ASSESSMENT OF SOLID WASTE MANAGEMENT IN ZARIA INDUSTRIAL ESTATES, NIGERIA

BY

Emmanuel Israel, OGBOLE

M.Sc/SCI/39912/2012-2013
P16PSGS8515

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN ENVIRONMENTAL MANAGEMENT

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT,

FACULTY OF PHYSICAL SCIENCES,

AHMADU BELLO UNIVERSITY,

ZARIA

SEPTEMBER, 2018

DECLARATION

I declare that the Dissertation entitled **—** "**Assessment of Solid Waste Management in Zaria Industrial Estate, Nigeria."** has been written by me in the Department of Geography and Environmental Management under the supervision of Dr. B. Akpu and Dr. B. Abdulkarim. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this project dissertation was previously presented for another degree or diploma at any University.

Emmanuel Israel Ogbole _____ _____

Signature Date

CERTIFICATION

This thesis entitled "Assessment of Solid Waste Management in Zaria Industrial Estate, Nigeria" by OGBOLE Emmanuel Israel, meets the regulation governing the award of the Degree of Masters of Science Environmental Management in Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Dr. B Akpu Chairman Supervisory Committee	_____ Signature	_____ Date
Dr. B Abdulkarim Member, Supervisory Committee	_____ Signature	_____ Date
Dr. A.K Usman Head of Department	_____ Signature	_____ Date
Prof. Z. K. Bala Dean, School of Postgraduate Studies	_____ Signature	_____ Date

DEDICATION

This dissertation is dedicated to my dear parents, Mr. Emmanuel Iduh and Mrs. Christiana Iduh. Without their dedication, effort, support, care and love, I could have never made it so far. I am eternally indebted to them. I would also like to express my sincere gratitude to my adviser and brother, Mr. Nelson Emmanuel for his encouragement and back up and for his patience and substantial assistance in proof reading my dissertation and providing valuable comments and proposals. Thank you for always being here for me.

ACKNOWLEDGEMENTS

The successful completion of this research work marks the end and yet the beginning of another facet in my life. This however would have been unrealistic without the contribution and assistance of quite a number of people who have been behind me all through.

First and foremost, I would like to express my profound gratitude to the Lord my God for the gift of life, sustenance, wisdom and understanding throughout the duration of this postgraduate programme. Father Thank you.

I am obliged to my Supervisors Dr. B. Akpu and Dr. B. Abdulkarim for their interest in and commitment to this work. Words cannot express my gratitude for their unlimited understanding and guidance that make me to complete my thesis. I pray God will reward them accordingly.

To them who have humanly made me what I am in life, I owe deep gratitude to my loving parents Mr and Mrs Emmanuel Ogbole for their love, care and understanding in the course of this academic pursuit, and to my loving siblings; Grace Emmanuel, Paul Emmanuel. I appreciate them for believing in me. Their love, encouragement and financial support sustained me throughout this struggle. They have been so wonderful; I am proud of them and happy to be associated with them all. I owe them all a lot in life. Special thanks to Mr. Bitrus Zamani, Mr. Innocent Okechuchwu, Mr. Musa Abdullahi who are in one way or the other associated with waste activity and provided me with information on waste. I will never forget their contribution to this work.

Lastly, my sincere appreciation to Mr. Daniel Okere who assisted me greatly while running my analysis using the statistical package for social science. It is my earnest prayer that we will all achieve our dreams by the special grace of God.

ABSTRACT

Industrial wastes have major impact on the environmental quality both nationally and globally. The waste produced could be hazardous in nature. The aim of this research is to assess the solid waste management in Zaria industrial estate, Nigeria. The study employed questionnaire administration and in-depth interview instruments. The industries for this study were purposively selected namely, Sunseed industries, Premier Seed Company, Olam Nigeria Limited and Nalmaco Industry. A total of 398 respondents' within the industrial zone were sampled in order to get information on the effect the waste has on them. The study employs descriptive statistic in analysis of data by the use of frequency tables and percentage in presenting the data collected from the questionnaire administered to the respondent. Results of the analyses showed that impurities (9.5%), trash and refuse (10.7%), mote (5.6%), soap stock (10.6%), boiling ash (23.8%), etc are the major wastes produced by industries in Zaria. The industries adopted source reduction (37.9%) and recycling (36.3%) as a way of managing their waste. However, the effect of industrial waste management practice was majorly flooding (39.6%), water pollution (23.1%) and air pollution (16.3%) which was as a result of dumping solid industrial waste indiscriminately. And that community sensitization (54.9%) is what the industries use to report the effect of their waste to the community as a way of reporting waste to the community. Also, the compliance level of industrial with recommended waste management practices by NESREA showed that Sunseed (3.67) recorded the highest, while the least was Premier seed limited with (3.29) respectively. Due to the effects of the waste a high proportion of respondents (46.2%) migrated out of the community because of the health implication the waste has on them. Based on the findings, it is recommended, that a technically based personnel should be used to handle industrial hazardous wastes. Industries need to receive authorization from Kaduna State Protection Agency (KEPA) before disposing any hazardous waste and setting up of recycling plant within the industries to enhance recycling.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Waste cannot be separated from human activities regardless of their socio economic and cultural development. United Nations Department of Statistics (2005) considers waste to be materials that are not prime products for which the generator has no further use for production, transformation or consumption, and wants to dispose. Waste may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residual materials recycled or reused at the place of generation are often excluded. Waste is defined as any material unused and regarded as worthless or unwanted (James, 2010). Waste is generated at the level of household, industrial and agricultural activities and is directly linked to human development, both technologically and socially (Bandara, 2007). The compositions of different wastes have varied over time and location, with industrial development and innovation being directly linked to increase in volume and diversity of waste materials (Baud, 2004).

Waste management is the collection, transportation, processing, treatment, recyding or disposal of waste materials to reduce their adverse effects on human health or amenities. The management of waste therefore, should focus on how to find the value and redirect it back to the community. Unfortunately, the unorganized process of collection and dumping results in complex mixture, thereby making separation and the entire waste management process very expensive (Sharama, 2005). All human activities generate waste, though industrial waste have some peculiarities particularly for areas with industrial activities.

Despite the increasingly urgent calls for sustainable development, environmental issues have continued to emerge as major aspects of discussion in the problems of economic growth and

development. Such issues were reported to center on global warming; noise, atmospheric, soil and water pollutions, declining of forest resources and Industrial wastes management (Dutta and Boise, 2008).

Industrial waste is said to be any material which comes from manufacturing processes and industrial sources which can be in form of solid, liquid and gases (Theisen and Vigil, 1993). It can broadly be defined as any liquid, gaseous, or solid substance, not sewage, resulting from any manufacturing or industry production process (Tchobanoglous *et al.*,1993). The waste produced is no longer useful for further industrial production and manufacturing process. Industrial waste could be hazardous and non-hazardous. The hazardous industrial waste affects the environment and human health and the non-hazardous poses nuisance to the environment (Gourlay, 1992 cited in Freduah, 2004). In fact, when the governments of African countries were required by the World Health Organization (WHO) to prioritize their environmental health concerns, the results revealed that waste was identified as the second most important problem after water quality (Senkoro, 2003).

Industrial waste management is the method employed in the control of generation, storage, collection, transfer and transport, processing and disposal of Industrial wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes (Tchobanoglous, Theisen, and Vigil, 1993). According to the authors, in order to accomplish an efficient industrial waste management, the fundamental aspects and relationships involved must be identified and understood clearly. In the light of this, Industrial waste management is an important environmental health service, and an integral part of basic Industrial services. Matete and Trois (2008) posit that the implications of poor waste management strategies is damaging to people's health and the environment. Despite the fact that

developing countries spend about 20 to 40 percent of their revenues on industrial waste management and other waste form, but they are unable to keep pace with the scope of the problem (Zerbock, 2003).

Industrial waste management is an integrated part of waste management, with an emphasis on maximizing resource use efficiency. In the pursuit of sustainable Industrial waste management, the prevention of waste generation is the first priority, followed by waste recovery and safe disposal of waste on the hierarchy of principles for Industrial waste management. These principles need to be put in practice through joint waste prevention and management measures if growing environmental degradation is to be avoided (La Grega *et al*. 2001)

Michigan Tech Institute of Materials Processing,(2003) in the United States, reported that the amount of hazardous waste generated by manufacturing industries increased from an estimated 4.5 million tons annually after World War II to some 57 million tons by 1975. By 1990, this total had shot up to approximately 265 million tons. This waste is generated at every stage in the production process, use and disposal of manufactured products. While in India, a study conducted by the State Pollution Control Board (SPCBs) reveal that about 4.43 million tons of hazardous wastes are generated annually, out of which 71,833 tons are incinerable, (SPCB, 2003). According to study conducted by the World Bank (1995) about 80% of Industries in Nigeria discharge solid, liquid and gaseous effluent directly into the environment without any prior treatment. About 5000 industrial establishments in Nigeria generate over 176,000 tons of hazardous waste per year (NESREA, 2007). The steel industries generate about 423,453 tons of solid waste per year; the food processing industries generate about 78,445 tons per year. The pulp and paper industries generate about 5,334 tons of waste per year. The study has also estimated that the steel industries generate about 83,414 tons of hazardous waste per year, while the textile industries generate about 10,011 tons of hazardous waste per year. The Pharmaceutical industries are next with about 6,260 tons of hazardous waste per year and the chemical and paint industries generate about 1,541 tons of

hazardous waste per year (NESREA, 2007). These could pose a serious health problem and degrade the environment except good waste management strategies are adopted.

The Industrial solid waste management practices are a management method that is used to minimize waste to a zero level. The management practice encompasses Reducing, Reusing, Recycling, Recovery and Reporting known as the 5Rs (NESREA, 2015). An important component of Industrial waste management (IWM) is to encourage producers to produce environmentally friendly goods and to produce less waste in the production cycle. It also mandates producers to take more responsibility for the waste they produce (Ukoje, 2011).

In general, source reduction (most preferred) is the most difficult stage to achieve in IWM hierarchy, but the stage together with recycling/reuse is the conceptualized application to resource and environmental management. The next favorable option is waste recycling and reuse; waste recycling is a process that involves collecting, reprocessing, and/or recovering certain waste materials (e.g. glass, metal, plastics, paper etc.) to make new materials or products. Waste reuse and recycling are often undertaken as a survival strategy by scavengers and recycling businesses (Cointreau and De kadt, 1991) thereby reducing the total amount of solid waste headed for the landfill. Waste reuse plays a valuable resource-conserving role: by minimizing, further exploitation of scarce natural resources, thus containing the spreading ecological footprints of the city (Agarwal, Singhmar, Kulshrestha, and Mittal, 2005; Bolaane 2006).Furthermore, source reductions, reuse, recycling are land- saving and pollution reducing strategies.

Next is recovery, which is another method of disposal and it involves passing the waste through a chamber at high temperature with an adequate supply of oxygen to oxidize all organic material. Its advantage is that it requires less land than landfills. Recovery disposes 99.999% of organic waste if properly carried out at 1200°C temperature and ambient oxygen (Hill, 2004). Energy recovered from the process can be utilized for electricity generation. Although it appears to be an extremely attractive option,

the high financial start-up and operational capital required to implement incineration facilities is a major barrier to successful adoption in developing countries (United Nations Environmental Programme, 1996). Lastly in the hierarchy is reporting which involved disclosure of industry environmental performance information, similar to the publication of its wastes generation information. Thus, process of communicating the social and environmental effects of industrial wastes to particular interest groups within society and to society at large (Gray, Owen and Adams, 1995).

In the past few years, research on waste management (WM) in Nigeria has focused essentially on contextualizing waste recycling as an approach to urban environmental management and livelihoods (Adeyemi, Olorunfemi and Adewoye, 2001; Agunwamba, 2003; Nzeadibe and Eziuzor, 2006; Nzeadibe and Iwuoha, 2008). The knowledge of waste reduction, reuse, recycling, recovery and reporting known as the 5Rs, might not be totally new in the Nigerian context. Rather, it is the current sophistication involved, which is the 5R that is rather new. Waste facilities in developing countries are minimal, but substantial quantities are diverted for recycling (Tajuddeen, 2003).

In spite of the enormous benefits associated with Industrial solid waste management strategies such as the 5Rs, only a handful of countries are able to put them into practice. For instance, most

of the economically developed countries are still unable to report, restore and recycle much of their waste (Anthony, 2009). Unfortunately, many people in African countries including Nigeria, until recently, regard the concern for effective strategies for managing industrial waste as a less important issue which may distract attention from the most urgent and serious problem of achieving a fast rate of economic growth. This attitude stems in part from the belief that environmental degradation with industrial waste generation is an inevitable price of development (Salau, 1992; Chukwu, 2010). Generally, the levels of concentration of heavy metal pollutants in river kubanni is on steady increase as observed by Iguisi *et al*. (2001) and Ewa *et al*. (2004). Thus, industries contribute greatly in the pollution of the water body close to

it and the environment thus posing serious toxicological risk (Udiba *et al.*, 2012)**.**It is on this note that this study attempts an assessment of industrial waste management strategies using Zaria as the spatial focus.

1.2 STATEMENT OF THE RESEARCH PROBLEM

Industrial waste management is of great importance due to lack of proper planning and management of wastes which leads to extensive pollution of surface and ground water, soil and atmosphere of surrounding environment (Vahidi, 2012).In the last decades, the uncontrollable impact of industrial waste on the natural environment has created critical ecological sustainable problems (Burritt, Hahn and Schaltegger, 2002).

One of the major environmental problems encountered in Nigeria is industrial wastes management (Alakinde, 2013). Industrial wastes are hazardous in nature and about 80% of the industries in Nigeria discharge solid, liquid and gaseous effluent directly into the environment without prior treatment (NESREA, 2007). The solid industrial wasted is dumped on land as it constitutes environmental nuisance. Some are also disposed in the drainages which block the flow of water and this is a breeding ground of insect-vector which transmits diseases. The liquid industrial waste is emptied directly into the streams and this pollutes the water and make it unfit for drinking. Meanwhile, industrial fuels burning and production processes produce dangerous gas and dust, which when inhaled and these have certain health impacts such as morbidity caused by dizziness, vomiting, and headache including death from lead poisoning, (World Bank, 1995).

It is a known fact that the developing countries lack the necessary information to set priorities, strategies, and action plans on environmental issues (Osibanjo, 2009). Plant-level monitoring of air, water and toxic waste emissions is at best imperfect, monitoring equipment is not available and where available is obsolete; data collection and measurement methodology are questionable, and there is usually lack of trained personnel on industrial sites (Oketola and

Osibanjo, 2009). Waste abatement technologies are largely absent and the consequence is a gross pollution of natural resources and environmental media.

In Nigeria industries discharge solid, liquid and gaseous effluent directly into the environment (NESREA, 2007). This is a symptom of poor adaptation of industrial technology. This situation is not different among industrial in Kaduna State. Zaria, a business hub in Kaduna State possess textile, food, tobacco and tannery industries, their production operation generate wastes. A cursory observation by the researcher shows that this is not different in the industrial area in Zaria with the discharge of untreated liquid waste into the water bodies. Solid wastes are found in and around the industrial site and also in drainages. This could cause serious health and environmental problem.

A number of relevant studies have been conducted. A few of them are examined to put this study in proper perspective. Said (2006) conducted a study on the management and minimizing of construction waste in Gaza strip. The study which was aimed at identifies waste minimization strategies employed by construction firms in the area realized that a sizable proportion of construction companies have specific policies for minimizing waste. Findings reveal that recycling is perceived to be more effective only when undertaken in combination with other waste reduction strategies. Result shows that 86% of the respondents adopted recycle as a waste management strategy, 14% of the respondents always re-use waste material. However, 47% sometimes re-use waste material. It shows that the combination of waste re-use and recycling is an effective strategy to reduce construction Industrial waste.

Stenis (2005) examined construction waste management based on industrial management models in Sweden. The study employed cost-benefit analysis, contribution margin analysis, the Polluter-Pays

Principle and a model Efficient Use of Resources for Optimal Production Economy (EUROPE). Thus, assigning economic model to industrial waste leads to reduction at the production phase. The result revealed that reduction of wastes at the source, leads to a decrease in overall waste produced, which shows that economic model application of industrial waste management is very efficient in waste mitigation. It shows that reduction of wastes at the source, leads to less waste produced. More so, source reduction focuses on reducing the volume and toxicity of waste generated (Kreith, 1994).

Omole and Alakinde (2013) examined the influence of socio-economic factors on solid waste generation and disposal in Ibadan metropolis. The study which made use of questionnaires, direct interview and correlation matrix realized that waste generated in the metropolis is a reflection of variation of socio-economic factors of the people. Also, the socio-economic factors such as income, age, education, and occupation and building types have greater influence in the choice of methods of disposal in Ibadan Metropolis. Their findings showed that 65% of waste was generated by the residents, 3.3% by commercials while 17% of waste generated by the Industries. While the predominant management method of the industrial waste generated was recycling (13%) and energy recovery (4%) is the least practice. Recycling and resources recovery are implemented in Nigeria and these is quite not significant compares to many developed countries (Wilson *et al.*, 2009)

Ajero and Chigbo (2014) in their study on the evaluation of industrial solid waste management approaches in some industries in Aba, noted that there was inadequate provision of protective measure in most of the industry and the awareness of respondents to the consequences of improper waste management was high (75.50%) while the level of attendance of health and safety treatment training was average (46.25%), however, none of the industries had health policy plan. The finding shows that open dumping (46%) which is the least acceptable method superseded the others while sanitary landfill (15.1%) and burning (13.5%) ranked 2nd and3rd respectively. These finding agree with those of Olafusi (2004) and

Iman *et al.* (2007) who reported that in most cities of Nigeria and other developing countries, the greater percentages of waste generated waste are dumped on the surface of the ground along major roads, streets and open spaces.

Ali (2004) on the other hand examined the effect of industrial waste pollution of river Kaduna on economic lives of people in Kaduna, Nigeria. The study examined the waste generated by different industries using questionnaire survey and oral interview. The results showed that re-use of industrial waste materials was not carried out , while most of the waste generated were dumped into the water bodies. The study shows that lack of proper treatment of industrial waste leads to the pollution of the river for domestic, recreational and agricultural activities. Thus, it was recommended that industries maintain minimal effluents into the river with adherence with environmental standards.

The assessment of industrial waste management problems greatly varies depending on the nature of industry, their location and mode of disposal of waste (NESREA, 2007). Sound waste management cycle helps in reducing the adverse impacts on the human health and environment, while enhancing the lifestyle and developing the economic state of the country.

To the best of the researchers' knowledge there is no research carried out on industrial solid waste management in Zaria. This is the gap this research intends to fill to advance the frontier of knowledge on solid waste management adopted by industries. The study addressed the following research questions:-

1. What are the type and composition of waste generated by the industries in Zaria?
2. What are the solid waste management practices adopted by the industries the study area?

3. What are the effects of industrial waste management practices on communities in the study area?

4. What is the extent to which the industries comply with the recommended industrial waste management practice?

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of this research is to assess the industrial waste management strategies in Zaria, Kaduna State, Nigeria. However, the specific objectives are to:

i. identify the types and composition of waste generated by industries in Zaria.
ii. examine the waste management practices adopted by industries in study area.
iii. examine the effects of industrial solid practices waste management s on communities in the study area
iv. examine the extent to which industries in Zaria comply with the recommended waste management practice.

1.4 SCOPE OF THE STUDY

The study is confined to the assessment of solid waste management in Zaria industrial estate. In terms of spatial extent, it covered the two industrial estates of Zaria which are Dakace and Chikaji industrial estates. The industries include Sunseed Nigeria Limited, Olam Nigeria Plc., and Premier Seed and Nemacol Limited. The industries were categorized under Food and Agro-Industries. These industries were basically selected because of the typical nature of their production activities, types of raw materials used, and methods of waste disposals. The temporal scope covered the industrial waste management practices as at 2016.

1.5 SIGNIFICANCE OF THE STUDY

Industrial waste management has become a major development challenge in Zaria in recent times. This deserves not only the attention of the waste management institutions but also concerns of corporate organizations and individuals to find a lasting solution to the problem. This is because, human health and resource could be lost through poor waste management and this will affect productivity. Careless and indiscriminate disposal of industrial waste and effluents contribute to the spread of disease such as cancer, liver and lungs failure (Environ quest, 2007). Reduction, reuse, recycle, recovery and reporting are some of the conservation means for sustainable natural resource management, including industrial waste (NESREA, 2015). This is the environmental justification for this study.

Inefficient means of waste disposal has led to pollution of the environment, this result to untimely human deaths, which was estimated to about 20,000 in a year (NEMA,1998). Poor waste management has been found to result into pollution of both surface and ground water through the leachate draining and impairing the permeability of soils as well as blockage of drainage systems (NEMA, 1998). Studies in the Kasubi- Kawala industrial area have established that the count of harmful Coliforms (1980 cfu/ml), Eschelica coli (540 cfu/ml) in protected springs far exceed the World Health Organization (WHO) thresholds (0 cfu/ml). The study will serve as a reference point to the waste management institutions as far as waste management is concerned. Additionally, the study will contribute to existing body of knowledge on solid waste management and also stimulates further research on the subject in other State in Nigeria.

CHAPTER TWO

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 CONCEPTUAL ISSUES

2.1.1 Waste

A quick look at the definitions of waste in media and printed documents reveal that waste is considered an unwanted good that is no longer useful or desirable. Citing Udocha and Uchegbu (2002), defined waste as those materials which are generated as a result of normal operations over which we have control in terms of their production, disposal or discharge. Waste could be seen as any substance or object which the producer or holder discards or intends or is required to discard.

Gilpin (1996) provides a more elaborate definition of the term waste. According to him, the concept of waste embraces "all unwanted and economically unusable by-products or residuals at any given place and time, and any other matter that may be discarded accidentally or otherwise into the environment" (Gilpin, 1996). Gilpinal so suggests that what constitutes waste must "occur in such a volume, concentration, constituency or manner as to cause a significant alteration in the environment". Thus, apart from waste being an unwanted substance that is discarded, the amount of it and the impact it makes on the environment also become important considerations in defining waste.

McLaren (1993) also referred to waste as "unwanted materials arising entirely from human activities which are discarded into the environment". This notion that waste results entirely from human activities is corroborated by Jessen (2002) who has noted that "waste is human creation" and "there is no such thing as waste in nature where cut-offs of one species become food for another". On his part, Palmer argues that, "there is no constellation of properties inherent in any lump, object or material which will serve to identify it as waste … an item becomes waste when the holder or owner does not wish to take

further responsibility for it". As a default definition, Palmer (1998) suggests that "any substance that is without an owner is waste". Davies (2008) also describes wastes as:

"…unwanted or unusable materials … that emanate from numerous sources from industry and agriculture as well as businesses and households … and can be liquid, solid or gaseous in nature, and hazardous or non-hazardous depending on its location and concentration" (Davies, 2008:4)

There are basically seven categories of waste namely residential, commercial/municipal, industrial, open areas, treatment plant sites, agricultural waste (Tchobanoglous, 1993). But for the purpose of the study, the focus is on industrial waste.

2.1.2 Industrial Waste

Industrial waste is said to be any material which comes from manufacturing processes and industrial sources which can be in form of solid, liquid and gases (Theisen and Vigil, 1993). It can broadly be defined as any liquid, gaseous, or solid substance, not sewage, resulting from any manufacturing or industry production process (Tchobanoglous *et al.*,1993). The waste produce is no longer useful for further industrial production and fails to fulfill its purpose. Industrial waste could be hazardous and non-hazardous. The hazardous industrial waste affects the environment and human health and the non-hazardous poses nuisance to the environment (Gourlay, 1992 cited in Freduah, 2004). In fact, when the governments of African countries were required by the World Health Organization (WHO) to prioritize their environmental health concerns, the results revealed that waste was identified as the second most important problem after water quality (Senkoro, 2003).

2.1.3 Industrial Waste Management

Industrial waste management is the strategies employed in the control of generation, collection, transport, processing and disposal of Industrial wastes in a manner that is in accord with the best

principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes (Tchobanoglous, Theisen, and Vigil, 1993). According to Adewole (2009) it is the collection, keeping, treatment and disposal of wastes in such a way as to render it harmless to human and animal life, the ecology and the environment generally. This definition is very crucial because the importance of waste management is to protect human lives in particular and the environment in general. Thus, industrial development also brings in its wake problems of environmental pollution and generates hazardous waste that often needs abatement. The production, development and widespread use of new packaging substances such as plastics have improved the standards of living for millions, but they have also introduced new threats to the environment, as typified by the histories of dichlorodiphenyltrichloroethane (DDT) and polychlorinated bi-phenyls (PCBs).

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

Although some developed countries have institutionalized industrial waste management policies, in many African countries industrial waste management policies either not existing or at best are fragmentary. For example, Cameroon with a population around 14 million of which half of the industries is in towns does not have good waste management programme. Thus, in many cases, waste disposal points are spontaneously created along the most accessible roads around the areas. Depending on the

performance of the official collecting system, the disposal points are more or less important. Traditionally, organic waste is also used for feeding domestic animals (Richard *et al.,* 2002).

Despite the increase in awareness of waste management system, many third world Countries is still under seriously challenged (Tevera, Conyers and Matovu, 2002). The management of industrial waste is still poorly handled. It is estimated that in 2006 the total amount of industrial solid waste generated globally reached 2.02 billion tonnes, representing a 7% annual increase since 2003. It is further estimated that between 2007 and 2011, global generation of industrial waste would have risen by 37.3%, equivalent to roughly 8% increase per year. Based on reports from its participants. The Basel Convention estimated that about 318 and 338 million tonnes of hazardous and other wastes were generated for 2000 and 2001 respectively (Global Waste Management Market Report, 2007). Regional studies revealed varying patterns of waste management among industries in developed and developing Countries. For instance Mukuka and Masiye (2002), reported increase in industrial waste production and poor management method is carried out in Lusaka, Zambia. A more alarming example was also found in Indonesia‘s region of Jabotatek, which includes Jakarta, where industrial population growth was fast and waste generation rate was estimated at 50,000 m3/day or 7 million tonnes per year (Otten, 1997).

With increase in industries in Nigeria, the challenge of industries waste management (IWM) in the country has increased and even now more complex (Oketola and Osibanjo, 2009). Contributory factors to the challenge include inadequate regulatory framework that has manifested in lack of interest of private sector investment in service delivery (infrastructure);uncoordinated institutional functions; low political will, low capacity to discharges duties, poor data information for planning, wrong attitude of waste generator amongst others. Yet on the increase is the demand for sustainable waste management service for public health and environmental protection. However, the commitment of the Lagos State

Government towards sustainable waste management has made Lagos state a model for other states in the country (Kofoworola, 2007).

2.1.4 Conceptual Framework

The theoretical framework for this study is based on the well-known theory of integrated sustainable industrial waste management (ISIWM), which has been extensively discussed by Schubeller, Wehrle and Christen (1996). It defines the main concepts of ISIWM and identifies the goals and principles that normally guide ISIWM system development. The key objectives and issues which should be addressed by ISIWM strategies with regard to political, institutional, social, economic and technical aspects are identified. In a simplified tabular manner, the scopes of industries waste management activities; actors and strategic actions imperative for sustainable industrial waste management are presented (see Table2.1). This framework is a modified version of the work done by UNIDO (2012).

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

Table 2.1: Conceptual Framework for Integrated Sustainable Industrial Solid Waste Management (ISISWM)

Strategies Objective

POLITICAL	INSTITUTIONAL	SOCIAL	TECHNICAL
Determine IWM goals and priorities	Device responsibility and authority for IWM to local industries.	Orient IWM to real needs of people including, the poor, women and children.	Achieve low life cycle cost of waste management facilities and equipment.
Define clear roles and jurisdiction for IWM.	Establish effective industrial institutions for IWM.	Encourage proper waste handling patterns by the industries	
Define clear roles and jurisdiction for IWM.	Establish effective industrial institutions for IWM.	Encourage proper waste handling patterns by the population.	Technology that facilitates user and private sector collaboration.
	Build industries capacity for IWM.	Mobilize community participation in industrial waste management.	
	Increase efficiency and through private sector involvement.	Protect health and socio-economic security of waste workers.	
	Extend lower cost IWM service through community participation.		
Strategic Issues			
Relative priority of collection services in relation to safe waste disposal.	Optimal distribution of functions and responsibilities.	Adaptation of waste management services to the needs of industry.	Coherence of technical systems in spite of differing requirements and decision makers.
Priority attributed to waste minimization-reduction and recovery.	Devolution of IWM responsibility in spite of limited local government capacity.	Effectiveness of awareness building or direct community involvement.	Estimation of life-cycle cost of technical alternative.
	Involving local governments in system planning and development.	Equity of IWM service access to the poor.	Appropriate standards for sanitary landfill design and operations.
Mix of instruments for waste management: regulations, incentives and/or motivations.	Responsiveness of waste management to real needs and demands.	Collaboration with and support of informal waste workers.	
Contribution of External Support Agencies (ESAs) to IWM policy formulation.	Raising the professional standing of waste managers.		

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

The priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment (Cooper, 1999). Further, Gilpin (1996) regards the business of waste management as a professional practice which goes beyond the physical aspects of handling waste. It also involves preparing policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public. Industrial waste management, therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment. Effective industrial waste management is, however, a growing challenge to all governments, especially in developing countries (Anthony, 2009) as shown in Table 2.1s.

2.2 LITERATURE REVIEW

2.2.1 Industrial Solid Waste Management Practices

2.2.1.1 Source Reduction

Source reduction involves altering the design, manufacture, or use of products and materials to reduce the amount and toxicity of what gets thrown away. (www.epa.gov.msw/facts, 2006).Denison and Ruston (1990) viewed source reduction as any action that reduces the volume or toxicity of solid waste prior to its processing and disposal in incinerators or landfills. This view is similar to the one given by Kreith (1994). According to him, source reduction focuses on reducing the volume and /or toxicity of waste generated. Source reduction includes the switch to point source reduction of industrial processes and to reduce or eliminate hazardous materials that enter the production process (EPA,1986). With the

use of technology (including measuring and cutting) to make changes to the production process; equipment, layout or piping; or operating conditions use to reduce waste.

According to USPS (2000) in the city of Thimphu in Bhutan to reduce industrial waste problems in future, reduction in waste generation and good operating practices such as waste minimization programs would be the most important factor. Examples of possible reduction at the industrial level include minimizing production material for manufacturing or processing (including bags),management and personnel practices, and cutting down on the use of disposable products and packaging loss prevention, and waste segregation help to reduce waste at their source(USPS, 2000).

It is agreed that, source reduction is an important method in industrial waste management. This is because there is nothing like waste on this earth. Wastes that are discharged may be of significant value in another setting, but they are of little or no value to the possessor who wants to dispose of it (EPA,1986). According to Tsiboe and Marbel (2004), Austria, the Netherlands, and Denmark developed a waste management processes to efficiently resolve the waste disposal problem by essentially coaxing their industries to separate their waste into categories; thereby enabling easy collection and consequently reduce its quantity. As suggested by the three authors, one way of effectively managing solid waste is to minimize industrial waste generation through source reduction (Tsiboe and Marbel, 2004).

Source reduction has many environmental benefits. It prevents emissions of many greenhouse gases, reduces pollutants, saves energy, conserves resources, and reduces the need for new landfills and incinerators (USPS, 2000). More than 55 million tons of industrial waste were source reduced in the United States in 2000, and this comprised 28% heavy metal solutions, waste inks, Solvents materials, 17% ink sludge's containing heavy metal (textile) , 10% durable goods (appliances, furniture, tires), 45% other industrial waste(yard trimmings, food scraps) (www.epa.gov.msw/facts, 2006). Most countries have developed strategies aimed at reducing

waste generation by addressing waste from the source. Polokwane Declaration on Zero Waste by 2022 was agreed upon at a meeting held in Polokwane city in 2000 so as to address the problems of waste in the country. This declaration was based on the urgent need to reduce waste at the source in order to protect the environment and to improve the waste management system which promotes effective waste reduction.

2.2.1.2 Recycling Activities

The United States Environmental Protection Agency (USEPA) (1999) has recommended recovery for recycling as one of the most effective waste management techniques. According to USEPA, recycling turns materials that would otherwise become waste into valuable resources and, it yields environmental, financial, and social returns in natural resource conservation, energy conservation, pollution prevention, and economic expansion and competitiveness. More importantly, a sizeable portion of what is thrown away contains valuable resources—metals, glass, paper, wood, and plastic—that can be reprocessed and used again as raw materials (USEPA, 1999).Kreith (1994) has also added that, recycling is the most positively perceived and doable of all the waste management options. According to the author recycling will return raw materials to market by separating reusable products from the rest of the industrial waste stream. The benefits of recycling are many, he added. It saves precious finite resources, lessens the need for mining of virgin materials which lowers the environmental impact for mining and processing. For example, according to the Institute of Waste Management cited by Tsiboe and Marbel (2004), UK recycles only 11per cent of its industrial waste, Italy and Spain only 3 per cent, Netherlands 43 per cent, Denmark 29 per cent, and Austria 50 per cent respectively. Having proposed recycling by different authors as the best option to manage solid waste in modern times; they have forgotten about the

cost component which is the key to successful implementation of any recycling project. Even developed countries are not able to successfully do it.

According to Momoh and Oladebeye (2010: 1) recycling has been viewed as a veritable tool in minimizing the amount of industries wastes that enter the dump sites. It also provides the needed raw materials for industries. According to them, it has been established that, it is the best, efficient and effective method of solid waste management system. However, this may not be cost effective in developing countries like Nigeria. Recycling could be of different forms which are returning waste material to original process or the use of waste material as a raw material substitute for another process (EPA, 1986).

2.2.1.3 Re-use

Re-use of materials is actually more attractive than recycling since it does not require reprocessing. Actually, reuse is a form of waste reduction, which extends resource supplies, keeps high quality matter from being reduced to low quality matter waste, and reduces energy use and pollution associated with manufacturing process (Ackerman, 1997).Re-use is a process by which discarded materials like scrap metals, plastic bottles, glass, paper, woody furniture and other material etc. in their original form are utilized. In other words, re-use is simply using materials for something other than the purpose for which they were originally designed (Bill, 2009). Re-use can be a creative process for using an item rather than throwing it away. Reuse conserves resources and energy too. Re-use is also known as —up cycling as opposed to —recycling, since materials such as plastic water bottles are often reused than recycled it can also be used for another purpose such as insulator (Bill, 2009).

According to Integrated Regional Information Networks (IRIN) (2007), reported that about 270 tonnes/day of industrial waste generated in Accra, plastic water sachets alone account for about 85 percent of the wastes. Over the years, plastic has replaced leaves, paper, glass and metal

as a cheaper and more convenient container and means of packaging in Ghana. But on the down-side, indiscriminate disposal of plastic materials poses major environmental problems including the clogging of drains and streams, threat to animals, soil damage and pollution of beaches in Accra. Anthony (2009), however, found that in Ghana there is a high level of re-use of some composition of industrial waste. These wastes include both plastic and glass bottles in the country.

2.2.1.4 Recovery

When waste cannot be prevented, reused or recycled, then we need to pursue strategies aimed at reducing volumes or toxicity before ultimate disposal (Fei-Baffoe, 2009). Recovery, according to Adara (1997) relates mainly to recovered energy from waste and that the appropriateness of the recovery strategies depends on the composition and the caloric value of the waste. Material recovery also aims at treating waste using effective and efficient methods such as incineration, while minimizing energy usage and the creation of new waste streams (Fei-Baffoe, 2009).

Waste can be processed into a fuel and used to produce a usable form of energy (FNQLSDI, 2008). Examples include incinerating waste to generate electricity, breaking waste down with (high temperature) plasmolysis to produce usable sources of fuel, or breaking down organic matter with anaerobic digestion to produce biogas (El-Haggar, 2007). According to the Centre for Environment and Development (2003: 9), incineration is a controlled combustion process for burning combustible waste to gases and reducing it to a residue of non-combustible ingredients. According to the Centre, during incineration, moisture in the solid waste gets vapourized and the combustible portion gets oxidized and vapourized. C02, water vapour, ash and non-combustible residue are the end products of incineration.

Incinerators have the capacity to reduce the volume of waste drastically, up to nine fold than any other method (Kreith, 1994). According to him incineration can also recover useful energy either in the form of steam or electricity. He however recognized that the main constraints of incineration are high cost of operation, relatively high degree of sophistication needed to operate them safely and economically as well as the tendency to pollute the environment through emissions of carbon dioxide. Having assessed the major methods that have been proposed by the various authors, literature has further revealed that there is an alternative method of managing industrial waste effectively which is synonymous to waste reduction and recycling as mentioned earlier on.

2.2.1.5 Reporting

It is often stated that the initiatives on industrial environmental reporting come from pressures from various groups that have a direct interest in the performance of industry. These groups include shareholders, banks, local communities, corporate customers, employees and business analysts (KPMG, 1994). But why do these stakeholder groups require environmental information? One argument is that environmental information is required because of the environmental risks assessment run by stakeholders, but this is a research area that needs to be more fully explored. The issue is particularly important since the answer to the question „why? " are likely to provide answers to what environmental information a company should disclose? (Ballantine and Stray, 1995)

Initial global surveys revealed that environmental reporting is primarily a large-industries matter. The disclosure of environmental information is ad hoc and usually involves only good news, but there have been signs of innovative and transparent attempts by some corporations (Gray, 1994). Similarly, Owen (1994:32) asserts "that these surveys have highlighted that environmental disclosures are ad hoc, partial, public relations driven, non-comparative, lacking independent attestation, and are largely qualitative and descriptive."Studies conducted in Africa such as (DeVilliers and Vorster, 1997; DeVilliers, 1999; Manby,

2003; Ite, 2004; Amaeshi, Adi, Ogbechie and Amao, 2006), has basically focused on issues such as green reporting in South Africa, corporate social responsibility among organizations in Nigeria, and other social responsibility issues. However, this literature clearly indicates that there is a dearth of studies that focused on corporate environmental disclosure practices in the continent compared to practices in the more developed nations. Nonetheless, despite the fact that researches from the continent are country and industry specific, the state of corporate disclosure seems to be on the rise (DeVilliers, 1999). Direct pressure from stakeholders and Ngo's could change the corporate environmental behavior in the continent, as exemplified by the case of oil companies in Nigeria (Amaeshi et al., 2006). Here, industries are involved in a number of corporate social responsibility activities in response to the massive pressure from militants located in the area were these industries operates in order to legitimize its oil extraction business (Manby, 2003; Ite, 2004).

Among the major disasters in the 1980s were Bhopal (Union Carbide), Schweizerhalle (Sandoz), and Prince William Sound (Exxon), all of which had both financial and environmental consequences for the companies involved (Patten, 1992). In 1984 a cloud of poisonous methyl iso-cyanate leaked from union Carbide's Pesticide Plant, located on the outskirts of Bhopal,India. Its effect on human life was devastating with approximately 4,000 deaths and 200,000 injuries. The financial impact was also pronounced and virtually immediate. Within five trading days of the chemical leak the market value of Union Carbide's common stock fell approximately to about 27.9% (from US $ 3,443 million to US $ 2,483 million) (Balcconire and Patten 1994). On March 24, 1989 Oil Tanker Exxon Valdez ran aground in Prince William Sound on Alaska's West Coast. Forty million litres of crude oil spilled into the sea, causing enormous damage to the marine flora and fauna. $16.5 billion was spent on clean up, in compensation and as punitive penalties (Schaltegger, Muller and Hindrichsen, 1996). It can be argued that environmental risk is one area

of risk that has grown in importance and has been summarized by Natale and Ford, (1995) as follows: Fines for pollution of land, water, or air; *Clean* up costs for land sites; Liability for disposal of hazardous wastes; System breaks down allowing environmental problems to occur; Loss of the public confidence (damaged reputation or corporate image) and Loss of market shares when environmental incidents occur.

Industries need to be able to respond to environmental challenges effectively. Where they face increasing pressures from the public to demonstrate social responsibility towards the environment, many companies seek to confirm their social responsibility by using environmental reports (Epstein and Freedman, 1994; Kolk, 1999; Hooghiemstra, 2000). Moreover, a variety of studies, argued that a number of industries who use published annual reports actually take environmental performance into account and environmental information is material for them. However, stakeholder theory provides an explanation of why a number of industries may need to engage in environmental disclosure and how these companies use such disclosures (Wehrmeyer and Tyteca, 1998)

According to Dowling and Pfeffer (1975) organizations can attempt through communication, to alter the definition of social legitimacy so that it conforms to the organization's present practices, output and values or the organization can attempt again through communication, to become identified with symbols, values, or institutions which have a strong base of social legitimacy. Gray, Kouhy and Lavers (1995) defined corporate environmental reporting as the process of communicating the environmental effects of organizations" economic action to particular interest groups within society and to society at large. Companies through the process of environmental communication may seek to influence the public's perception towards their operations. They attempt to create a good image and make self-congratulatory claims (Deegan and Rankin, 1996; 1997; 1999 cited in Dixon, *et al.*, 2005). These will in the long run

promote less waste production and can also aid industries in the design of more environmentally preferable processes, products, and services for the future.

2.2.2 Laws/Regulations on Industrial Solid Waste Management in Nigeria

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

The Federal Environmental Protection Agency (FEPA) Act is the major legal framework on environment in Nigeria. At the return to democratic governance in 1999, FEPA metamorphosed into the Federal Ministry of Environment in June 1999. Since a ministry is more of a policy-making organ, the Federal Government established in November 2006 the National Environmental Standards and Regulations Enforcement Agency (NESREA) with powers similar to the defunct FEPA for effective enforcement of environmental regulations in the country. All FEPA's laws

have been repealed with the NESREA act signed into laws by the President of Nigeria in July 2007.

The federal laws are the minimum standards in the states. The Constitution allows states to establish stricter standards than the Federal and also impose stiffer penalties on violators (UNIDO, 2012**).** Nigeria has various Ministries, Agencies and Departments (MDAs) involved directly or indirectly with environmental issues. These include Federal Ministry of Environment, State Environmental Protection Agency, State Ministry of Environment, various Local Government and Area Councils and NESREA. The local governments authorities are given the responsibility of municipal solid waste management by law, however due to inefficiency hence the intervention in waste management activities by various States environmental protection board/agency (Table 2.3). The National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations S.I.9 of 1991 imposes restrictions on the release of toxic substances and stipulates requirements for monitoring of pollution; it also makes it mandatory for existing industries and facilities to conduct an environmental audit.

The National Environmental Protection (Waste Management) Regulations S.I.15 of 1991 regulates the collection, treatment and disposal of solid and hazardous wastes from municipal and industrial source. The National Guidelines and Standards for Environmental Pollution.

Table 2.2: Nigerian Laws/Regulations Related to Industrial Solid Waste Management

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

Source: Adapted From UNIDO, 2012.

Control in Nigeria 1991 provide the basic instrument for monitoring and controlling industrial and urban pollution in Nigeria (UNIDO, 2012).

The various environmental institutions in Nigeria include; Federal Ministry of Environment (FME), National Environmental Standards and Regulations Enforcement Agency (NESREA), State Environment Protection Agencies (SEPAs), State Ministry of Environments (SMEs), State Ministry of Health (SMH), State Waste Management Authorities/Boards(SWMA/B), Local Government Environmental Health Officers (LGEHO), Community Based Organizations (CBO) and Non-Governmental Organizations (NGOs). The FME has responsibility to administer and enforce environmental laws in Nigeria. The relevance of such laws/regulations is for it to be adhered to and for the various ministries, agencies and departments develop, organize, implement policies and programmes on sustainable waste management information system, training of waste management professionals in integrated industrial waste management as part of institutional strengthening, development and demonstration of successful business model in integrated industrial waste management (e.g. waste to wealth) using the concept of public private partnership (PPP), and national integrated waste management strategy (UNIDO, 2012).

2.2.3 Effect of Industrial Waste Management Practices on Communities

Adekoya (2011) carried out a study on the impact of sawmill industry on the adjoining residential property in Ikire. The effect of the sawmill was examined in six different locations of the town such as Naira and kobo, Summoye, Moro, Sango, New express way and Fatima area. The author found out that the sawmill industry inflict a lot of nuisance to most of the house at 500m radius to the selected sawmill, some of the nuisance identified by the study are: sawmill industry generates a lot of vibration and loud noise to the extent that it causes inconveniencies, partial deafness, through noise meter readings. The study established that the intensity of the noise pollution by the sawmill machines outweigh the UN standard of 50 decibel. Other effect of sawmill as rated by the work was that sawmill generate dust particles, waste, smoke when burning

of sawdust which causes irritation and other health problem to the residents. Other effects of sawmill location is that it devalues the residential property value of an adjoining property.

Olatunbosun (2009) examined the impact of West African Portland Cement (WAPCO) on the housing environment in Ewekoro, Ogun State. The study adopted questionnaire and the findings shows that the effect of WAPCO industries on residential housing was (52.4%) which explain the decrease in housing demand by people living in the area. Also, it shows that the industries produce about (54.8%) of solid waste which possess serious health problems to the resident at Ewekoro.

Janaka de Silva (2002) conducted a cross-sectional comparative prevalence study to evaluate the effect of air pollution on individuals who lived in an industrial zone in Sri Lanka. Moreover, they compare the individuals who are living in non-industrial zone. The authors used a pretest questionnaire. In their research, they concluded that children in the industrial area were 2 to 3 times more likely to have respiratory infections like coughing and asthma and the adult population was 2 to 1 times more likely to have respiratory infections such as asthma and lung cancer than the people who are living in non-industrial zone.

In another study Aston (2001) conducted a study in Europe Industrial Wastes Status by environmental protection agency (EPA). The study made used of questionnaire administered to some selected industries. The result showed that about 65.8% of industries management their waste and complied to regulatory standards and 34.2% of the industries fall short of the recommended standards. The findings further reveal that the gaseous waste and dust in air within the industrial area was a major factor in the high incidence of tuberculosis, bronchitis and asthma amongst residents.

2.2.4 Waste Management Practices Adopted by Industries

Binavapour (2011) conducted a study on industrial waste management in Hamadan industrial zone, Hamadan, Iran. The objective of this study was to assess the hazardous waste minimization and separation. The researcher applied qualitative description to interpret and present the data obtained from randomly selected sample of heavy industries. The study shows that there is no special compartment for collecting industrial wastes, unfair placement and improper use of waste containers, inadequate assignment of budget to the sector, illegal ways of disposing wastes, and insignificant participation of the community in waste management.

Jan (2002) conducted a study that focused on Industrial Waste Management Models in Sweden. The objective of the study was to determine the commonly known business economic models, tools, methods and organizational theories as well as the Pollute-Pay-Principle that can be applied in waste management. System theory was adopted in order to get a clear picture of the model societal context; the economic model methods are studied and modified from a waste management point of view. The findings point at the possibility to modify commonly used cost- revenue methods including the Pollute-Pay-Principle in an industry.

Aisa (2011) investigated the role of Industrial Solid Waste Management in East Africa Capital Cities. The research focuses on the technical and social aspects of solid wastes management and the role of industries in producing and handling these wastes. The study made use of questionnaires, direct interview to sample 20 industries. Their findings showed that 75% of waste generated by the industries is due to technical problems of the machine, 25% is by social industrial aspect.

Eunomia (2009) assessed International Review of Industrial Waste Management Policy. They advocated that in respect of waste management, there are some increasingly strong markers provided in the policy development. Also, the revised directive suggests that policy would do well to take heed of the

requirements below:_ Ensure that mechanisms are in places which lead to the separate collection of Glass, metals, paper and plastic (where appropriate), again pre-empting the WFD requirements;- Implement measures designed to lead to separate collection of bio-industrial waste;

Hogland and Stenis (2000), examined the assessment and system analysis of industrial waste management in Stora, Sweden. The concept of integrated industrial waste management was adopted. Findings showed that integrated concept of industrial waste provide a step-by-step method of obtaining the optimal industrial waste management system with respect to energy, economy and environmental. Also, it is the most advantageous system for future waste handling at the company Stora, regarding environmental impact, energy balance and economy.

Otti (2011) investigated a model for solid waste management in Anambra State. Moreover, the study aimed to determine which type of integrated solid waste management option or programme will be used to implement minimized cost and maximized benefit (benefit cost ratio) over a long planning period. The optimization system was adopted which is an optimal solution and a feasible solution. The research findings showed that waste management problems is best managed by integrating different waste management practices. This contains many innovative features and removes many limitation frequently encountered in often existing optimization modeling for waste management.

Mesgarof (2013) analyzed industrial waste management and disposal in Kermanshah City in Iran: The objective of the study was to examine the overall pattern of industrial waste generation, collection and disposed by using both primary data which was collected from 30 industries, as well as secondary data. In this study, the researcher applied descriptive and inferential statistics with map. The findings of this study show that 76.32% of industries kept their wastes in dumping site, 80% of industrial wastes are recycled and 11% of industries disposed their

wastes as unsanitary dumping. This shows that the implementation of an appropriate system to manage industrial wastes in the zone is necessary.

Stenis (2002) carried out a study on industrial solid waste management and joint production in Sweden. The study examines the possibilities to use the joint production theory for industrial waste management profitability estimation. Major results showed a joint production theory that can be applied in estimating the profitability of fractionating industrial solid waste, a given product and the wastes produced in connection with its manufacture being regarded as a production-planning unit.

Collins (2008) investigated environmental responsibility and industries performance. Using a field survey methodology, a sample of sixty manufacturing companies in Nigeria was studied. The industries were categorized into two groups, environmentally 'responsible' and 'irresponsible' firms. An investigation was undertaken into the relationship between firm performance and three selected indicators of sustainable business practice: employee health and safety (EHS), waste management (WM), and community development (CD), common within the 30 'responsible' firms. Findings from empirical results reveal that the sustainable practices of the 'responsible' firms are significantly related with firm performance. In addition, sustainable practices are inversely related with fines and penalties. It concludes that, within the Nigerian setting at least, sustainability affects corporate performance and sustainability may be a possible tool for industry waste conflict resolution as evidenced in the reduction of fines, penalties and compensations.

2.2.5 Problems of Industrial Waste Compliance Level

Since the Rio Conference to address the core environmental issues such as environmental degradation and waste management there has remained the greatest problems for many industries

in developing countries to meet up with the required standard. Thus, in Nigeria a high level of liquid, solid and gaseous waste (oil spills, gas flaring) is produced by the industries while efforts to reduce the rate of industrial wastes production is yet to yield significant results (Sada and Odemerho, 1998).Major industrial waste disposal heavily contaminates marine shorelines, causing severe localized ecological damage to the near-shore community. The harmful effects of these on the environment are many. These improper waste disposals destroy plants and animals in the estuarine zone. It settles on beaches and kills organisms and marine animals like fishes, crabs and other crustaceans**.** It endangers fish hatcheries in coastal waters and as well contaminates the flesh of commercially valuable fish (Worgu, 2000).On the Nigerian Coastal environment, large areas of the mangrove ecosystem have been destroyed. Industrial wastes has also destroyed farmlands, polluted ground and drinkable water and caused drawbacks in fishing of the coastal waters. As a result of these environmental problems, there is the need for industries (both the manufacturing and agro-industries) to have a good management method to deal with waste disposal in an efficient way (Nwankwo and Ifeadi, 1988).

Kadafa, Adati Ayuba (2013) examined the current status of Municipal Solid Waste Management Practice in FCT Abuja. The study aims at identifying the current challenges and areas requiring improvement in FCT Abuja. The data collection was in stages, using an integrative approach via semi-structured interview and field observations. The qualitative data was analyzed descriptively, while the quantitative data was analyzed using basic statistics. Findings show that municipal solid waste management is a serious issue which affects human health and environmental sustainability. These implications are yet to be properly addressed within the FCT Abuja.

Abila and Kantola (2013) assessed solid waste management problems in Nigeria. The research attempted a synthesis of problems relating to solid waste management in Nigeria and proposes a

conceptual knowledge management approach for tackling industrial waste problems in cities across Nigeria. The research adopted a knowledge management approach and strategy application. Result showed that the inefficient management of waste by industries can be attributed to inadequate information on waste management as well as poor implementation of government policies. It reveals that the industrial solid waste management is not only technology centered strategies but also people centered.

Modebe and Onyeonoro (2008) examine Household Solid Waste Management in Awka, Anambra State. The study aimed at ascertaining the waste handling practice among household in Awka, Anambra state. A Descriptive Research Design was employed using cross- sectional data. A total population of 200 households was selected using a multi-staged sampling technique and questionnaires administered. Data collected were analyzed, relevant proportions and test significance done. Findings revealed that the bulk of waste generated was organic waste and nylon bags. Most of them (85%) stores the waste generated in a closed container outside the

house. About 70% of the respondents dispose their waste through the government waste management agency, while 27% of them dump their waste in unauthorized places and the remaining patronize the mobile cart pushers, most waste is not sorted prior to disposal. Despite very good knowledge of waste recycling only 18% of the residents practice it. More than half of the respondents expressed dissatisfaction with the level of government involvement and wish that it could do more. Great government involvement, community participation and possible involvement tribe private sector as practiced in some places, appears to be the way out of the sanctuary quagmire faced by the residents of Awka.

Ghavami (2010) assessed storage of industrial waste in Sanandaj Iran: The objective of this study was to explore the structure and performance of storage facilities of industrial waste practices by investigating the relationship with economic, demographic and environmental effect on households. The study

employed both multinomial logit and probit estimation econometric models in order to identify and describe the main determinants of industrial choice on storage standards. The researcher randomly selected 200 sample industries. The study showed that 80% of the industries do not stores their waste properly and 20% of the industries properly store their waste. Thus, the current status of waste storage of industries in Sanandaj is not in accordance with the principles of environmental and long-term storage of waste at zone may cause adverse consequences on the environment.

However, during recent years' in Nigeria, interest in industrial waste shows that it is an important source of energy use and material recovery. Today, most industries are in need of a detailed analysis of their waste management at all stages of production. Industries owners who have already studied waste streams within the company and the possibilities of recovery and resource saving usually find that there are large economic as well as environmental benefits if adequate waste management is implemented (Bioenergy, 1996).The benefits of successful industrial waste management programs aiming at minimization of wastes frequently result in significant reductions in manufacturing and production costs, more efficient use of valuable resources, improvements in process and product quality and reductions in waste generation, treatment and disposal costs. Additional benefits of industrial waste minimization programs may include a reduction in a generator's long-term liability for any hazardous wastes produced and the potential for positive publicity for being proactive and doing the right thing" Childers, (1998). A commonly suggested way to cope with the pollution aspect of the waste problem is to let the polluter carryall the costs of preventing and controlling any pollution that it originates.

2.2.6 Types and Composition of Waste Generated by Industries in Nigeria

About 5000 industrial establishments in Nigeria generate over 176,000 tons of hazardous waste per year (NESREA, 2007). The steel industries generate about 423,453 tons of solid waste per year; the food processing industries generate about 78,445 tons per year. The pulp and paper

industries generate about 5,334 tons of waste per year. The study has also estimated that the steel industries generate about 83,414 tons of hazardous waste per year, while the textile industries generate about 10,011 tons of hazardous waste per year. The Pharmaceutical industries are next with about 6,260 tons of hazardous waste per year and the chemical and paint industries generate about 1,541 tons of hazardous waste per year (NESREA, 2007).

Table2.3: Composition of Industrial Waste Generated in four Nigerian Cities (2005)

INDUSTRIAL STA	KEY INDUSTRIES	Waste Characterization and Description
Lagos tons/year)	Food processing, Textile Pharmaceuticals, Metal Fabrication and finishing, Paint	***FOOD PROCESSING*** (High BOD, Dissolved Oxygen depletion, high suspended solids)
Port Harcourt (tons/year)	Oil Refineries, Paint, Petrochemicals	***REFINERIES, PETROCHEMICALS*** (aldehydes, ammonia, organic acids, oxides of sulphur and Nitrogen, carbon monoxide, and hydrocarbons)
Kano3,400 tons/year)	Tanneries and Textile	***TANNERIES*** (heavy metals, Cr, TDS is high, COD is high, acidity, sulphid is low; ***TEXTILES*** (contain bleaching agents, reducing agents, silicates and inorganic salts, oils, grease, wax, Cr, Pb, Zn, Cu, low D.O., high COD
Kaduna 1,700 tons/year)	Metallurgy, Tanneries, Chemical,Manufacturing, Pharmaceutical, Textile	***IRON & STEEL*** (Suspended solids, phenols, ammonia, cyanide, heavy m oil & grease, dissolved iron)

Source: Adapted From UNIDO, 2012.

In Nigeria, waste generation increases with urbanization, and the four most industrialized states are Lagos (home to approximately 60% of the Nigerian industries), Rivers, Kaduna and Kano. Consequently, the compositions of waste generations for 2005 are summarized in Table 2.2 for comparative purpose (FEPA, 2007).

Basically, one of the major issues related to solid industrial waste management in Nigeria is open and uncontrolled burning of solid waste and release of environmental pollutants associated with it especially the persistent organic pollutants. Table 2.3 reveals that organic waste constitute the highest in the waste composition and thus forms the (POPs) in the four most industrialized states of Nigeria; Lagos, Port-Harcourt, Kaduna and Kano accounts for about 35.50%, 60.00%, 63.05%, and 50.50% respectively. While about 19.50%, 10.50%, 5.37%, and25.40% are waste from plastic in Lagos, Port-Harcourt, Kaduna and Kano respectively. Furthermore, paper accounts for about 9.80% (Lagos), 6.50% (Port-Harcourt), 5.67% (Kaduna), and 10.20 %(Kano). Whereas, for metal waste about 4.00% (Lagos), 4.20% (Port-Harcourt), 6.22% (Kaduna), and 4.60% (Kano). The least waste material in the composition of industrial waste generated in the four Nigerian cities is glass which accounts for about 3.90% (Lagos), 3.60% (Port-Harcourt), 7.50% (Kaduna), and 3.85% (Kano) (UNIDO, 2012).

Estimates of the various industrial wastes composition have been carried out in several investigations (Rushbrook and Pugh, 1999; John *et al.*, 2006; Igoni *et al.*, 2007; Kofoworola, 2007; Sha'Ato *et al.*, 2007). Who opined that there is a continued increase of waste growth within these cities. Igoni (2007) studied various parameters as composed within the industrial waste such as moisture content, bulk density and chemical analysis. Rushbrook and Pugh (1999) inferred that variations in the rate of generation and composition of industrial waste could be attributed to changes in the socio- economic characteristics of the generator. This implies that socioeconomic dynamics affect both the quantity and composition of waste generated by the industries.

In Kaduna, the scale of industrial production and waste generation and the negative impacts associated with them varies dramatically from industries to industries, depending in a large part on a industrial‘s wealth and size. Perhaps the greatest environmental nuisance and threat facing the ever growing urban agglomeration in the state today is the collection, transportation and disposal of industrial

waste (This is the case with Zaria). Transversing the length and breadth of the state are heaps of solid industrial waste constituting eyes sore in the urban (UNIDO, 2012; Majani, 2002; United Nations Environmental Programme, 1996; Attahi, 1999**)**. Furthermore, Perera (2003) observed that there is improper management of industrial waste which led to poor sanitary conditions and waste-clogged drains in the cities with associated health problems.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA

3.1.1 Location and Size

Zaria is located within Latitudes $11^0$4' 0' ' - 11^0 10' 0' ' North of the Equator and Longitudes $7^0$38' - 7^0 46' East of the Greenwhich meridian (Fig.3.1).It lies on the high plains of Northern Nigeria with the tropical continental climate. Zaria is the second largest town in Kaduna state, and has become a junction point both in terms of rail and road transportation. There are many nucleated settlements with patches of open spaces in between usually used for agricultural purposes (Abbass, 1997).

3.1.2 Climate

Based on annual oscillation of the northern-east and south-west trade winds which determine climatic conditions in the entire West Africa region, the climate of Zaria urban area is semi-arid, similar to what is obtainable in the Sahel-Sudan ecological zone. The main features of the climate include relatively extreme temperature and precipitation regimes. The climatic conditions are such that four distinct seasons can be identified in respect of key indices of temperature and moisture as follows; a cool dry season from December to January characterized by north-easterly (Harmattan) winds, a dry season from March to May which proceeds the rainy season, a warm wet season from June to September which is mainly rainy season and an intermediate period of mild condition in temperature and humidity between October and December (Hore, 1970).

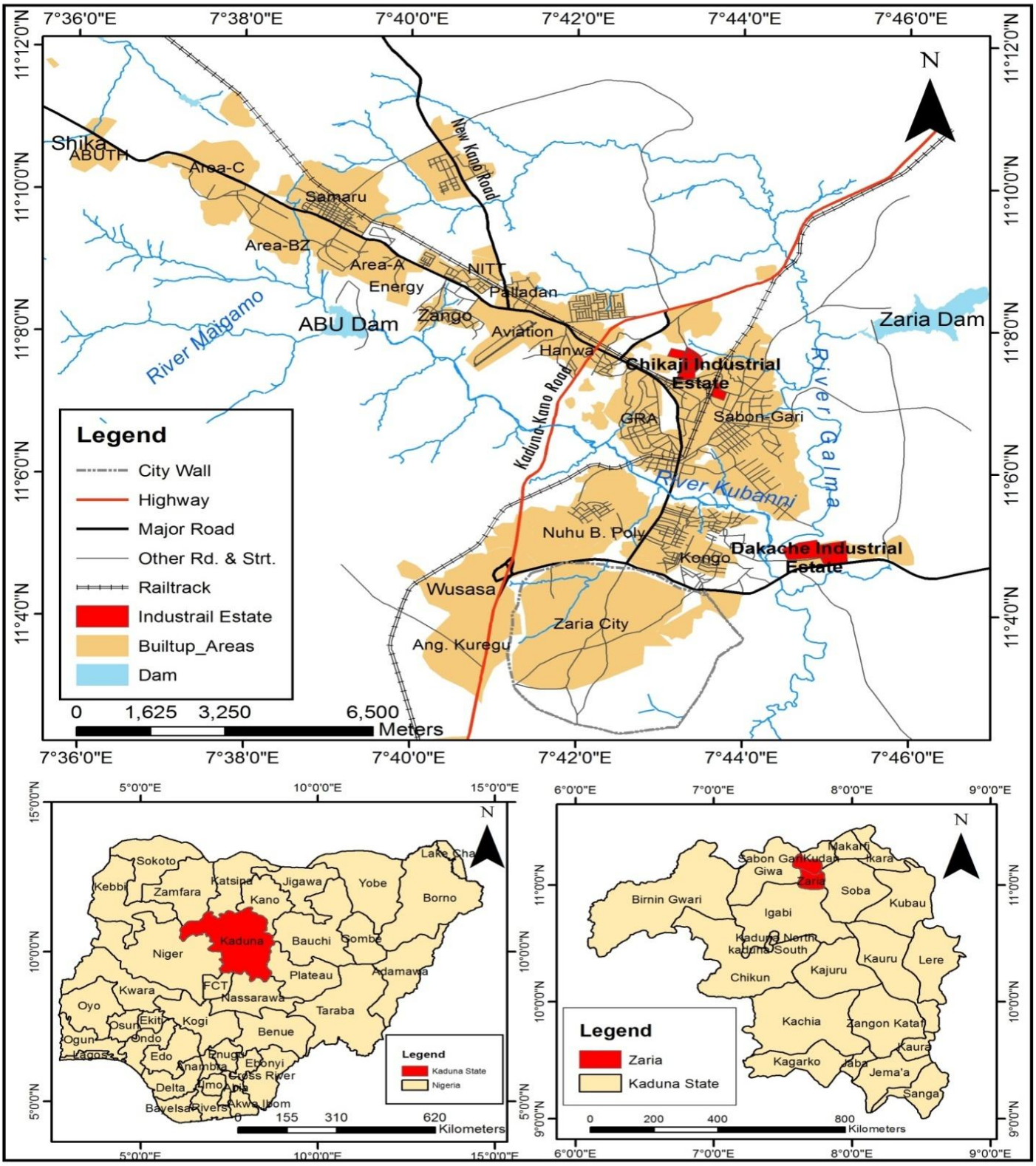

Figure 3.1: Zaria Showing the Industrial Estates

Source: Modified from the Administrative Map of Kaduna State, 2012

3.1.3. Soil and Vegetation

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

The natural vegetation of the study area is the northern guinea savanna type. But the natural vegetation are absent within the vicinity of the gulley, resulting from the occurrence of the gulley itself due to poor vegetal cover, cleared for the purpose of cultivation, urbanization and construction of structures like the railway track. The land management practices have resulted in the evolution of thorny shrubs intersparsed with short annual grasses. The dominant shrub around the area is *Isoberlinia doka* with an average height of 20 metres. Other less frequent shrub species are *Butyrospermum spp*, *Piliostigma spp*, *Vitex spp*, *Terminalai spp* and *Dichrostachys spp* (Jackson, 1970). The common grass communities around the study area are mostly *Andropogoneae* such as *Hyparrhnia spp*, *Andrpogon spp*, *Schizachyrium*, *Semi-berbe* and *Monocymbium ceresiiforme* and are almost completely absent during the long dry season.

However, as soon as the rainy season begins grasses sprout and shrubs germinate very rapidly, no sooner had they become well established than the rain comes to an end again. Extensive grazing also contributes to the absence of grasses (Jackson, 1970). Tree plants include *Mangifera indica*, dotted everywhere, *Parkia clappertoniana* and several others that are useful to man. Despite cultivation activities going on, these are left standing. The vegetation is thick and greenish but dry and brownish during the wet and dry season respectively (Jackson, 1970). The relationship of the physical characteristics of Zaria to the study is that waste materials (comprising plastics, sachet water bags, scrap metals, glasses, organic materials etc.) If left uncollected, chock drainages especially the non-biodegradable waste materials thereby preventing rain water from percolating or infiltrating through the soil and these results in stagnant water which takes days for it to completely drain down into the soil. Areas that are water logged combines with waste materials most times traffic flow, serves as a good breeding ground for disease vectors like mosquitoes, rodents etc. and also contribute to bad odour and diseases like cholera diarrhea among others. Waste if not properly managed can pollute water bodies and in turn affects animals and agricultural land, and aid soil erosion.

3.1.4. Drainage System

The drainage system focuses on three major rivers; the Galma, Kubanni and Saye river basins. The Galma river and its tributaries are mostly ephemeral or seasonal in character and their flows are highly irregular (i.e. drying up from January to June) following rainfall events in streams such as Kabanni and Saye. The Galma river area belongs to the northeastern part of Kaduna river basin which borders the Chad basin to the north. The Galma River is one of the main tributaries of Kaduna River. It has headwaters near the northwestern edge of the Jos Plateau and falls near the Magami village (Ali, 1995). The Drainage is commonly dendritic because there is no structural

control on the drainage lines on the deeply weathered plains. The channel patterns of the drainage basin are of types, those with large number of un-branched first order tributaries with high stream frequencies and drainage densities such as Awai, Maramara and kubanni to East of Zaria (Urquhart, 1976). The relief of Zaria region is a plain, extensive gentle rolling peneplain which extends from Sokoto to Lake Chad and northward from south of Kaduna toTugueddi scarp near Agades (Niger Republic). This embraces most of the northern Nigeria and has been correlated with the mid tertiary African planation surfaces, recognized in other parts of the continent. The plain varies in height, reflecting both regional slopes to the south and a local relative relief of 30m- 46m. The plain is intermittently dotted by rocks, inselbergs and lateritic iron stone-capped mesas, with the prominent landmark of Kufena (Thorp, 1970).

3.1.5. Economic Activity

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

3.1.6 Land Use

3.1.6.1 Industrial Land Use

Industrial activities in Zaria urban area are broken into two industrial estates. The first establishments is located in Chikaji industrial areas, such industries include the following among others; American Bristish Tobacco Company, Comrade Cycle Company, Electricity Meter Company etc. The second are industries processing and production of agricultural product such as Olam Nigeria Plc., Zaria Company, Sunseeds Nigeria Plc. are located in the urban area, but largely with residential and commercial land uses (Ajayi,2007).

3.1.7 Population and People

Zaria is a dual city and centre of activities. It is a medium town on a fast growing population with a growth rate of 3.5% per annum (Kaduna state statistic year book, 1996).While the current population of Zaria according to 2006 census population was estimated as 408,198 (NPC, 2006). According to 2006 census, Zaria had a population of 408198. Based on 3.5 growth rate of 2006 census. The population of Zaria was projected to about 698343 by 2015. The development and growth of the town is attributed to its location in northern Nigeria. Zaria is an old walled town probably founded in about 1536, later in the century became the capital of Hausa state of Zazzau. Zaria (Zazzau) is one of the seven Hausa states, the Hausa Bakwai (true Hausa), Daura,Kano, Gobir, Katsina, Rano and Biram(Musa, 1993).

3.2 METHODOLOGY

3.2.1 Reconnaissance survey

As a preparation for the study, a reconnaissance survey was undertaken to the study area. The objective was to obtain available relevant information on the environment of the study area and establish a cordial working relationship with relevant stakeholders. In the course of the study, heaps of waste were seen in and around the industries and industrial wastewater was channeled into nearby streams.

3.2.2 Type of Data

In order to achieve the aim and objectives of this study, the following data were used:

i. Types of industrial waste generated

ii. Quantity and composition of industrial waste generated

iii. Disposal techniques and management of industrial wastes

iv. Industries compliance with the recommended waste management practice

v. Problem/Challenges of managing industrial waste

3.2.3 Sources of Data

Two major sources of data were used in carrying out this research. They are the primary and secondary sources of data. The primary sources of data used were questionnaire survey and interview. Questionnaire were used to obtained data on types and composition of waste generated, effects of the waste, disposal techniques as well as industrial compliance to waste management standards. The heads of industrial waste management department were interviewed so as to get data on waste management strategies used by the industries. Relevant documents, published books, journals, seminar papers and past dissertation amongst others were used for literature review.

3.2.4 Sample Size and Sampling Techniques

In order to gain the advantage of an in-depth study and effective coverage, samples were drawn from the population of the study area. Consequently, using a population of approximately 44,150.The Yaro Yamani sample selection formula was used to determine the sample size for the selected industrial area as shown in equation 1.

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

Where: n = represent the sample size, **N** = sample frame, **e** = is used to represent the error limit. Form the total population of 44,150, using 5% as the margin of error. A sample size of three hundred and ninety eight (398) was used for the study; as such 398 copies of questionnaire were administered. Purposive sampling technique was used to select the eight localities surrounding the industrial estate based on their proximity and exposure to industrial pollution and environmental risk. This was done in order to examine the effect of the waste the industries has on the localities These localities are Angwan Kaya, Dogarawa, Kwantiresha, Sabon Layi Chikaji, Chikaji, Dakace, Dambo, and Nagoyi. Systematic sampling was used to select respondents for administration of questionnaires to the household. Questionnaires were proportionately distributed as shown in Table 3.1.

Table 3.1: Population of Localities and Sample Size

Locality	Population of Locality in	Projected 2016 Population	Sample Size
Angwan Kaya	678	1,420	13
Dogarawa	644	1,348	12
Kwantiresha	885	1,853	16
Sabon Layi Chikaji	1,481	3,101	28
Chikaji	10,818	22,651	204
Dakace	3,107	6,505	59
Dambo	3,154	6,604	60
Nagoyi	319	668	6
Total	**21,086**	**44,150**	**398**

Source: Computed by Author from Nigerian Population Census Data 1991

Also, to determine the sample size of the industries in the study area, the Yarmani (1967) formula in equation 1 for sample size determination was used. Therefore using the total population of industrial staff (335) by 2016, the sample size for industries is 182; as such 182 samples were randomly selected for questionnaire administration to the industrial workers proportionately to each industries based on the sample size of the industries as shown in Table 3.2

Table 3.2: Population Size of Industry

S/N	Name of Industry	Industry Population in 2016	Sample Size
1	Premier Seed Nig. l	65	35
2	Nelmaco Nig. Ltd.	35	19
3	Sunseed Nig. Ltd.	215	117
4	Olam Nig. Ltd	20	11
	Total	335	182

Source: Field Survey, 2016.

Oral interview with heads of industrial waste management department of each industry was also conducted to supports the data gotten from the questionnaire. This enabled the researcher to obtain data on the strategies employed and its management. Visual observations together with photography were used to capture the visual impressions of the conditions and different aspects of the industrial solid waste management.

3.2.5 Data Analysis

The study employs descriptive method in analysis of data. The descriptive analysis involves the use of frequency tables and percentage in presenting the data collected from the questionnaire administered to the respondent. Hence, the data collected from the respondents were analyzed using statistical techniques. With these tables, it will be very easy to see the opinion of respondents at a glance and

conclusions easily drawn. Simple percentages will also be used to analyze the data generated from the study. For clarity, the analytical method for each objective is presented.

Objective i: to identify the type and composition of waste generated in the industries in Zaria.

The data used to achieve this objective was derived from questionnaire survey. The questionnaire was randomly administered to the worker of each industry; an informal discussion was also done with industrial workers in the form of interview. The data was analyzed and presented using frequency tables and chats.

Objective ii: to examine the waste management strategies adopted by the industries in the area.

In order to examine the waste management strategies adopted by the industries, an appointment was secured with the head of industrial waste department and lists of items outlined were discussed. The result was analyzed using descriptive statistics.

Objective iii: to examine the effects of industrial waste management practices on communities in the study area. The data used to achieve this objective was derived from the response from questionnaire which was administered to the household head. The data was analyzed descriptively using frequencies, percentages and bar graphs to show the effects of industrial waste management practice on communities.

Objective iv: to examine the extent that industries comply with the recommended waste management practice. The data was gotten through administering of questionnaire to the heads of the industrial waste management unit and this was determined using a five point Liket Scale (LS). Values assigned to these options were 5, 4, 3, 2 and 1 respectively. The data was analyzed by getting the mean score of the industrial response based on the five points LS and computed as

5+4+3+2+1=15/5 = 3.00---------- (2)

The extent of industrial compliance with standard waste management practices with mean score less than 3.0 was taken as those which had less compliance level while those with mean score equal or above 3.0 was taken as having greater compliance level.

Since the items were rated on a 5-point scale, the mean of each item is 2.5. However, the mean of 3.0 was used as cut off point for accepting or rejecting each of the items by the researcher. This idea was based on the assertion of Nwankwo (1999) when he states that researcher should fix a mean cut-off point higher than the scale mean for accepting the items. He explains that any mean score higher than the scale mean (X) indicated that the respondents rated it high because to them it is very true or correct.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

Among the socio-economic variables of the respondents considered in this study include sex, age, marital status, educational qualification, occupation and length of stay as shown in Tables 4.1 and 4.2 as well as Figure 4.1.

4.1.1: Sex, Age and Marital Status

Table 4.1 shows the distribution of respondents by sex, age, marital status. The results show that males (61%) have the highest proportion, while the females' respondent was 39%. The dominance of male respondents over female counterparts was due to the fact that male respondents were more accessible and willing to give information as compared to females. The table further shows that 35.9% are within the age bracket of 18-27 years, 26.3% are within the age of 38-47years, while and 3.8% are 68 and above years. This directly implies that the respondents are mature and should be capable of providing objective responses in the study. The table also reveals that more than half (60.9%) of the respondents are married. The implication of the above analysis is that there is high possibility of obtaining objective responses from the respondents due to their experience and level of responsibilities.

Tables 4.1: Sex, Age and Marital Status of the Respondents

Sex	Frequency	Percent (%)
Male	242	60.8
Female	156	39.2
Total	**398**	**100.0**
Age		
18-27 years	143	35.9
28-37 years	51	12.8
38-47 years	105	26.3
48-57 years	59	14.7
58-67 years	25	6.3
68 years and above	15	3.8
Total	**398**	**100.0**
Marital Status		
Single	120	30.2
Married	242	60.8
Widowed	36	9.0
Total	**398**	**100.0**

Source: Field Survey (2016)

4.1.2: Educational Level and Occupation of the Respondents

It was also noticed that most of the respondents had secondary education (52.6%) given the high response. Only 26, 9% had tertiary education (Table 4.2). This shows that majority of the respondents had a formal education which depicts their relative exposure to the importance of this research study. The Table further showed that trading/business was the major occupation of the respondents as it accounts for about 30.2% and civil servant (21.8%) recorded the least. The dominance of those with occupation as trading is not surprising, as this can be attributed to the region being an agricultural production area. This suggests that most of the respondents have adequate knowledge and to give true and just response due to their understanding towards healthy industrial waste management practices.

Table 4.2: Educational Level and Occupation of the Respondents

Educational Qualificatio	Frequency	Percent (%)
None	33	8.3
Quranic	13	3.2
Primary	36	9.0
Secondary	209	52.6
Tertiary	107	26.9
Total	**398**	**100.0**
Occupation of Responde		
Civil service	87	21.9
Trading	120	30.2
Artisan	94	23.6
Others	97	24.4
Total	**398**	**100.0**

Source: Field Survey (2016)

4.1.3: Length of Stay in the Area

Figure 4.1 reveals the length of stay by respondents in the area. It was however noted that more than half of the respondents (55.1%) had stayed in the study area for more than 10 years. These were mainly traders and farmers. Those that are civil servant rarely spend much time within that area, because most of them are concerned of the proximity of the industries to residential buildings. This implies that the responses can be relied on, given that the respondents are believed to have adequate knowledge of their environment given their length of stay.

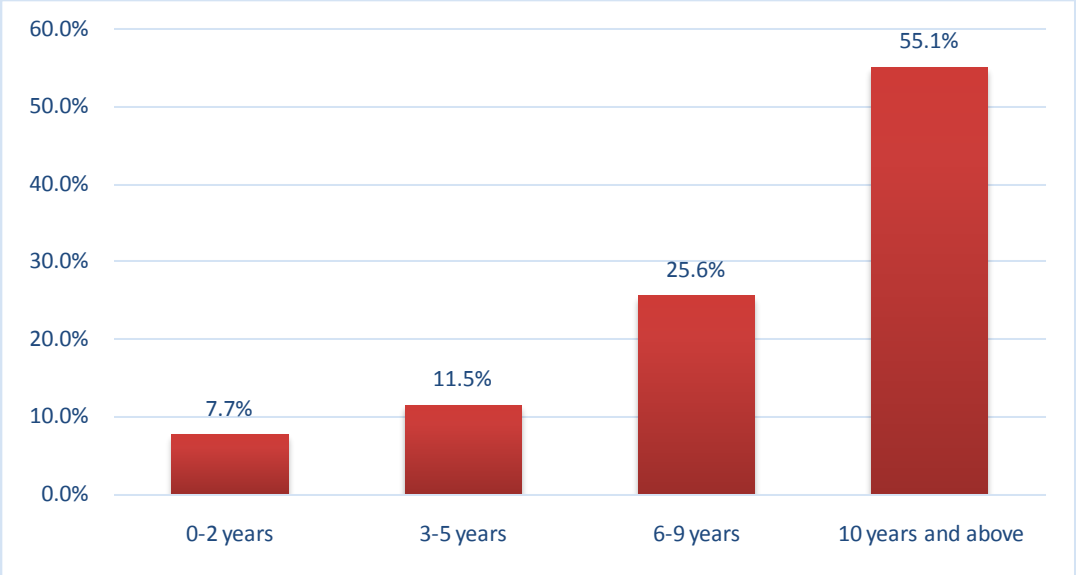

Figure 4.1: Respondents' Length of Stay in the Area
Source: Source: Field Survey (2016)

4.2 APPROXIMATE DISTANCE OF INDUSTRIES TO THE VARIOUS WARDS

4.2.1 Relative distance of Industries to the Residents

The distance between the settlement and the industries is difficult to maintain because of urban sprawl. The standard distance of industries to the settlement ranges from 3-5 km from the projected growth boundary of the settlement (Friso de Vor et al, 2005).

Table 4.3 reveals the relative distance of the industries to the various wards in kilometer, Dogarawa ward was relatively closer to Nelmaco Nigeria limited and Premier Seed limited (0.52 and 0.51) kilometer, Also, Dakace, Nagoyi and Angwan Kaya ward are relatively close to Olam Nigeria Limited and Sunseed Nigeria Limited. This implies that most industries are located in close proximity with residential area, hence residents of these wards could be most exposed to the harmful effects of industrial wastes generated by these industries if not properly managed.

Table 4.3 shows the relative distance of industries to the wards.

Table 4.3: Relative Distance of Industries to the Ward in Kilometer (Km)

Ward	Olam Nig. Ltd	Sunseed N Ltd	Premi Seed	Nelmaco Ltd
	Km	Km	Km	Km
Dambo	1.04	1.01	-	-
Dakace	0.45	0.40	-	-
Nagoyi	0.50	0.56	-	-
Angwan kaya	1.20	1.50	-	-
Chikaji	-	-	0.85	0.98
Dogarawa	-	-	0.50	0.51
Kwantiresha	-	-	0.52	0.54
SabonLayiChikaji	-	-	0.62	0.68
Total	**3.29**	**3.47**	**2.50**	**2.71**

Source: Field Survey, 2016

4.3 TYPE AND COMPOSITION OF INDUSTRIAL WASTE MANAGEMENT PRACTICE

4.3.1 Types and Composition of waste generated by the Industries

The types and compositions of waste generated by the industries per month from January, 2016 to December, 2016 are shown in Table 4.4

The finding of the study showed that Sunseed Nigeria Limited (68.2%) generated the highest proportion of waste which includes impurities, trash, refuse, firewood scale, soap stock and this was followed by Premier Seed Limited (17.9%) as shown in Table 4.4. The study agreed with Iguisi *et al* (2001); Butu and Ati (2013) who traced the sources of these chemical elements such as europium, manganese, arsenic, zinc and copper into Kubanni dam in Zaria that is used for domestic purposes as the waste emptied into the

water bodies from the industries and the ones dump on open land. It is therefore not over assumption to observe that water sources for human consumption are exposed to this similar threats.

Table 4.4 showed also the different composition of waste generated by the industries. The findings revealed that the composition of waste generated by Sunseed Nigeria limited and Premier Seed Nigeria limited includes heavy metal, oil, grease, fungicide, bacteria and cyanide. Olam Nigeria limited and Nelmaco Nigeria Limited was observed to produce wastes which compose of plastics, woods, glass, metal, cotton wick and seeds (see Plate I, II and III in appendix). This is an indication that waste generation by industries required proper and efficient management.

Table 4.4: Types and Composition of waste generated by the industries

Types of Waste	Composition of Waste	Estimated Quantity(tons) Kg				Total	%
		Premier Seed Nig. Ltd	Olam Nig. Ltd	Nelmaco Nig. Ltd	SunSeed Nig. Ltd	Qty.	
Impurities	Chaff, broken/rotten kernels	750	_	450	_	1200	9.53
Trash and Refuse	Packaging materials, empty bags,dust, empty containers, Plastics, wood, glass and metal	500	300	300	250	1350	10.73
Mote	Cotton wick and Seed	_	700	_	_	700	5.56
Soap Stock	Wash water, High suspended solid, Fungicide and Insecticide.	1000	_	_	337	1337	10.62
Organic waste	Free floating oil and Cyanide	_	_	_	1000	1000	7.95
Bioling ash	Particulate and Sulphur	_	_	_	3000	3000	23.83
Spent earth	Volatile organic carbon	_	_	_	1000	1000	7.95
ETP Sludge	Heavy metal, grease, oil and bacteria.	_	_	_	2000	2000	15.89
Gaseous emission	CO2, NO2,SO4 and NH2NO2.	_	_	_	500	500	3.97

Firewood scales	Bark, saw dust and fibres.	_	_	_	500	500	3.97
		2250 (17.9)	**1000 (8.0)**	**750 (6.0)**	**8587(68.2)**	**12587**	**100**

Source: Waste Management Department of the Industries/Author, 2016

4.3.2: Estimated quantity of industrial waste generation by composition

Table 4.5: Analysis of estimated quantity of industrial waste generation by composition

Name of Industry	Estimated Monthly Quantity (tons)	Percentage (%)
Premier Seed Nig. Ltd	2250	17.88
Olam Nig. Ltd	1000	7.95
Nalmaco Nig. Ltd	750	5.96
Sunseed Nig. Ltd	8587	68.22
Total	**12,587**	**100**

Source: Field Source, 2016

Table 4.5 reveals that Sunseed Nigeria limited generate a monthly estimated quantity of waste (68.22%) which is approximately two (2) times the percentage composition of wastes generated by the other three industries in the study area. This is due to fact that, the size of operation and the large amount of material used in the production processes leads to the large amounts of waste generated by Sunseed Industry. Also, some of the machinery used in the industry is obsolete and are unable to maximize most of the materials without producing waste. The monthly estimated quantity of waste (2250 tons) generated by Premier Seed Nigeria limited is low because of the efficient use of technology.

4.4.: Estimates of Hazardous and Non- hazardous Industrial waste generation

Result from Table 4.6, shows that most of the industries in Zaria produce hazardous waste (78.15%). This is an indication that they require special treatment and disposal techniques. Also

Olam Nig Ltd and Nelmaco together with other industries produce non-hazardous waste (21.85%). However, Sunseed Nigeria limited generates more of hazardous wastes such as, boiling ash, ETP sludge, gaseous emission, spent earth, soap stock than any of the industries and this affects both agricultural activities and the environment.

However, it was noted that Premier Seed Nigeria Limited generates chemical waters which if not properly managed could make the water in the area unfit for drinking and for other domestics' purposes. While the waste generated by Olam Nigeria limited and Nalmaco limited composed of less hazardous chemicals which are easily biodegradable and does not affect the environment as shown in Plate IV (see appendix V). This is an indication that waste generation by industries is a function of materials produced and scale of production and bye product/waste involved at the different stages of production. This study is in line with Sharma (2010) who noted that depending on the type of materials used.

Table 4.6: Analysis of estimates of Hazardous and Non- hazardous Industrial waste generation

Category	Sunseed Nig Ltd	Olam Nig. Ltd.	Premier Seed Ltd.	Nelmaco Nig. Ltd	Total Quanty(ton)	%
Hazardous Waste	Boiling ash , Spent Earth, Soap Stock, ETP Sludge, Gaseous emission	Nil	Chemical water, Chemical dye Container	Nil	9837	78.15
Non Hazardous	Refuse, Organic waste, Firewood scale	Trash , Mote	Empty bags, dust, impurities	Chaff, Dust, Stone, Empty container, Broken kernels	2750	21.85
Total					**12587**	**100**

Source: Field Survey, 2016.

The waste produce by most industries are hazardous waste and contain chemical elements such as lead, manganese, cadmium and other heavy metals like antimony, arsenic, pesticides, bleaches, discarded electronic sets such as computers, toys, handsets and television and a waste of range of toxic chemicals which occur in solvents, paints, disinfectants and wood preservatives.

In support interview with the Head of Waste Management Unit Sunseed Nigeria Ltd revealed that:

"During the production of vegetable oil and poultry feeds some hazardous wastes like sludge, spent earth, soap stock and carbon (II) Oxide are produced which contain harmful chemicals"

Plate III-V (see appendix V), showed the different types of hazardous and non-hazardous waste generated by the industries.

4.5 SOLID WASTE MANAGEMENT PRACTICES OF THE INDUSTRIES

4.5.1 Waste Reduction, Reuse, Recycle, Recovery

Table 4.7 shows the strategy used by the industries in managing their waste.

Table 4.7 Waste management practices (reduction, reuse, recycle and recovery) of selected industries

Company name	Reduction	%	Reuse	%	Recycling	%	Recovery	%	Total	
	Freq.		Freq.		Freq.		Freq.		Freq.	%
Premier Seed Nig. Ltd	15	8.2	6	3.3	12	6.6	2	1.1	35	19.2
Olam Nig. Ltd	2	1.1	6	3.3	2	1.1	1	1.0	19	6.5
Nelmaco Ltd	2	1.1	9	5.0	7	3.9	1	1.0	11	11.0
Sunseed Nig. Ltd	50	27.5	18	9.9	45	24.7	4	2.2	117	64.3
Total	**69**	**37.9**	**39**	**21.5**	**66**	**36.3**	**8**	**5.3**	**182**	**100**

Source: Field survey, 2016.

However, the data obtained shows that almost all the industries employed one form of waste management practice ranging from reduction, reuse and recyding, and they do mainly for economic purpose. As indicated in table 4.7 Sunseed Nigeria Limited adopt waste reduction (27.5%) follow by recycling (24.7%) strategy often carried out than reuse and recovery. They pointed out that due to the nature of the waste, they try to reduce waste at the point of production and if that is not achieved, they recycled the waste they produced. In Olam Ginnery limited they re-use (3.3%) more of their waste. The reason is that it is less tedious and can easily be carried out. They sometimes carried out source reduction (1.1%) and recycling (1.1%) to compliment the reuse strategy. Premier Seed Nigeria Limited adopts the methods of source reduction (8.2%) and recycling (6.6%) of their waste, while Nelmaco on the other hand also manage their waste through reuse (5.0%) method and sometimes uses recycling (3.9%). However, from the above, we can understand that most of the selected industries adopt the waste management strategies such as source reduction (37.9%) and recycling (36.3%) to manage their industrial solid waste.

To support these findings, interviews were conducted with the Head of Waste Management Department in the selected industries. Information obtained from the Head of Waste Management Department in Sunseed Nigeria limited, who stated that their major strategy in managing waste is source reduction and this is done in order to conserve environmental resources. According to him the company ensures full production process to minimize waste to the barest minimum and this is achieved through improvements in design, production, use, reuse, recycling, improvements in operations and maintenance. He pointed out that the waste generated by the industry is hazardous which affect both human and the environment; but nothing was done by the industry to reduce the effect of these waste.

Also as revealed from Olam Nigeria limited much of their wastes were reuse and recycle. They produce plastic, wood and cotton. These are sorted out into their category and for the plastics waste; they are use in the storage of seeds and chemicals. The mote is processed by

separating the cotton from its seed. The cotton is further processed into wool, while the seed is sold out to other industry.

In addition, the discussion with Premier Seed Nigeria Limited revealed that their main strategy in managing waste is use of source reduction. According to him, this method is aims at reducing the amount of waste produced and is more effective way to handle waste from its generating point. The industry is involved in the production of genetically improved seed and seed preservation. According to him, he said that chemical is used in an appropriate amount and we ensured that it did not leached out to pollute the soil and environment. They also revealed that the empty bags the industries produce is sorted out and clean by washing them. This is use to package broken kernels and chaff. This is the waste the industry carried recycling on.

In addition, Nelmaco Industries employed reuse and recycling strategies in managing its waste. The empty container the industries produced is use for storage of other materials and also broken kernels produced are use as organic manure to increase soil fertility. Therefore, from the above discussion we can understand that most of the industries employ reduction and recycling waste management strategy and that none of the industries ensured they work hard to reduce the effects of these waste in any way.

4.5.2 Techniques of Reporting Effects of Waste to the Public

Table 4.8 shows the medium the selected industries use in reporting the harmful effect of waste generated to the public.

The result showed that from the total sampled Olam Nigeria Limited uses community sensitization 2.7%, techniques to report the effects of waste. They pointed out that these techniques are cost effective.

Table 4.8 Technique of Reporting Effects of Waste to the Public

	Premier Seed Nig. Ltd		**Nelmaco Ltd**		**Sunseed Nig. Ltd**		**Olam Nig. Ltd**		**Total**	
Items	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Leaflet/Handbills	4	2.2	1	0.6	15	8.2	2	1.1	22	12.1
Internet	8	4.4	1	0.6	20	11.0	1	0.6	30	16.6
Radiobroadcast	1	0.6	2	1.1	18	9.9	2	1.1	23	12.7
TV announcement	0	0.0	1	0.6	5	2.7	1	0.6	7	3.9
Community sensitization	22	12.1	14	7.7	59	32.4	5	2.7	100	54.9
Total	**35**	**19.3**	**19**	**10.6**	**117**	**64.2**	**11**	**6.1**	**182**	**100**

Source; Field survey, 2016

While Premier Seed Nigeria limited (64.2%), Nelmaco(10.6%) and Premier seed Nigeria limited used community sensitization in reporting the harmful effects of their waste, the reason being that it has a wide coverage than any other techniques. The findings draw a conclusion on the procedures of environmental disclosure on waste management strategy by the industries giving more priority to community sensitization (54.9%).

4.5.3 Waste disposal and Treatment Technique

Table 4.9: reveal waste disposal and treatment technique which the industries use.

Table 4.9: Waste disposal and Treatment Technique of selected industry

	Premier Seed Nig. Ltd	**Nelmaco Ltd**	**Sunseed Nig. Ltd**	**Olam Nig. Ltd**	**Total**

Items	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Landfill	9	4.9	4	2.2	20	11.0	2	1.1	35	19.2
Open dumping	15	8.2	9	4.9	60	33.0	4	2.2	88	48.4
Incinerator	6	3.3	2	1.1	25	13.7	2	1.1	35	19.2
Waste sale	2	1.1	3	1.7	7	3.9	2	1.1	14	7.7
Stream dumping	3	1.6	1	1.0	5	2.8	1	1.0	10	5.5
Total	**35**	**19.1**	**19**	**10.9**	**117**	**64.4**	**11**	**6.5**	**182**	**100**

Source: Field survey, 2016

The industries use different ways to dispose their wastes. These methods are presented in Table 4.9. As observed in (table 4.9), open dumping (48.4%) are the common waste disposal methods practice by most of the selected industries. In addition, landfills (19.2%) were also use by the industry in burying hazardous waste. However, Sunseed Nigeria Limited and Premier Seed Nigeria Limited dispose their liquid wastes into nearby water bodies or rivers through pipes with or without any treatment. It can also be seen that some of the industries like Olam and Nelmaco sometime uses incinerator (19.2%). Therefore, it can be gathered from the analysis that open dumping is the common practice of waste disposal adopted by the industries. Plates VIII-X, (shown in appendix V), further showed the disposal and treatment techniques of the industries in the study area.

4.6 EFFECTS OF INDUSTRIAL WASTE MANAGEMENT ON COMMUNITIES

4.6.1 Environmental consequences

Table 4.10 reveals the major problem caused by improper disposal of industrial wastes.

Table 4.10: Effects of Improper Industrial Waste Management Practices on the Communities

Options	Number of response	Percentage %
Flood	118	39.65
Environmental aesthetics	36	9.05
Out-break of disease	41	10.30
Unfit water	92	23.12

Land fertility	46	11.5\
Air pollution	65	16.33
Total	**398**	**100**

Source: Field Survey, 2016

It shows that of flooding (39.65%) was common in Dambo and this was as a result of indiscriminate dumping of industrial waste which in turn block drainages, there by obstructing the free flow of water. Also, the air quality has been polluted by the activities of the industries especially around Dakace, Chikaji (16.33%) environs. In addition, poor environmental aesthetics (9.0%) has been destroyed because of improper waste disposal. Agricultural land within the study area was adversely affected thereby leading to poor agricultural yield in Dambo, Chikaji (11.56%) wards. This implies that improper industrial waste management poses a great threat to the health conditions of the people, and the environment.

The study agreed with Olajide (2014) on a similar study that consequences of improper dumping of waste in Katsina Metropolis causes mosquitoes infestation, flies and rodents infestation, contamination of food, spread of communicable disease, dust and smoke and bad smell. Plate XI (See appendix V), shows fumes emitted from one of the industries which causes air pollution and result to poor health of the communities around the industries. From this, one can understand that air pollution due to improper industrial waste management practice caused health problems to the residents

4.6.2 Health Related Problems due to waste disposal

In Table 4.11 responses of participants on the effect of the industries during waste disposal. This indicates that discharge of industrial liquid wastes into water bodies produces bad smell from the disposal of liquid waste (62.31%) are the most common problems that are highly affecting the health situation of the residents during their disposal. In addition, (17.09%) of the respondents said

that noise from the industries affects the health of the residents. In similar proportions (10.80%) of the respondents said that their health is affected by smoke and dust from the industries in their vicinity, while (9.79%) complained of disease resulting into circulatory system diseases, irritation or inflammation of the eyes and nose, skin and gastro intestinal system diseases etc.

From the above discussion one can conclude that all forms of industrial wastes or pollution are affecting health of the residents.

Table 4.11: Health Related Problems due to waste disposal

Problem	No of responses	Percentage %
Discharge of industrial liquid wastes and subsequent bad smell	248	62.31
Noise arising from their production	68	17.09
Dust and smoke	43	10.80
Disease occur	39	9.79
Total	**398**	**100**

Source: Field Survey, 2016

However, the effect of such wastes varies in type. Disposing of liquid waste into water bodies and its subsequent bad smell is the most identified industrial waste problem while dumping of solid waste is relatively the least identified problem by the respondent households.

4.6.3 Socioeconomic Effects as a result of improper Waste Management Practices

Figure 4.2 shows the various ways respondents are affected by poor waste management practices.

It reveals that 55.2% of the respondents indicate that migration out of the community is their only resort as a result of the challenges faced by improper waste disposal from the industries. On the other hand, 18.7% said that most of the landfill dumping sites was no longer suitable for agricultural purposes; as such they are compared to change their occupation. However, 36.1% were traumatized of further environmental deteriorations which may affect their health.

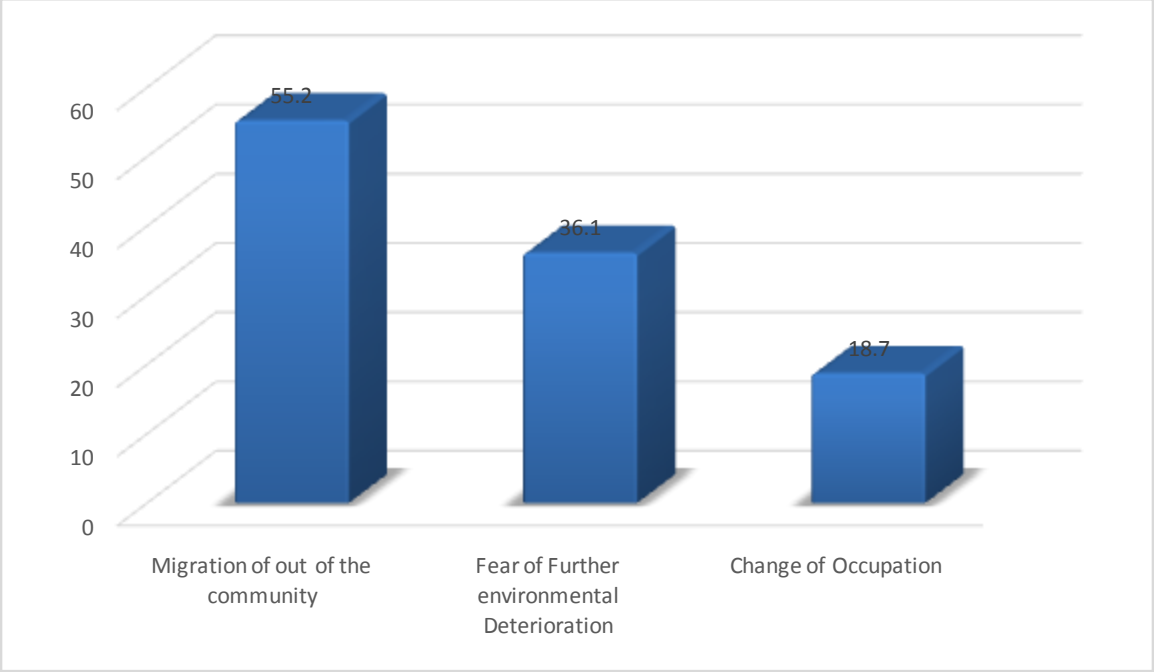

Fig. 4.2 : Socioeconomic Impact of Improper Waste Management

Source: Field Survey, 2016

This indicates that if nothing is done to improve the management of industrial waste in the study area, the continuous outward migration of residents might lead to pressure on available infrastructural facilities in the surrounding areas.

4.6.4 Measures in Controlling the Effects of waste within the Environment and Residents

According to the Head of Waste Management Department of Sunseed Nigeria Limited said they are highly conscious of their activity on the environment as well as on resident, this makes the company emphasize on source reduction of its waste to ensure environmental safety within the limits of the provisions by National Policy on Environment especially exposures to hazardous waste. Olam Nigeria Plc also affirmed that the industry practice landfill measures by burying certain waste that is hazardous to the environment, this help at preventing and minimizing the negative outcomes of wastes resulted from their industrial activity. Information obtained from Premier Seed Nigeria Limited reveal that the industry minimizes the effects of waste by increasing waste prevention, promoting material efficiency and creating public awareness. Also, there is an anti-pollution equipment install which is known as excavator which helps to reduce pollution during production processes (Factory Manager Premier Seeds, 2016). In Nelmaco Limited, it was recounted that the industry minimize the effects of its waste on the environment and the resident by the use of incinerator and recycling of resources.

4.7: COMPLIANCE LEVEL OF INDUSTRIES TO WASTE MANAGEMENT PRACTICE

4.7.1 Extent of Compliance to Waste Management Practice

Table 4.12 indicates the level of industries compliance to standard waste management practices in the study area. The finding showed that Sunseed (3.67) recorded the highest compliance of recommended

waste management practices this is because they adhered strictly to most of the compliance level by developing friendly ecological products, noise exposure limitation, promotion of education on environmental consciousness and aesthetic and good sanitary conditions of the factory/environment., followed by Olam Nigeria limited with 3.58, complied with release of environmental information, emergency plan response/equipment, efficient use of energy and report to NESREA. Premier seed limited and Nelmaco Nigeria limited have the least compliance level, which could be attributed to their operations and do not produce much hazardous waste as a result some of the waste management practices might not be applicable to them.

It was however noted that release of environmental information and implementation of environmental management compliance recorded the same mean score of 4.50 indicating the highest complied waste management practices among the four industries.

Practice	Name of Industry				Average	Rank
	Sunseed	Nalmaco	Olam	Premier		
Release of Environmental information	4.00	5.00	5.00	4.00	4.50	1
Implement Environmental Management Compliance	5.00	4.00	5.00	4.00	4.50	1
Develops friendly ecological products	5.00	4.00	4.00	4.00	4.25	3
Aesthetic and good sanitary conditions of the factory/environment	4.00	4.00	5.00	4.00	4.25	3
Noise exposure limitations	5.00	4.00	5.00	3.00	4.25	3
Promotes education on environmental consciousness	5.00	4.00	4.00	4.00	4.25	3
Industries liable to for clean-up, remediation and restoration in case of spill	5.00	4.00	4.00	4.00	4.00	7
Have Environmental Impact Statement	4.00	4.00	4.00	4.00	4.00	7
Carry out Environmental Audit	4.00	4.00	4.00	4.00	4.00	7
Industries liable to for clean-up, remediation and restoration in case of spill	5.00	4.00	4.00	4.00	4.00	7
Emergence Respond Plan and Equipment	3.00	4.00	5.00	4.00	4.00	7
Ensure workers safety to limit of exposure to hazardous waste	5.00	4.00	4.00	3.00	4.00	7
Efficient use/reuse of energy	4.00	3.00	4.00	4.00	3.75	13
Possession of Environmental Seal	4.00	4.00	3.00	3.00	3.50	14
Efficient use/reuse of water	4.00	3.00	4.00	3.00	3.50	14
Hazardous waste management	4.00	3.00	2.00	4.00	3.25	16
Carry out Recycling programmes	3.00	4.00	2.00	3.00	3.00	17
Set mitigation programs	2.00	2.00	4.00	4.00	3.00	17
Observe effluent limitations	4.00	2.00	4.00	1.00	2.75	19
Report of all discharges, treatment and disposal to FEPA	4.00	4.00	2.00	0.00	2.50	20
Visual identity towards the environment	2.00	4.00	2.00	2.00	2.50	20
Report of accidental discharge to FEPA	0.00	4.00	2.00	4.00	2.50	20
Possess greenhouse emission reduction process	2.00	2.00	2.00	3.00	2.25	23
Possesses institution to develop environmental projects	2.00	0.00	2.00	2.00	1.50	24
Total	**3.67**	**3.50**	**3.58**	**3.29**	**3.51**	

Table 4.12: Industrial Compliance with Waste Management Practices

Source: Field Survey, 2016

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The study set out to assess the management of industrial solid wastes in Zaria. A total number of 398 respondents and four industries were involved in the study. The study identifies the types and composition of waste, the waste management practices industries uses, the effect of the waste and industrial waste management compliance. This chapter presents the following summary, conclusion and recommendation.

5.2 SUMMARY OF FINDINGS

The study revealed that the major waste produced by the industries in the study area was gaseous waste, cotton wastes, ash, spent earth, soap stock, organic and liquid waste. The study notes that Sunseed (68.2%) is one of the industries that generate the largest amount of waste produce every month. These include liquid sludge which is highly acidic and affect lands and humans, soap stock, organic waste, spent earth, gaseous waste and firewood scales. Most of the wastes produced employed source reduction, reused, and recycled as the waste management practices the industry adopts, while Olams Nigeria limited (8.0%) produced mote and trash every month. The industrial practices for managing waste is reuse and source reduction. Premier seed with a percentage of (17.9%) adopts source reduction, reused and recovery used to manage impurities, chemical water, chemical container, empty bags and dusts they produced.

Less processing and manufacturing activities is taking place in Nalmaco as these characterized the little amount of waste produced. The waste includes chaff, dust, empty container and broken kernels with (6.0%) every month. The industry carried out waste reused and recycled. The survey

indicates that most of the industries carried out community sensitization (54.9%) as a way of reporting their waste because of lack of transparency in their industrial operation in Zaria due to hazardous waste (78.15%) generated by majority of the industries and causes harm to human and the environment.

The study revealed that Sunseed Nigeria limited 3.67 has the highest compliance level as they followed strictly the guidelines. This shows that the industries produce less toxic solid waste into the environment more than what is made public. This was followed by Olam Nigeria limited with a compliance value of 3.58. The industry with the least compliance level was Premier seed Nigeria limited and this is due to lack of proper industrial monitoring and adherence to the FEPA Act.

It also emerged that most of the industries uses open dumping (48.4%) to dispose their waste. And only few of them dispose their waste through landfill (19.2%) and incineration (19.2%). The disposal sites had no internal access and are sited near residential area or settlement. Industrial dump site in Zaria are not designated and the environmental implications as revealed by the study are that waste are indiscriminately disposed create unsanitary outlook and other effects like environmental degradation, air pollution, outbreak of diseases like diarrhea, cholera etc and that landfill which is the only means of disposal are very close to residential areas and are not properly managed.

The study also noted that community sensitization (54.9%) is the reporting techniques most of the industries used to report the effect of waste. However, only few of the industries uses internet (16.5%) and radiobroadcast (12.6%) to report the effect of their waste. However the lack of reporting techniques that covers a wide range of populace is not practice within the industries in Zaria.

The study revealed that there are several effects caused by improper disposal of waste in Dambo and Dakace ward ranges from flooding (39.65%), which is the major effect to disease out-break, destroyed environmental aesthetic, unfit water for drinking and reduces soil fertility. The implication is that it causes migration out of the community. This indicates that if nothing is done to improve the

management of industrial solid waste in the study area, the continuous outward migration of residents might lead to low economics and agricultural output in the surrounding areas. Also in Dakace and Chikaji wards has unfit water (23.12%) in river and streams. This is due to the fact that most industries within the study area emptied the liquid waste in the water body. In Dakace ward, air pollution (16.33%) is the major challenge been experience, this pollute the atmosphere and causes different skin and respiratory tract diseases.

It was also revealed that most of the industries in Zaria mostly carried out source reduction (37.9%) and recycling (36.3%) as the solid waste management practices industries in Zaria adopted. The discussion with the industries asserts that they rarely carried out waste recycling but carried out waste reporting in the form of community sensitization (54.9%). This shows that the industries in Zaria do not practice the integrated industrial waste management method.

5.3 CONCLUSION

By adopting the wealth aspect from waste or treating industrial wastes as resources, in terms of solid waste management practices has effectively become not only a service but an instrument for ensuring a good healthy environment for all.

The findings of the study reveal that the types of waste generated by industries in the study area were ash waste, cotton, organic waste, smoke, liquid water soap stock, spent earth. Also the composition of industrial wastes includes metal, oil, grease, bacterial and cyanide. Most of these wastes are hazardous 78.15% in nature and poses serious danger to human health and the environment.

Sunseed Nigeria limited 3.67 has the highest compliance level as they followed strictly the guidelines outline by FEPA. That source reduction 37.9% and recycling 36.3% are the solid waste management practices adopted by the industries in Zaria.

This shows that there is a cause and effect relationship between proper industrial waste management and people's health conditions and environment. It is when industrial wastes are efficiently handled, that the environment becomes pristine, friendly and protected from diseases. This calls for a synergy between government, private sector, groups, individuals and the media

5.4 RECOMMENDATIONS

Based on the findings, recommendations were developed to promote industrial solid waste management in Zaria industrial estate and they include:

1. The type of waste produce by industries should be separated from other sections and handled by technically-biased personnel to avoid overlap of functions which leads to inefficiency. A holistic and industry-focused approach in empowering the industries to make choices for their waste management should be the key focused of intervention. Within this framework, the collaboration of all stakeholders such as company and allied matter, government agencies such as the ministries of trade, labour and state security and Manufacturing Association of Nigeria to dialogue and design policies and regulations that will create a strong waste department with the expertise to management hazardous waste by the use of scientific techniques develop for dealing with industrial waste management. This will encourage the emergences and development of industrial ecology where wastes from one activity are input of raw materials for another activity.

2. Enforcement of compliance standard should be pursued by KEPA. The results from this study have indicated that waste management from the industries compliance level is inadequate. The situation is worst among small scale industries. Industries need to be responsible to follow the national waste standard management level. The small and large scale industries in Zaria should be required to seek authorization from Kaduna State Environmental Protection agency before disposing harmful waste under relevant rules; equally the agency should be committed in

enforcing the relevant rules. Towards this, law should be promulgated to tax the industries that violated these rules. The tax will help offset the environmental damage by going towards environmental restoration, protection and spreading information to increase knowledge on these issues. It is possible that through the efforts of KEPA and industries, a mechanism could be evolved for better management. The industries should be made to undertake the detailed risk assessment of the waste.

3. Produce and implement an integrated industrial management plan with the relevant stakeholders. A policy should be formulated based on reduce, reuse, recycle recover and reporting by the industries. Companies are expected to improve their waste and environmental performance and efficiency on a regular basis. Segregation should be done at the point of waste generation and can be achieved through proper training, cleaning standard and tough enforcement. Industrial waste should be collected and transported in safe containers. The open dump site should be closed and municipal should work in conjunction with the industrial sector towards development of specific sanitary landfill for the treatment and disposal of waste. Facility should be installed to extract gas which can be burnt to generate the needed electricity in Zaria

4. Personnel handling wastes of the industries should be made to wear appropriate protective clothing by government environmental protection agency. Mechanical methods for handling waste should be adopted where machine are used to collect the waste for disposal instead by the use of hand. Also, the waste department of the industries should be educated about the dangers of manual handling of hazardous waste. When there is a pollution that affects the community, industries should be made to pay the affected people as a way of compensation and protect the community from further reoccurrence. There should be a synergy between the industrial

management and the community Head to organize programmes to educate the people and provides incentive as a way of corporate social responsibility.

5. Release of environmental report by the industries to government agency and the public in Zaria. Generally the government should promote waste reporting system in all industries through awareness programmes, training and demonstration projects which should cover all stakeholders concerned. Also the industries should be pressure by government to report all information about their operation and waste generated. This will help government to carried audit of the industries and authenticate such report. Public availability of information would serve a number of functions, including educating the general public and it will help industries to comply to national environmental agreement. All waste management issues are under the authority of local government councils; the state government only provides policies and guidelines for the local government councils to adopt. Regarding the types of waste, the agency does oversee the affairs of both industrial waste and effluent from some of the few industries in the study.

5.5 SUGGESTIONS FOR FURTHER STUDIES:

i. Spatio-Temporal Analysis of Morbidity rate and Mortality incidence effects of industrial waste in Zaria, Nigeria.

ii. Assessment of Agricultural crop yield in relation to industrial waste as manure use sustainably in Zaria, Nigeria.

REFERENCES

Abbass, I. M.(1997). The Political Economy of Rural Development in Nigeria: A Study of Rural Zaria. Unpublished PhD Dissertation Ahmadu Bello University, Zaria.

Ali, M., (1996), Primary Collection of Solid Waste Management in Faisalabad, Pakistan.Draft FinalReport. Water, Engineering and Development Centre (WEDC).Institute of

Development Engineering. Loughborough University: Loughborough. (Chapter 2)

Agarwal, A. Singhmar, A. Kulshrestha, M. and Mittal, A.K. (2005). Municipal Solid Waste Recycling and Associated Markets in Delhi, India: *Resources, Conservation and Recycling,* 44 (1): 73-90.

Adara OA (1997). Current state of the art of environmental education in Nigeria. In Lawal, M.B and Mohammed, A. A (Eds), Proceedings of the National Workshops on Popularising Environmental Education in Nigeria Universities. University of Calabar, Nigeria. Pp. 16- 18. Agbola T (1993). "Environmental Education in Nigerian Schools".

Ajero,C.M.U. and Ukaga,C.N. (2006). Development, Global Change and Public Health.

Mwgasoft Owerri.

Anthony, B. (2009). Urban Environmental Problems in Ghana; A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi- Takoradi: Norway, NTNU.

Aston.C. (2001). The dust and unhealthy air in factory area was a major factor of tuberculosis, bronchitis, asthma. EnvironmentalProtection Agency. Europe.

Arunasalam.P, Bandula.C, Dissanayake.S, Janaka.J & Ranjan.P, (2002).A cross-sectional comparative prevalence study to evaluate theeffect of air pollution on individuals who lived in an industrial zone and in a non-industrial zone. Archives of Environmental Health:An International Journal, 57(6), 579-583. Sri Lanka. Doi: 10.1080/00039890209602091.

Ajayi O.M. (2007) The Practice of Waste Management in Construction Site in Lagos State: Nigeria. University of Lagos ISN: 196.220.66.2

Agunwamba, J.C. (2003). Analysis of Scavengers' Activities and Recycling in some Cities of Nigeria. Environmental Management, 32 (1): 116-127.

Anthony, B. (2009). Urban Environmental Problems in Ghana; A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi- Takoradi: Norway, NTNU.

Ajero C, Chigbo UA study on the evaluation of industrial solid waste management approaches in some industries in Aba, South Eastern Nigeria. W Afr J Ind Acad Res. 2012;4:103– 112.

Arreaza, T. M. (2005). Synergies to Tackle Waste Management Challenges in Latin America. Accessed from: http://www.wscsd.org/2005/02/17/synergies-to-tackle-waste management-challenges-in-latin-america. 21/07/07.

Attahi, K. (1999). Abidjan, Cote d'Ivoire. *Onibokun, A.G. (Ed). Managing the Monster. Urban Waste and Governance in Africa.* Ottawa: IDRC. Pp. 11- 48.

Adekoya, A.A. (2011) Effect of Sawmill location on the environmental development of Ikire, An. Unpublished MSc. Housing dissertation, Department of Urban and Regional Planning University of Ibadan.

Aujogbo C.A. (2012) Appraisal of the effect of Industrial Location on the Resident, of adjoining Neighbhood. And unpublished Msc environmental Management, dissertation submitted to the Department of Environmental Science and Tecnicology Federal University of Agriculture Abeokuta, Ogun State Nigeria.

Amaeshi, K. M., Adi, B. C., Ogbechie, C. and Amao, O.O. (2006): Corporate Social Responsibility in Nigeria: Western Mimicry or Indigenous Practices? *Research Paper Series- ISSN 1479-5124 No. 39-2006* International Centre for Corporate Social Responsibility Nottingham University Business School

Bowley, A. L. (1926). Measurement of the precision attained in sampling. *Bulletin of the International Statistic Institute*, 22(1), 6-62.

Blacconiere, W. G. and Patten, D. M. (1994): Environmental Disclosures, Regulatory Costs and Changes in Firm Value, *Journal of Accounting and Economics*, Vol. 18, No. 3, pp.357-377.

Ballantine J. and Stray S. (1995): Current Research Issues in Environmental Disclosure, *Workshop Document*. Retrieved November 23, 2006, from http://www.windspeed.net/research.pdf.html

Basel Action Network (BAN), (2008) Turn Back the Toxic Tide. Accessed from: http://www.ban.org/index.html. 23/12/07.

Bill, V.L. (2009). The 3Rs: Reduce, Re-use and Recycle, a Case Study. Michigan, *Technology and Children: A Journal for Elementary School Technology Education.* (1): 1-6.

Bayero University Kano Consultancy Unit, (2012) In: Iriruaga, E.T. (2012) Solid waste Management in Nigeria. Lagos, D-Waste Management for Everyone.Pp.1-6. Accessed from: http://www.d-waste.com/new-infographics/item/124-solid-waste-management-in- nigeria/124-solid-waste-management-in-nigeria.html?shov. On 1/5/2013.

Burritt, R., Hahn, T. and Schaltegger, S. (2002): Towards a Comprehensive Framework for Environmental Management Accounting – Links between Business actors and Environmental Management Accounting Tools, Australian Accounting Review, July. Retrieved November 4th, 2007 from http://www.unilueneburg/edu.html.pdf

Baud, I. (2004). Markets, partnerships and sustainable development in solid waste management; raising the questions. *Solid Waste Management and Recycling*, 76(1), 1-18.

Bandara, N., Hettiaratchi, J., Wirasinghe, S., & Pilapiiya, S. (2007). Relation of waste generation and composition to socio-economic factors: a case study. *Environmental Monitoring and Assessment, 135*(1), 31-39.

Central Intelligence Agency (2007).*World Factbook*.Retrieved February 2007, from http://www.odci.gov/us.cia/publications/hsolo/factbook/global/index.html

Central Intelligence Agency (2008). *World Fact book – Nigerian Economy*. Retrieved July 2008, from http://www.odci.gov/us.cia/publications/factbook/ng.ecoy/html

Chukwu, K. E. (2010). Effects of Enugu Urban Environment on the Water Quality of Streams in Nyaba Catchment Area of south Eastern Nigeria. Unpublished Ph.D Thesis. University of Nigeria, Nsukka.

Cointreau, S. and De kadt, M. (1991). Living with Garbage: Cities Learn to Recycle. Development Forum, January-February, 1991.

Cointreau, S. (2001). Declaration of Principles for Sustainable and Integrated Solid Waste Management. Accessed from: http://web.worldbank.org. on 17/06/07.

Cooper, J. (1999). Solid Waste Management in Copenhagen: *The Challenges of Environmental Management in Urban Areas*. Aldershot and Vermont, Ashgate.

Coonan, C. (2007). Sent from Britain: Our Waste, Pollution and a Poisoned Sky. *The Independent*, (2): 1-10.

Davies, A. R. 2008. The Geographies of Garbage Governance: Interventions,Interactions and Outcomes. London, Ashgate

Dutta, P and Bose, S (2008). Corporate environmental on the Internet in Bangladesh:An Exploratory Study. *International Review of Research Papers, Vol. 4, No. 3*, June 2008, pp. 138-150.

Deegan, C. and Rankin, M. (1996). Do Australian Companies Objectively Report Environmental News? An Analysis of Environmental Disclosures by Firms Successfully Prosecuted by the Environmental Protection Agency. *Accounting, Auditing and Accountability Journal* 9 (2) pp.50-67.

DeVilliers, C.J. and Vorster, Q. (1997): *Green Reporting in South Africa*, 3rd edition, University of Pretoria Press, Department of Accounting.

Dowling, J. and Pfeffer, J. (1975). Organizational Legitimacy: Social Values and Organizational Behavior. *The Pacific Sociological Review*. 18 (1) pp.122-136.

Environ Quest (2007). The Quest for the Environmental Justice: Human Right and Politics of Pollution (Ed).

Embretson, S.E., Reise, S.P.,(2000). Item Response Theory for Psychologists. Lawrence Erlbaum Associates, New Jersey.

Ewa, I.O.B., M.O.A. Oladipo and S. Hankouraou, 2004. Determination of metals in Nigerian River sediments using Energy Dispersive X-Ray fluorescence technology. Nigerian J. Phys., 16(2): 49-51.

El-Haggar, S. M. (2007). *Sustainable industrial design and waste management: Cradle-to-cradle for sustainable development* (p. 424). Oxford: Elsevier/Academic Press.

European Environment Agency (EEA), (2011). Waste Opportunities; Past and Future Climate Benefits from Better Municipal Waste Management in Europe, *Annual European Union Greenhouse Gas Inventory 1990–2009 and Inventory Report 2011,* EEA Technical Report No 2/2011, European Environment Agency. Accessed from: (http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2011) on 1 July 2011.

Friso, D.V., Henri, L.F. (2005). The Impact of Industrial Sites on Residential Property Value: A Hedonic pricing Analysis for the Netherland.

First Nations of Quebec and Labrador Sustainable Development Institute. (2008). *Reduce, Reuse, Recycle and Recover Waste: A 4R's guide for the First Nations communities of Quebec and Labrador*. Retrieved from www.iddpnql.ca/an/documents/4rsguide.pdf

Fofana M. (2009). Program Officer Natural Resources Management, Swedish International Development Cooperation (SIDA), Bamako, Personal communication.

Federal Environmental Protection Agency(2007).Guidelines and Standard for Industrial Effluents,Gaseous emission and Harzardous waste Management in nigeria.

Gray, R. H, Owen, D. L. and Adams, C. A. (1996). Accounting and Accountability: Changes and Challenges in Corporate social and environmental reporting. Prentice-Hall, London.

Gay L. R., (1976). Educational Research : Competencies for Analysis and Application. Merrill Publishing Company Ohio.

Gilpin, A. 1996. Dictionary of Environment and Development. Chester and New York, John Wiley and Sons

Guilding, C. and Kirman, C (1998). Environmental Accounting in the New Zealand Contracting Industry *Pacific Accounting Review Vol. 10, No. 1*, pp.27-49.

Godfrey, L. and Scott, D. (2011). Improving waste management through a process of learning:

the South African waste information system. *Waste Management & Research*, 29(5): 501–511.

Godfrey, L., Scott, D., Difford, M., Trois, C., 2012b. Part II – The effect of data on waste behaviour: The South African waste information system. Waste Management 32, 2163- 2176.

Gray, R; Koughy, R. and Lavers, S. (1995). Methodological Themes – Constructing a Research Database of Social and Environmental Reporting by UK Companies. *Accounting, Auditing and Accountability Journal* 8(2) pp.78-101.

Gray, R.H., Owen, D., & Adams, C. (1995), *Accounting and Accountability: Changes and Challenges in Corporate Social and Environmental Reporting*, Prentice Hall, Hemel Hempstead.

Gray, R; Owen, D. and Adams, C. (1996). *Accounting and Accountability- Changes and Challenges in Corporate Social and Environmental Reporting*. Hertfordshire: Prentice Hall Europe.

Gilpin, A. (1996). *Dictionary of Environment and Development*. Chester and New York, John Wiley and Sons.

Gbekor, A. (2003). Domestic Waste Management. *Ghana Environmental Protection Agency (EPA) Newsletter,* 47 (5). Accra: Ghana EPA.

Global Waste Management Market Report (2007) In: Lawal, A.S.D. (2011). Composition and Spatial Distribution Solid Waste Collections' Points in Urban Katsina Northern Nigeria. Unpublished M.Sc Research Proposal, Department of Geography, Bayero University, Kano.

Gurdian, G. and McDonald, L. (2011). Waste and Recycling Technical Report. Nicaragua, Community Innovators Lab. (MIT CoLab) and UNDP Project Document, a draft proposal, Revised RAAS. Pp.12-15.

Girling, R. (2005). *Rubbish! Dirt on Our Hands and Crisis Ahead*. London, Eden Project Books, Transworld Publishers Ltd.

Hill, M. K. (2004). Understanding Environmental Pollution, UK: Cambridge University Press.

Hettige, H., Martin, P., Singh, M., and Wheeler, D. (1994). The Industrial Pollution Projection System (IPPS) policy research working paper, No. 1431, part 1 and 2.

Hore, P.N. (1970). Weather and Climate of Zaria. In: Mortimore, M.J. (ed.) *Zaria and its Region*. Occasional Paper, No. 4, Department of Geography, Ahmadu Bello University, Zaria.

Hardoy, J. E. (1997). Health and Environment and the Urban Poor. In Gurinder, S. B.; Levy, S.; Todd Kjellstrom., (eds.) International Perspectives on Environment, Development and Health: Towards a Sustainable World. New York: Springer Publishing Company Inc.

Hooghiemstra, R. (2000): Corporate Communication and Impression Management New Perspectives why Companies Engage in Corporate Social Reporting. *Journal of Business Ethics*, Vol. 27, pp.55–68

Hardoy, J.E. Mitlin, D. and Satterthwaite, D. (2001). *Environmental Problems in an Urbanizing World, Local Solutions for City Problems in Africa, Asia and Latin America,* London and Stirling: VA. Earthscan Publications.

International Organisation for Standardisation (1997). *ISO 14031: Environmental Management and Environmental Performance Evaluation*: Guidelines(ISO/TC 207/SC4N248; Geneva: ISO)

Iguisi E.O., Butu, A.W. and O.F. Ati (2013). Sources and Levels of Concentration of Metal Pollutants in Kubanni Dam, Zaria, Nigeria. *International Journal of Environment and Earth Science* 2(2). In Press.

Iguisi, E.O., I.I. Funtua and O.O. Obamawe, 2001. A preliminary study of Heavy metals concentration inthe surface water of Kubanni Reserviour Zaria.Nigeria J. Earth Sci., 1(2): 26-34.

International Organisation for Standardization (2002). *ISO 14031: Environmental Performance Evaluation*. Retrieved on 18th July, 2007 from http://www.altech-group.com/ftp/EPEarticle.pdf.

Imam, A. Mohammed, B. Wilson, D.C and Cheeseman, C. R (2007) Solid waste management in Abuja. Doi:10.1016/j.wasman. 2007.01.006.

Ite, U. E. (2004): Multinationals and corporate social responsibility in developing countries: a case study of Nigeria, *Corporate Social Responsibility and Environmental Management*, Vol. 11, No. 1, pp.1-11.

Imam, A. Mohammed, B. Wilson, D.C. and Cheeseman, C.R. (2008). Solid Waste Management in Abuja, Nigeria. *Waste Management*, (1): 468 – 472.

Integrated Regional Information Networks (IRIN) (2007). Ghana Government Declares Recycling War on Plastic Waste. *Humanitarian News and Analysis for Africa, Asia and the Middle East*. UN Office for the Co-ordination of Human Affairs. Accessed from: http://www.irinnews.org/report.aspx?reportid=50772 on 22/07/08.

Iriruaga, E.T. (2012). Solid Waste Management in Nigeria. Lagos, D-Waste Management for Everyone. Pp.1-6. Accessed from: http://www.d-waste.com/new-infographics/item/124-solid-waste-management-in-nigeria/124-solid-waste-management-in-nigeria.html?shov. On 1/5/2013.

Jackson, M. I. (1958). Soil Chemical Analysis. New Jersey: Prentice Hall Inc. Eaglewood Cliffs.

Jackson, G. (1970). Vegetation of Zaria. In: Mortimore, M.J. (ed.) Zaria and its Region. Occasional Paper, No. 4, Department of Geography, Ahmadu Bello University, Zaria.

Jaiyeoba, I. A. (1986). An Analysis of the Relationship between Soil Properties and Soil Forming Factors in the Nigeria Savannah. Unpublished Ph.D Thesis, Department of Geography, Ahmadu Bello University.

Jha, R., Murthy, K. V. B., Pacific, A. N. U. R. S. o., & Division, A. S. E. (2003). *A critique of the Environmental Sustainability Index*: Division of Economics, Research School of Pacific and Asian Studies, Australian National University.

Jessen, M. 2002. Zero Waste Services. Accessed at: http://www.zerowaste.ca/articles.html. 21/06/07

Janis Bernstein (2004). Tool kit on Social Assessment and Public Participation in Municipal SolidWaste Management. Retrieved on 29/09/2010 from http://www.worldbank.org/urban/uswm/socialassesstool.pdf

James R. M. (2010) Waste Reduction Strategies for Improved Management of Household Solid Waste in Jamaica. *International Journal of Environment and Waste Management* Vol.6, No.1 and 2, pp.4-24.

Jessen, M. (2002). Zero Waste Services. Accessed from: http://www.zerowaste.ca/articles.html. On 21/06/07.

Kumah, A.M.(2007). The Situation of Solid Waste in Ghana. Accra, Ghana.

Kreith, F. (1994). Handbook of Solid Waste Management. McGraw Hill, USA.

KPMG (1994): *KPMG International Survey of Environmental Reporting*. London KPMG

Kaseva, M.E. and Gupta, S.K. (1996). Recycling an Environmentally Friendly and Income Generating Activity Towards Sustainable Solid Waste Management. Case Study-Dar es salaam City, Tanzania. *Resources, Conservation and Recycling* (17): 299-309.

Kofoworola, O. F. (2007) Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria. *Waste Management*, **27**(9), pp.1139-1143.

Li, Lin. (2001): Encouraging Environmental Accounting Worldwide: A Survey of Government Policies and Instruments, *Corporate Environmental Strategy, Vol. 8*, pp.1-3.

LaGrega, M., Buckingham, P. and Evans, J. (2001). *Hazardous Waste Management*. 2nd Edition NewYork: McGraw Hill.

Liu, X. Y. (2007) In: Anthony, B. (2009). Urban Environmental Problems in Ghana; A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi-Takoradi: Norway, NTNU.

London Waste Action, (2007). Promoting Sustainable Waste Management in London. Accessed from: http://www.londonwasteaction.org/ on 03/06/08.

Langenhoven, B. and Dyssel, M. (2007). The Recycling Industry and Subsistence Waste Collectors: A Case Study of Mitchell's Plain. *Urban Forum*, 18 (1): 114-132.

Medley, P. (1997). Environmental Accounting: What does it mean to professional accountant? *Accounting, Auditing and Accountability Journal*, *Vol. 10, No.4*, pp.594-600.

Michigan Tech Institute of Materials Processing. January 15, 2003. Industrial & Solid Waste Recycling Technologies. http://www.imp.mtu.edu/sldwaste/sldwaste.html

Musa, I. J. (1993). Journey to Work pattern in Zaria Urban Area. Unpublished M.Sc. Thesis. Ahmadu Bello University, Zaria, Nigeria. Pp. 41-53.

Matete, N. & Trois, C. (2008) Towards Zero Waste in emerging countries - A South African experience. Waste Management, 28(8), pp.1480-1492.

Ministry of Local Government Rural and Urban Development (MLGRUD) (1995). Zimbabwe Urban Solid Waste Management study, Ministry of Local Government Rural and Urban Development.

Mukuka, L and Masiye, G. (2002). Urban Solid Waste Management in Zambia in Conyers D. Matovu and Tevera. (eds) The challenges and New Innovations in Urban Solid Waste Management: Issues and Policy Options. Municipal Development Programme.IDRC.

Majani, B. B. K. (2002). Urban Solid Waste Management in Dar es Salaam, Tanzania in Conyers, D., Matovu, G. and Tevera, (eds) The challenges and New Innovations in Urban Solid Waste Management: Issues and Policy Options. Municipal Development Programme. IDRC.

Manby, B. (2003): Shell in Nigeria. Corporate Social Responsibility in the Ogoni Crisis: Case study for the Carnegie Council and Ethics on International Affairs. Retrieved on December 3, 2007, from http://www-scf.usc.edu/~cstern/Shell%20Nigeria%20Case.pdf

Mueller, A. W. (2005). A Value Chain Analysis of Cardboard Collection in Inner City Durban, South Africa. Durban: School of Development Studies, University of KwaZulu-Natal. Pp . 3-52.

Millennium Assessment Report, (2005). Living Beyond Our Means: Natural Assets and Human Well-being (Statement of the MA Board). Accessed from: http://www.millenniumassessment.org/en/Reports.aspx on 02/11/08.

Muktar, M. (2011). The Economics of Waste Scavenging in Kano State. Department of Economics, Bayero University, Kano- Nigeria. Pp 4-5.

Momodu N.S., and Oladebeye R.O (2010). Mitigating the impact of solid wastes in urban centres in Nigeria. J Hum Ecol. 2011;34:125–133.

Modebe G., and Onyeonoro A. (2008). Examine Household Solid Waste Management in Awka, Anambra State. Anambra State University, Awka-Nigeria.

Mesgaraf H, Sadeghi H., (2013). Examining the Awareness, Attitude, and Performance of People Relative to Urban Solide Wastes Management of the Kermanshah, Proceedings of the Fourth National Conference on Environmental Health, Yazd, Iran,

Nzeadibe, T.C. and Iwuoha, H.C. (2008). Informal Waste Recycling in Lagos, Nigeria. Communications in Waste and Resource Management, 9 (1): 24-30.

Nzeadibe T C (2008). Analysis of waste recycling activies in Nsuka region of south eastern Nigeria. Proceedings of 50th Conference of ANG, Dept, of Geog, University of Calabar, Calabar.

National Environmental Standards and Regulation Enforecment Agency Act.(NESREA) 2007.

National Environmental Standards and Regulation Enforecment Agency Act.(NESREA) 2015.

Nwankwo , O.C., (1999). A Practical Guide To Research Writing. Enugu; FERDINCO.

Nwankwo, N. and Ifeadi, C.N. (1988): *Case Studies of Environmental Impact of Oil Production*, in Sada, P.O. and Odemerho, F. O. (Eds) Environmental Issues and Management in Nigerian Development. Ibadan. Evans Brothers.

Nkwocha.E.E. & Egejuru .R.O. (2004).The effects of industrial air pollution on the respiratory health of children in Nigeria. Nigeria.

Natale, S and Ford, J. (1995): The Social Audit and Ethics, *Journal of Management,* Vol. 9, No. 1, pp. 29-33.

Nzeadibe, T.C. (2009). Solid Waste Reforms and Informal Recycling in Enugu Urban Area, Nigeria. *Habitat International,* 33 (1): 93-99.

Ogu, V. (2000). Stakeholders' partnership approach to infrastructure provision and management in developing world cities: lessons from the Sustainable Ibadan project. *Habitat international, 24*(4), 517-533.

Ogawa,H.(2005).Sustainable Solid Waste Management in2 Developing Countries.(www.gdrc.org.). Accessed on 30th January, 2010.

Osibanjo, O. & Nnorom, I. C. (2009) Material flows of mobile phones and accessories in Nigeria:Environmental implications and sound end-of-life management options. *EnvironmentalImpact Assessment Review*, **28**(2-3), pp.198-213.

Omole, F. K and Alakinde M. K (2013). Managing the unwanted materials: The agony of solid waste management in Ibadan Metropolis, Nigeria. *International Journal of Education and Research Vol. 1 No. 4.*

Olafusi, O.R (2004) Waste Disposal and Management. A case for healthy environment. Unpublished Housing SeminarReport, Department of Architecture, federal University of technology, Akure, Nigeria.

Omuta, G. E. D. (1987). In: United Nations Industrial Development Organization (UNIDO) (2012) Development of Policy and Institutional Framework for Sustainable Integrated Municipal Solid Waste Management (IMSWM) in Nigeria, Federal Republic of Nigeria. Pp. 7-24.

Otten, L. (1997). Integrated Solid Waste Management paper in Cleaner Production and Consumption. Harare, Zimbabwe.

O Osibanjo, A.P.,(2009). The impact of industries on surface water quality of River Ona and River Alaro in Oluyole Industrial Estate, Ibadan, Nigeria - African Journal of Biotechnology,

Okoanegbete J.F. (2009) Appraisal of effect of land acquisition, oil exploration and housing development on escavours Region of delta state. An unpublished Msc Housing dissertation submitted to the department of urban and Regional planning University of Ibadan, Nigeria.

Olatunbosun G.B. (2009) Impacts of West African Portland Cement on the housing environment of Ewekoro. An unpublished Msc Housing dissertation submitted to the department urban and Regional planning, University of Ibadan, Nigeria.

Oketola, A.A., and Osibanjo, O. (2009). Estimating sectoral pollution load in Lagos by Industrial Pollution Projection System (IPPS): Employment versus Output. *Toxicological & Environmental Chemistry*. 91, (5), 799-818.

Puopiel, F. (2010) Solid Waste Management in Ghana: The Case of Tamale Metropolitan Area.A master‟s thesis presented for the department of development policy and planning, Kwame Nkrumah University of Science and Technology. Available at: http://dspace.knust.edu.gh (Accessed date: 10 may 2011)

Patten, D. M. (1992b): Intra-Industry Environmental Disclosures in Response to the Alaskan Oil Spill: A Note on Legitimacy Theory, *Accounting, Organizations and Society* Vol. 17, No. 5, pp.471–475.

Palmer, P. 1998. Definitions of Waste. Accessed at: http://www.interleaves.org/recycling/waste

Perera, K.L.S. (2003). _An Overview of the Issue of Solid Waste Management in Sri Lanka'. *Bunch, M.J., Suresh, V.M. and Kumaran, T.V. (eds). Proceedings of the 3rd. International Conference on Environment and Health.* Chennai, India. 15-17 December, 2003. Chennai Department of Geography, University of Madras and Faculty of Environmental Studies, York University. Pp. 346-352.

Palczynski, R.J. and Scotia, W.N. (2002). Study on Solid Waste Management Options for Africa. Project Report. Final Draft Version. Prepared for African Development Bank Sustainable Development and Poverty Reduction Unit, Abidjan. July 2002. Accessed from: http://www.afdb.org/pls/portal/docs/PAGE/ADB_ADMIN_PG/DOCUMENTS/ENVIRONMENTALANDSOCIALASSESSMENTS/SOLID%20WASTE%20MANAGEMENT% 20STUDY.PDF. On 12/07/08.

Richard, J.P. Wolfville and Nova, S. (2002). Study on Solid Waste Management Options for Africa. Canada: African Development Bank; Sustainable Development and Poverty Reduction Unit.

Ranagnathan J. and Ditz, D. (1996). Environmental Accounting: A Tool for Better Management. *Management Accounting*, Vol. 74, No. 2, pp.38-40.

Stenis J. 'Environmental Optimisation in Fractionating Industrial Wastes Using Contribution Margin Analysis as a Sustainable Development Tool'. *Env, Develop and Sust*. 2005. In press.

Stenis J. 'Environmental Optimisation in Fractionating Industrial Wastes Using Cost-Benefit Analysis'. *Res, Cons and Rec* 2004;41(2):147-164.

SPCB (2003). Hazardous Waste Management – Prerequisite for issuing authorization for waste generator.

Said S. A (2006) Managing and Minimizing Construction Waste in Gaza Strip. Unpublished

M.Sc Thesis, Islamic University of Gaza

Salau, A. T. (1992): "Global Environmental Change: A Research Agenda for Africa. *CODESRIA Working Paper 2;* 49 pp.

Sokomba, O. (1980). In: Lawal, A.S.D. (2011) Composition and Spatial Distribution Solid Waste Collections' Points in Urban Katsina Northern Nigeria. Unpublished M.Sc. Research Proposal. Bayero University, Kano, Nigeria.

Sharama, B. K. (2005) *Solid, Toxic and Hazardous waste. Environmental chemistry*. India Goal Publishing.

Sada, P.O.and Demerho, F.O (1998): Environmental Management and Development: Introduction of the main issues in Sada, P.O.and Odemerho, F. O (Eds) Environmental Issues and Management in Nigerian Development. *Ibadan. Evans Brothers*

Sanyanga, R. and Masundire, H. (1999). Waste Management in the Zambezi Valley: Case Studies from Botswana, Zambia and Zimbabwe in Yap, N.T.P. (1999) (eds) Cleaner Production and Consumption in Eastern and Southern Africa; Challenges and Opportunities. University of Guelph, Canada: Weaver Press Series.

Schubeller, P. Wehrle, K. and Christen, J. (1996). Urban Management and Infrastructure. Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries. Working Paper No. 9. UNDP/UNCHS (Habitat/World Bank/SDC Collaborative Programme on Municipal Solid Waste Management in Low-Income Countries. St, Gallen, SKAT.

Skinner, C. (2002). Understanding Formal and Informal Economy Labour Market Dynamics: A Conceptual and Statistical Review with Reference to South Africa, CSDS Research Report No 50. Durban: University of Natal.

Tchobanoglous, G., Theisen, H. and Eliason, R. (1977). Solid Wastes: Engineering Principles and Management issues. McGraw-Hill Publishing Company, USA.

Tchobanoglous, G., Theisen, H. and Vigil, S. (1993). Integrated Solid Waste: Engineering principles and management issues. McGraw-Hill Publishing company, USA.

Tsiboe, I.A. and Marbell, E.(2004). A Look at Urban Waste Disposal Problems in Accra. - Roskilde University, Denmark.

Townend WK, Cheeseman CR. (2005). Guidelines for the evaluation and assessment of the sustainable use of resources and of wastes management at healthcare facilities. Waste Manage. Res., 23: 398-408.

Thorp, M. B. (1970). Landforms of Zaria. In: Mortimore, M.J. (ed.) Zaria and its Region. Occasional Paper, No. 4, Department of Geography, Ahmadu Bello University, Zaria.

Tchobanoglous, G., Theisen, H., Vigil, S. (1993). Integrated Solid Waste Management: Engineering Principles and Waste Management Issue. Boston: Irwin McGraw-Hill.

Tevera, D. Conyers, D. and Matovu, D. (2002). Solid Waste Management Practices in Eastern and Southern Africa: The Challenges and New Innovations in Urban Solid Waste Management: *Issues and Policy Options Case Studies in Tanzania, Zambia, Zimbabwe*. Canada: International Development Research Centre.

Urquhart, A. W. (1976). Planned Urban Landscape of Northern Nigeria. Ahmadu Bello University Press, Zaria.

United Nations Environmental Programme (UNEP) (2009). Developing Integrated Solid Waste Management Plan Training Manual, Volume 2: Assessment of Current WasteManagement Systems and Gaps Therein. Osaka/Shiga, Japan.

Ukoje, J.E. (2011). Analysis of the Determinants of Participation of Stakeholders in Solid Waste Management in Zaria, Nigeria. Unpublished Ph.D. Thesis. Urban and Regional Planning, Ahmadu Bello University, Zaria, Nigeria. Pp. 4-22.

United States Environmental Protection Agency (USEPA) (1999). State and Local Solutions to Solid Waste Management Problems. (http://www.epa.gov). Accessed on 18th July,200969

USPS (2000). Solid Waste Management Plan for Thimphu City, Bhutan, Draft version, April 2000 .Bhutan: Urban Sector Programme Support Secretariat.

UNEP. (2005). Integrated waste management scoreboard: A tool to measure performance in municipal solid waste management *United Nations Environment Programme*: United Nations.

UNDS (2005). Municipal solid waste generation, recycling and disposal in the United States: Facts and figures for 2003. United Nations Department of Statistics, Washington, D.C., USA.

United States Environmental Protection Agency (1995): *An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms*, EPA 742-R-95 001 June).

Udiba UU, Ogabiela EE, C Hammuel, Ade-Ajayi AF, Odey MO, YusufU, Abdullahi M, Gauje B (2012). Assessment Of Some Environmental Pollutants In Soil, Dareta Village, Zamfara, Nigeria,J. Trends in Advanced Sci. Eng.TASE 5(1) pp 27 – 37

United States Environmental Protection Agency (1995).*An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms*, EPA 742-R-95 001 June

United Nations Environmental Programme (UNEP) (2009). Developing Integrated Solid Waste Management Plan Training Manual, Volume 2: Assessment of Current Waste Management Systems and Gaps Therein. Osaka/Shiga, Japan.

United Nations Environmental Programme (UNEP) (1996). International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management, International Technology Centre and Harvard Institute for International Development. Osaka, IETC Technical Publications Series, Issue 6.

United Nations Centre for Human Settlement (UNCHS) (2001). The State of the World's Cities 2001 Habitat. Nairobi, United Nations Centre for Human Settlement.

United Nations Industrial Development Organization (UNIDO) (2012). Development of Policy and Institutional Framework for Sustainable Integrated Municipal Solid Waste Management (IMSWM) in Nigeria, Federal Republic of Nigeria. Pp. 7-24.

Vahidi, H., F. Ghazban, M.A. Abduli, A. Banaee and V. Dehghani Kazemi, (2012). Fuzzy analytical hierarchy process disposal method selection for an industrial state; case study Charmshahr, The Arabian Journal for Science and Engineering, Accepted.

Wright, J.B. and McCurry, P. (1970). Geology of Zaria. In: Mortimore, M.J. (ed.) *Zaria and its Region*. Occasional Paper, No. 4, Department of Geography, Ahmadu Bello University, Zaria.

World Bank (1995) "Defining an Environmental Development Strategy for the Nigeria Delta", Vols I & II.

World Bank (1995) Nigeria: "Strategic Options for Redressing Industrial Pollution", Vols I & II.

William, P. C. (2005). Waste management. A Global Concern. New York McGraw-Hill Publisher. Pp 3-44

Wilson, D.C. Velis, C. and Cheeseman, C. (2006). Role of Informal Sector in Recycling in Waste Management in Developing Countries. London: Habitat International, 30 (4): 797-808.

World Commission on Environment and Development (WCED), (1987). Our Common Future (The Brundtland Report) – Report of the 1987 World Commission on Environment and Development. Oxford, Oxford University Press.

Wehrmeyer, W., and Tyteca, D. (1998): Measuring Environmental Performance for Industry: From Legitimacy to Sustainability? *The International Journal of Sustainable Development and World Ecology,* Vol. 5, pp.111-124

Worgu, S.O. (2000): Hydrocarbon Exploitation, Environmental Degradation and poverty in the Niger Delta Region of Nigeria, *Presented in Lund University LUMES Program.*

Zerbock, O. (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations. (www.cee.mtu.edu). Accessed on 18th July,2009.

APENDICES

Appendix I

HOUSEHOOD QUESTIONNAIRE:

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT
FACULTY OF SCIENCE, AHMADU BELLO UNIVERSITY ZARIA.

Dear Respondent,

The researcher is student of the above named university conducting a research on **solid waste management in Zaria Industrial Estate, Nigeria.** Please, your sincere responses to these questions are required. Information supplied will be used strictly for academic purpose. Your assistance and cooperation is highly appreciated.

PLEASE INDICATE YOUR ANSWERS TO THE FOLLOWING QUESTIONS BY PLACING A TICK IN THE APPROPRIATE BOXES.

Section A. BACKGROUND INFORMATION

Location code…….

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

1. Age group (a) 18-27 yrs ( ) (b) 28-37 yrs ( ) (c) 38-47 yrs ( ) (d) 48-57 yrs ( ) (e) 58yrs -67 ( ) (f) 68yrs & Above ( )

2. Sex (a) Male ( ) (b) Female ( )

3. Marital status (a) Single ( ) (b) Married ( ) (c) Widowed ( )

4. Highest educational qualification? (a) None ( ) (b) Quranic ( ) (c) Primary ( ) (d) Secondary ( ) (e) Tertiary ( ) (f) Others (specify) …….

5. Occupation (a) Civil Service ( ) (b) Trading ( ) (c) Artisan ( ) (d) Others (specify)_____

6. How long have you been living in this area? (a) 0-2 yrs (b) 3-5 yrs (c) 6-9 yrs (d) 10 yrs and Above

SECTION B: EFFECT OF INDUSTRIAL WASTE

7. What type of industries are close to your residence (a) Olam Nig Limited ( ) (b)Sunseed Nig. Limited ( ) (c)Premier Seed ( ) (d)Nelmaco Limited ( )

8. What are the type of wastes generated by the industries?(a) Cotton waste( )(b) Ash waste ( )

(c) Organic waste ( ) (d) Smoke ( ) (e) Liquid water ( ) (g) other ( ) Specify_____

_____

9. What are the effects of the wastes generated? (a) it causes flood ( ) (b) it reduces

Environmental Aesthetics ( ) (c) it brings about outbreak of disease ( ) (d) make water

unfit for drinking (e) affect land fertility for agricultural purpose ( ) (f) pollute atmospheric

air ( ) (g) Others ( ) Specify_____

_____

10. What are the activities adopted in your residents to mitigate the negative effect of the waste generated by the industries? (a) Change of occupation ( ) (b) Migration out of community ( ) (c) Others ( ) Specify_____

11. What are the health related problem due to waste disposal (a) Discharge of industrial liquid which lead bad smell (b) Noise disturbance (c) Dust and Smoke (d) Causes diseases

12. What are the efforts industries take to reduce the effects of the waste they produce?_____

_____

THANK YOU FOR YOUR RESPONSE

Appendix II

INDUSTRIAL QUESTIONNAIRE:

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT FACULTY OF SCIENCE, AHMADU BELLO UNIVERSITY ZARIA.

Dear Respondent,

The researcher is student of the above named university conducting a research on **solid waste management in Zaria Industrial Estate, Nigeria.** Please, your sincere responses to these questions are required. Information supplied will be used strictly for academic purpose. Your assistance and cooperation is highly appreciated.

PLEASE INDICATE YOUR ANSWERS TO THE FOLLOWING QUESTIONS BY PLACING A TICK IN THE APPROPRIATE BOXES.

Section A. BACKGROUND INFORMATION

Name of company_____

Position of Respondent_____

SECTION B: INDUSTRIAL WASTE GENERATED **TYPE OF WASTE**

1. What are the types of waste generated in your industries? (Please make a list)_____

_____

_____

_____

SECTION C: INDUSTRIAL WASTE MANAGEMENT STRATEGIES

2. What methods do you use in managing the waste generated in your Industries?

i. Reduction ( )
ii. Reuse ( )
iii. Recycling ( )
iv. Recovery ( )
v. Reporting ( )

3. Why do you prefer this/these strategies_____?

_____

_____

4. Do you reduce waste at the point of production? Yes( ) No( )

5. If Yes, How do you carry it out?_____

_____

6. If No, why_____

7. Is there any item waste re-use? Yes ( ) No ( )

8. If Yes, what item(s) of waste is/are re-used?_____

9. If No, why_____

10. Is there any form of waste recycling in your industries? Yes ( ) No ( )

11. If Yes, what item of waste is/are recycled? _____

12. If No, specify_____

13. Do you carry out waste recovery in your Industries Yes ( ) No ( )

14. What are the waste materials you carry out waste recovery on_____

_____

15. If No, specify_____

16. What medium do you use in reporting the effect of the waste (a) leaflet/Handbills ( ) (b) Internet (c) Radiobroadcast (d) TV announcement (e) Community sensitization

17. Do you think waste reporting is an effective method to management waste? No/Yes

18. Give reasons_____

19. How do you dispose your waste in this industry? (a) Incineration ( ) (b) Burying ( )

(c) Shredding ( ) (d) Dumping in drainages ( ) (e) Landfill ( ) (f) Dump in water bodies ( )

(g) Open dump ( ) (h) Others ( ) Specify_____

20. How is waste transported? (a) open vehicles ( ) (b) Enclosed compaction vehicles ( ) (c) Trolley ( ) (d) Wheeled vehicles( ) (e) Trucks ( ) (f) Channels pipe ( ) Others( )
Specify_____

Appendix III

SECTION C: WASTE MANAGEMENT GUIDELINE

What is the extent of your compliance to the industrial waste management guideline						
S/N	Item	SA	A	UD	D	SD
21	Have environmental information releases in a specific report					
22	Possesses an implemented Environmental Management Compliance requirement.					
23	Have Environmental impact statement(EIS)					
24	Carry out Environmental audit been implemented in part of its operations (EAR)					
25	Environmental management plan is carried out (EMP)					
26	Possess an emergency respond plan and equipment to combat hazardous industrial waste					
27	The collection, transport and final disposal of waste is the responsibility/liability of our industries generating the waste. And in case of spill shall be liable for clean up, remediation, restoration and where necessary, compensation to all affected parties.					
28	Possesses an environmental seal					
29	Hazardous Waste Management					
30	Carried out recycling Programs					
31	Develops friendly ecological products					
32	Efficient use/reuse of water					
33	Efficient use/reuse of energy					
34	Noise exposure limitations					
35	Set Programs to mitigate/recover degraded/impacted areas					
36	Promotes education/training to disseminate environmental Consciousness					
37	Possesses a greenhouse gas emission reduction process					
38	Observe effluent limitations					
39	Possesses a foundation/institution to develop environmental Projects					
40	Records of all discharges (solid, air and liquid), treatment and disposal must be remitted to the nearest FEPA office on a monthly basis.					
41	Have visual identity of the company (website design) is geared toward the environment					

42	Ensure workers safety within the limits of the provisions by the National Policy on Environment from exposures to hazardous waste.					
43	Any accidental discharge must be reported to the nearest FEPA office and nearest community within twenty-four (24) hours of the release.					
44	Ensures general aesthetic and good sanitary conditions of factories and the environment.					

Source: Adapted from NESREA, 2007.

Appendix IV

INTERVIEW QUESTIONS TO HEAD OF WASTE MANAGEMENT DEPARTMENT

1. What are the types of waste generated by your industry?

2. What are the strategies your industry used to manage their wastes?

3. How do you carry out these strategies?

4. Why do you prefer this strategy to others?

5. What measure do you take in controlling the effects of the waste within the environment and residents?

Appendix V

PLATES

Plate I: Firewood Scales Waste Combined with Dust Produce from Sunseed
Source: Field Survey, 2016

Plate II: Impurities Waste from Premier Seed

Source: Field Survey, 2016.

Plate III: Trash Waste at Olam Nigeria Limited at Dambo Ward

Plate IV: Heaps of Boiling Ash within Sunseed Industry Premises

Source: Field Survey, 2016.

Plate V: Chemical Water Seeping of a Chemical Processing Room at Premier Seed

Plate VI: Dry Spent Earth Dump on Open Land Close to Sakaru Community Jos road
Source: Field Survey, 2016

Plate VII: Packaging Material Dumped Close to Liquid Sludge in Sakaru
Source: Field Survey, 2016.

Plate VIII: Open Dump for both Premier Seed Industries
Source: Field Survey, 2016

Plate IX: Industrial Chimney Emitting Gaseous Waste into the Environment
Source: Field Survey, 2016