the practice of solid waste management among the households in Katsina State is not significant

Table 4.3.3: One sample t-test analysis on Practice of solid waste management among the households in Katsina State

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean	difference	df	t Computed	t Critical	p
PRACTICES	711	33.3897	4.28944	.29391	33.38967	710	113.606	1.96	0.011

P< 0.05, t calculated > t critical at df 710

The one sample t-test analysis shows that the practice of solid waste management among households in Katsina State was significant. This is because the calculated p value of 0.011 is lower than the 0.05 alpha level of significance, and the computed t value 113.606 is higher than the 1.96 t critical value at df 710. Their mean practice of solid waste management among households is 33.3897 and with a standard deviation of 4.28944. This shows that the practice of solid waste management among households in Katsina State is high. Therefore the null hypothesis which states that the practice of solid waste management among households in Katsina State is not significant was thereby rejected.

Hypothesis Four the null hypothesis state that there relationship between knowledge and Attitude of solid waste management in is no significant Katsina among households State

Table 4.3.5: Pearson Product Moment Correlation (PPMC) analysis on relationship between knowledge and Attitude of solid waste management among households in Katsina State

Variables	N	Mean	STd.dev	Df	Correlation index	Critical r	P
Knowledge	711	36.4233	3.37463	710	0.751**	0.088	0.010
Attitude	711	35.9531	3.86660				

*****. Correlation is significant at the 0.05 level (2-tailed).***

Outcome of the Pearson Product Moment Correlation (PPMC) statistics revealed that significant relationship exist between knowledge and Attitude of solid waste management among households in Katsina State. This is because the calculated p value of 0.010 is lower than the 0.05 alpha level of significance, and its computed correlation index r value of 0.751 is greater than the 0.088 critical r value at df 710. The relationship between knowledge and Attitude of solid waste management is directly proportional, that is, the higher their knowledge of solid waste management, the higher and better their Attitude towards solid waste management and vice versa. Therefore the null hypothesis state that There is no significant relationship between knowledge and Attitude of solid waste management among households in Katsina State, was thereby rejected.

Hypothesis Five: the null hypothesis state that there is no significant relationship between knowledge and practice of solid waste management among households in Katsina State

Table 4.3.4: Pearson Product Moment Correlation (PPMC) analysis on relationship between knowledge and practice of solid waste management among households in Katsina State

Variables	N	Mean	STd.dev	Df	Correlation index	Critical r	P
Knowledge	711	36.4233	3.37463	710	0.620**	0.088	0.020
Practice	711	33.3897	4.28944				

*****. Correlation is significant at the 0.05 level (2-tailed).***

Outcome of the Pearson Product Moment Correlation (PPMC) statistics revealed that significant relationship exist between knowledge and practice of solid waste management among households in Katsina State. This is because the calculated p value of 0.020 is lower than the 0.05 alpha level of significance, and it's computed correlation index r value of 0.620 is greater than the 0.088 critical r value at df 710. The relationship between knowledge and practice of solid waste management is directly proportional, that is, the higher their knowledge of solid waste management, the higher and better their practices towards solid waste management and vice versa. Therefore the null hypothesis state that there is no significant relationship between knowledge and practice of solid waste management among households in Katsina State hence the hypothesis was not accepted.

4.3 Discussion of Results

The finding of this study revealed that knowledge of solid waste management among households in Katsina State was significant, this coincide with the finding of Awopetu1,Coker, and Awopetu,(2012) conducted a research in Benue State. The study focused on residents' knowledge of solid waste reduction, reuse and recycling (3Rs), as sustainable solid waste management options in Makurdi metropolis, Nigeria. Analyses of the data revealed that > 72% of the respondents in the three environmental zones are aware of the fact that solid waste can be reused, reduced and recycled. According to Senthil and Vadivel (2015) Dept. of Geography Government Arts College, India the study mainly focuses on people attitude and awareness about the solid waste disposal. More than half of the respondents are using small dustbin to put household wastes. One forth, half, and one fourth of them are disposing waste daily once, twice and thrice respectively.

This study also revealed that attitude of households towards solid waste management among households in Katsina State was significant this oppose the finding of Aliyu (2010), in Kano State, wastes were dumped in the open space on the street at close proximity to the houses and public places and some were dumped very close to the river, while others were dumped right into the river, especially in the city and the suburban zones. This assertion was supported by CPCB (2000), that bacteria like E.coli often lead to depletion of the dissolved oxygen, thereby endangering the survival of aquatic organisms. Release of wastes with high quantity of nitrates and phosphate compounds into rivers could result in obnoxious algae blooms. The Government needs to put uninterrupted electricity supply in place as a basic ingredient for small medium and large scale industry.

This study shows that practice of solid waste management among households in Katsina State was significant. Ogwueleka, (2003), stated that solid waste generation exceeds collection capacity. People often dump waste at any vacant plot, public space, and river or burnt it in their backyard, thereby polluting the air. Less than 60% of (MSW) generated is collected in developing countries. Zurbrugg (2003) describes that one to two thirds of the solid waste generation in developing countries is not collected. There is no regular routine collection.

Moreover this study revealed that significant relationship existed also between knowledge and attitude of solid waste management among households in Katsina State, this is in line with the finding of Ijeoma (2014) the results indicate that participation in solid waste separation activities depends on the level of awareness of recycling activities in the area, household income, educational level and gender. The study conducted by Benjamin (2014), examined the interaction influence between self-monitoring and locus of control on attitude towards solid waste management among residents in Lagos metropolis of Nigeria. The results showed a significant interaction influence of self -monitoring and locus of control on attitude towards solid waste management of residents. The survey revealed that contemporary SWM practices have been improved but still unsatisfactory. Source separation and recycling were hardly practice and people habitually sweep their places while throwing the waste components in the streets or nearby plots. Krishnal (2015) Solid waste has become a critical issue with increasing population creating a negative impact on environment. The study examined the knowledge, attitudes and practices in solid waste segregation and management in Eravur Urban Council. It was also found that 82% of the household heads believed that the burning of waste makes health risk. 98% of the household heads concerned about disease (Eg: Dengue, Malaria) that were related to improper storage

and disposal method of waste. About 84% of the household were concerned about the service that provided by Urban Council.

Lastly this study revealed that significant relationship existed between knowledge and practice of solid waste management among households in Katsina State, This was evident in Jurczak's (2008) study where he observed that generally, generation of total municipal solid waste had signifying about poor waste management practices. This was evident where he observed that generally, generation of total municipal solid waste had significantly increased in Poland due to poor management of waste which in turn was due to lack of knowledge. The study claim that waste management should commit to changing the current performance towards more environmentally desirable methods, such as reuse and waste prevention (Fagan, 2003; Arcadis Belgium 2010; Bell and Sweeting, 2013). For example, Bell and Sweating argue that the current waste policy in Bristol, UK, put more economic burdens on households while it is in favor of business actors (Bell and Sweeting, 2013). They contend that the reason for the unfair policy stems from a policy framework that prefers recycling over waste reduction. It seems, however, difficult to find research that examines how effective waste management is in solving environmental problems regarding waste, and how far waste management has advanced to achieve more control over waste and environmental problems. Thus, the concept of environmental effectiveness can be a useful tool to examine the effectiveness of waste management in the bigger picture, as determined by the four factors (e.g., economic structures, time, science, and regulatory structures) it is made up of. In addition, this enables to figure out how the waste management reflects and uses these four determinants in the management process, in order to create a more environmentally effective approach in waste management

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study assessed the knowledge, attitude and practice of solid waste management among households in Katsina State of Nigeria. Chapter one examined, the background to the study, statement of the problem, the purpose, hypotheses, significance of the study, delimitations and relevant on the research topic of the study. Related literature on empirical and conceptual frame work were reviewed and presented in chapter two of the study covering important areas as; solid waste management, classification of solid waste management, waste management in Nigeria, collection of solid waste, disposal of solid waste, knowledge, attitude and practice of solid waste management . An ex-post factor research design was adopted for this study. The population of the study was all households in Katsina State of Nigeria number 3,250,960. Multi- stage sampling technique was used to select local government areas, senatorial districts, households and subsequently seven hundred and twenty (720) respondents used for this study from the population (see Table 3.1). The research instrument used for this study was a researcher-developed structured questionnaire which consisted of four sections. (A,B,C and D). The research instrument was validated by five experts from the Department of Human Kinetics and Health Education The research instrument was administered by three (3) research assistants who were instructed on how to administer and retrieve the copies of the questionnaire

from the respondents. A total of 720 copies of the questionnaire were administered and 711(98.8%) copies of the questionnaire were appropriately filled, returned and used for the analyses. However, 9(1.3%) copies of the questionnaire were not dully filled, therefore, these copies were not used. The data collected for this study were analyzed using frequencies and percentages; mean and standard deviations for demographic characteristics and the structured research questions respectively. Inferential statistics of one sample t-test was used to analyse hypotheses 1-3 and PPMC was used to analyse the hypotheses 4-5. All the five (5) null hypotheses were tested at 0.05 level of significance. From these analyses, it was deduced that the five (5) null hypotheses formulated by the researcher were rejected.

5.1.1 Summary of the findings

The followings are the summary of the findings of this study:

1. The knowledge of solid waste management among households in Katsina State was significant. Their mean knowledge of solid waste management among households is 36.423 with a standard deviation of 3.37463.(P=0.02)

2. The attitude of households towards solid waste management among households in Katsina State was significant. Their mean Attitude of solid waste management among households is 35.9531 with a standard deviation of 3.86660.(P=0.01)

3. The Practice of solid waste management among households in Katsina State was significant. The mean was 33.3897 and with a standard deviation of 4.28944. This shows that the Practice of solid waste management among households in Katsina State is adequate.(P=0.011)

4. Significant relationship existed also between knowledge and attitude of solid waste management among households in Katsina State, as a computed correlation index r value of 0.751. The relationship between knowledge and Attitude of solid waste management was directly proportional, that is, the higher their knowledge of solid waste management, the better their attitude towards solid waste management.(P=0.020)

5. Significant relationship existed between knowledge and practice of solid waste management among households in Katsina State, when computed r value of 0.620 was greater than the 0.088 critical r value at df 710. The relationship between knowledge and practice of solid waste management was directly related, that is, the more their knowledge of solid waste management, the more and better their practices of solid waste management.(P=0.01)

5.1.2 Contribution to knowledge

1. The knowledge of members of households about solid waste management in Katsina state, Nigeria was significant, especially their knowledge that solid waste are burnt at their houses, trucks are used for transportation of waste and that solid waste can be recycled to useable materials.

2. The attitude of members of households towards solid waste management in Katsina state, Nigeria was significant.

3. The practice of solid waste management among households in Katsina state, Nigeria was significant, as most of them practice recycling of solid waste than open dumping system of solid waste management, while most used dustbins for dumping solid wastes and the use of cart pushers to dump the solid waste generated.

4. There was relationship between knowledge and practice of solid waste management among households in Katsina state.

5. Relationship existed between knowledge and attitude of solid waste management among households in Katsina state.

5.2 Conclusion

On the basis of the findings of the study, the following conclusions are drawn:

1. The households have knowledge about solid waste management in Katsina state, Nigeria.

2. The households have positive attitude towards solid waste management in Katsina state, Nigeria.

3. The households have good practice of solid waste management in Katsina state, Nigeria.

4. Relationship existed between knowledge and attitude of solid waste management among households in Katsina state, Nigeria.

5. Relationship existed between knowledge and practice of solid waste management among households in Katsina state, Nigeria.

5.3 Recommendations

On the basis of the conclusion drawn, the following recommendations are made:

1. Health educators/environmental health officers should organized and facilitate seminars, workshops and conferences that will educate households more on solid waste management in Katsina state, Nigeria.

2. Government should encourage the households to maintain their positive attitude towards solid waste management by providing them with equipment such as dustbins, wheel barrows, .

3. Government should provide trucks, incinerators, wheel barrows and other equipment that can be use to improve waste management practice.

4. Health educators should provide good knowledge that can influence practice of solid waste management among households in Katsina state, Nigeria.

5. Private waste companies should be encouraged by the government to complement the official government waste disposal management system in the state

5.4Limitations of the study

This study is limited in the following ways:

i. Having restricted to solid waste management the study left a wider gap by ignoring liquid waste materials a problem which only further study could solve.

ii. The researcher experienced series of obstacles in the distribution of the questionnaire especially with houses where the head of the household do not stay on working days. But with the patience and dedication only 9(1.2%) of the questionnaire were missing (not returned).

iii. Also, the study neglected industrial areas where both liquid and solid wastes are discharged which may require further studies.

5.5 Suggestions for Further Studies

The study which is entitled assessment of knowledge, attitude and practice of solid waste management among households in Katsina state, Nigeria, can be further studied in the following ways:

1. Assessment of Knowledge Attitude and Practice of liquid waste management among household in Katsina state.
2. Assessment of Knowledge Attitude and Practice of waste management among staff in industrial areas of Katsina state metropolis.

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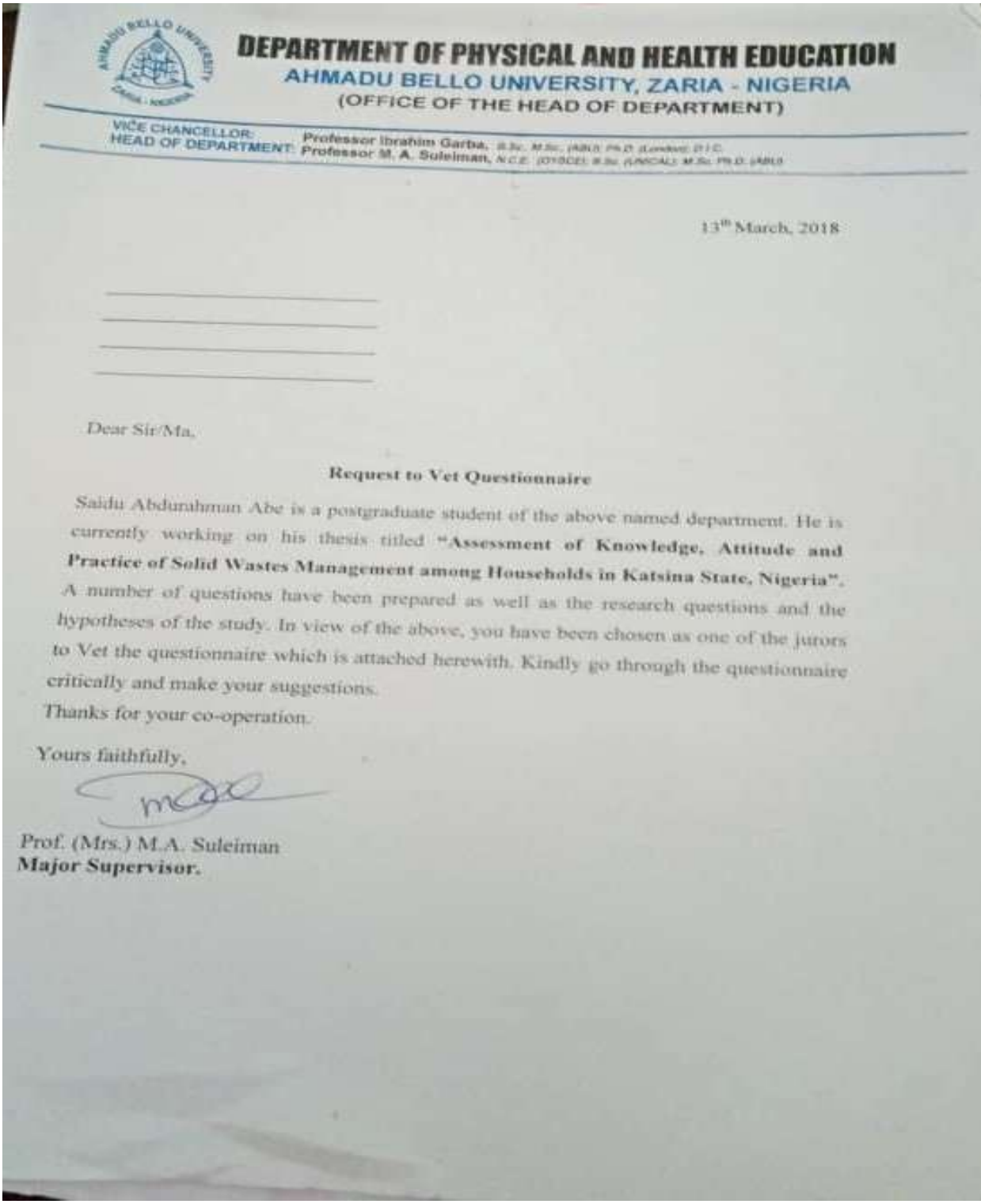
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APPENDICES

APPENDIX I



DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA - NIGERIA
(OFFICE OF THE HEAD OF DEPARTMENT)

VICE CHANCELLOR: Professor Ibrahim Garba, B.Sc., M.Sc., (ABU), Ph.D. (London), D.I.C.
HEAD OF DEPARTMENT: Professor M. A. Suleiman, N.C.E. (DYSCE), B.Sc. (UNICAL), M.Sc. Ph.D. (ABU)

13th March, 2018

Dear Sir/Ma,

Request to Vet Questionnaire

Saidu Abdurahman Abe is a postgraduate student of the above named department. He is currently working on his thesis titled **"Assessment of Knowledge, Attitude and Practice of Solid Wastes Management among Households in Katsina State, Nigeria"**. A number of questions have been prepared as well as the research questions and the hypotheses of the study. In view of the above, you have been chosen as one of the jurors to Vet the questionnaire which is attached herewith. Kindly go through the questionnaire critically and make your suggestions.

Thanks for your co-operation.

Yours faithfully,

Prof. (Mrs.) M.A. Suleiman
Major Supervisor.

APPENDIX II
QUESTIONNAIRE

Instructions: Please tick (√) the option that present your status.

Section A: Demographic Information of the Respondents.

1 **Gender**

a) Male ( )

b) Female ( )

2 Age Range: in years

a) 18-27 ( )

b) 28-37 ( )

c) 38-47 ( )

d) 48-57 ( )

e) More than 57 ( )

3 Marital Status

a) Married ( )

b) Single ( )

c) Divorced ( )

4 Occupation

a) Civil servant **( )**

b) Business **( )**

c) Farmer **( )**

d) Trader ( )

5 Level of Education

a) Primary Certificate ( )

b) Secondary Certificate ( )

c) Tertiary Certificate ( )

Instructions: Please tick (√) statement that best describes your opinion.

Section B: Knowledge of Solid Wastes Management among Households in Katsina state.

	SA	A	DA	SDA
1. I am aware that people have a proper knowledge on solid waste management				
2. I am aware that transported often fall indiscriminately on the road making the environmental unhygienic.				
3. I know that trucks are used for transportation of waste.				
4. I am aware that proper solid waste management is the responsibility of every member of the households.				
5. I know that government provide dumping side for domestic used,				
6. I am aware that use of truck will helps in evacuating of solid waste.				
7. I know that to control any solid wastes in the environment, open dumping system can be used.				
8. I am aware that sewer system is a method of solid waste management.				
9. I know that solid waste are burnt at my house.				
10. I know that solid waste can be recycling to useable materials				

Instructions: Please tick (√) statement that best describes your opinion.

Section C: Attitude of the Respondents towards Solid Waste Management in Katsina state.

	SA	**A**	**DA**	**SDA**
1. I feel that waste collected is disposed into water bodies.				
2. I feel that waste materials are dumped at the designated station.				
3. I feel waste products are often dumped into gutters.				
4. I feel waste products are dumped indiscriminately in the open space.				
5. I feel that waste products are accumulating on dump site.				
6. I feel waste products end up in open dump road side.				
7. I feel that the sanitary staff inspectors should be available.				
8. I feel the sanitary inspectors prohibiting indiscriminate dumping of waste are effective.				
9. I feel that there are designated areas for dumping of waste for the households.				
10. I feel that recyclable materials are seen as unfit for use and can pose health threat				

Instructions: Please tick (√) statement that best describes your opinion.

Section D: Practice of Solid Waste Management Among Households in Katsina state.

	SA	**A**	**DA**	**SDA**
1. I practice recycling of solid waste than open dumping system of solid waste management.				
2. I pay government to evacuate solid waste generated.				
3. I dump at site designated for dumping solid waste which is always burnt.				
4. Government has provided dumping containers which I use.				
5. I dump solid waste inside gutter.				
6. I dump solid waste on open space inside water way.				
7. I use open space for defecation.				
8. I use cart pushers to dump the solid waste generated.				
9. I use dustbin to store solid wastes.				
10. I clean my environment on weekly basis.				

APPENDIX III

Population	Sample	Population	Sample	Population	Sample
10	10	220	140	1200	291
15	14	230	114	1300	297
20	10	240	140	1400	320
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	159	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	340
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	355
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	369
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	330
190	127	950	271	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000 +	384

Krejcie and Morgan (1990:228)