

Waste management handling in Benin City

Peter Oseghale

Degree Thesis
Industrial Management
2011

Förnamn Efternamn

DEGREE THESIS	
Arcada	
Degree Programme:	Industrial Management
Identification number:	6329
Author:	Peter Oseghale
Title:	Waste management handling in Benin City
Supervisor (Arcada):	Mariann Holmbelg
Commissioned by:	
<p>The researcher was inspired by the topic “Waste management handling” due to the ugly situation of waste being littered all over the city, which have defaced Benin City and it’s environ, leading to drain block, serving as a breeding places for mosquitoes etc.</p> <p>Waste is unavoidable component of human existence. If properly managed and disposed poses no hazard to human existence. However, unmanaged waste, left to litter and decay particularly in inhabited location spells serious dangers to human health.</p> <p>The aim of this study is to improve the situation of indiscriminate waste disposal method in Benin city, efficiently managing waste and creating awareness of the dangers associated with waste. The author interviewed thirty (30) people to extract information on how they handle waste generated from their homes.</p> <p>The finding reveals that the government and various agencies responsible for handling the waste issues are lagging in their responsibilities, thereby leaving the citizens to handling their waste which subsequently leads to improper methods of disposal i.e. open burning which leads to air pollution.</p>	
Keywords:	waste, recycling, ecological footprint, plastics,
Number of pages:	60
Language:	English
Date of acceptance:	

Contents

1	INTRODUCTION	8
1.1	OBJECTIVE OF THE STUDY	10
1.2	PURPOSE OF THE STUDY	10
1.3	HYPOTHESIS.....	10
2	WASTE MANAGEMENT IN RELATION TO ECOLOGICAL FOOTPRINT	11
2.1	Ecological Footprint.	11
2.2	EFFECTS OF ECOLOGICAL FOOTPRINT	16
2.3	Poor Air Quality.....	16
2.4	Increase in Greenhouse Gas Emissions	16
2.5	Depletion of Water Sources.....	16
2.6	CARBON FOOTPRINT.....	17
2.7	WAYS TO REDUCE OUR FOOTPRINT	18
3	GEOGRAPHICAL AND ECONOMIC ASPECTS OF NIGERIA	19
3.1	ECONOMIC	19
3.2	CLIMATE	21
3.3	ENVIRONMENTAL ISSUES	22
3.4	LEGAL ISSUES	22
4	Benin CITY HISTORICAL DEVELOPMENT	24
4.1	Population.....	24
4.2	ECONOMY – AGRICULTURE	25
4.3	ECONOMY INDUSTRIES	25
4.4	TRANSPORTATION.....	26
4.5	Industrial and Commercial Opportunities in Edo State.....	27
5	WASTE MANAGEMENT IN BENIN CITY	28
5.1	PROBLEMS.....	29
6	QUANTITY OF PLASTIC WASTE REFLECTION IN BENIN CITY	36
6.1	Polyethylene terephthalate	39
6.2	PE Plastics.....	41
6.3	Polypropylene (PP).....	42
6.4	Polystyrene (PS) Plastics	43
7	Plastic Recycling	44
7.1	THE RECYCLING PROCESS.....	45
8	Types of recycling processing.	47

8.1	Recycling setback.....	47
9	Conclusion and recommendation	53
10	References.....	58

List of Figures

Figure 1 Biologically productive land and water.....	12
Figure 2 interconnection between, biodiversity, ecosystem health and provision of ecosystem services.....	13
Figure 3 ecological overshoot.....	15
Figure 4 Typical sources of waste plastic in Benin.	34
Figure 5 composition of plastics in benin	35
Figure 6 Map of Africa	50
Figure 7 Map of Nigeria.	51
Figure 8 Map of Edo State	52
Figure 9 waste bin.....	55
Figure 10 waste truck.....	56
Figure 11 unapproved dumpsite.....	57

ACKNOWLEDGEMENTS

I am heartily thankful to my supervisor, Mariann Holmberg, whose encouragement, guidance and support from the onset to the final stage of this thesis. I would like to thank Badal Durbo, Henry Ericsson for their valuable assistance during the entire study period in Arcada.

I owe my deepest gratitude to God, Oseghale Family for their support towards making my dream a reality. And not leaving out my lovely son Dennis Okhiafoh Oseghale.

1 INTRODUCTION

Waste handling means the collection, transportation, storage, transportation, treatment, utilization, processing the final disposal of wastes into more useful materials. Proper waste handling means preventing breeding or harborage of flies and mosquitoes, rodents or other disease carrying vectors; preventing air and water pollution, conserving and protecting resources, preventing health and physical hazards associated with the handling of solid waste.

Effective waste management handling would lead to encouraging the following practices in descending order of priority,

Waste reduction

Waste recycling

Energy recovery or incineration and

Land filling

The researcher thought about this waste handling topic visit to Benin City, the situation was needing an urgent attention due to its devastating condition; the city was clogged with waste materials, as plastic materials was on dominances.

The unstable power supply in most Nigerian cities is as old as man, due to high temperature ranging between 28⁰C to 33⁰C people tend to consume more chilled drinks, water, beverages etc which are usually made from plastics, in both homes and public places, government buildings. After consuming these products the waste ends up in the street, creating problems of drain block, breeding places for mosquitoes, attracting flies and other disease carrying vectors that are dangerous to human.

The author is optimistic that waste recycling will create a better atmosphere for inhabitant, create job to the people and to mention a few. Additionally, by educating the people about the negative impact of waste will help ease waste problems, for instance people do burn their wastes at home, unaware of waste compatibility, different types of waste often includes hazardous waste.

Waste is undeniably, un-avoidable component of human existence. If properly managed and disposed poses no hazard to human existence. However, waste unmanaged, left to litter and decay especially in inhabited locations spells serious dangers not to only to health but to socio-economic well-being as well. The improper domestic waste management has gradually evolved into what appears to continuous crisis to the nation. However, with recent developments in managing waste and reduction techniques, there is an increased awareness of the need, not only proper disposal but also to conserve energy and material resources by passing selected waste products through industrial process. One such process, which has proven to be successful so far, is recycling. This paper therefore recommends waste recycling to the various authorities responsible with waste management in Benin, for effective waste control as well as for the health, economic and environmental benefits to the community.

1.1 OBJECTIVE OF THE STUDY

- a) To contribute to the existing literature on waste management.
- b) To manage wastes efficiently.
- c) To make the City dirt free or reduce to minimal.

1.2 PURPOSE OF THE STUDY

The researcher is interested in finding out how best to manage the waste being generated in Benin City. Additionally, in partial fulfillment of my Bachelor's degree Programme.

1.3 HYPOTHESIS

- That, proper waste management will generate revenue to the Government and to interested persons.
- That, it will create job opportunities.
- That, it will reduce health related issues i.e. malaria

2 WASTE MANAGEMENT IN RELATION TO ECOLOGICAL FOOTPRINT

Waste is directly related to the consumption of food and other materials that are dumped or discarded into the environment. Ecological footprint makes a relationship between these factors- the amount of land needed to dispose per capital of waste generated.

The most popular method of waste disposal in Nigerian cities is burning, which usually contains hazardous waste which release pollutants into the air.

Solid waste usually ends up in the landfill and when such wastes are not discarded properly they are washed away by rain (producing contaminated fluid called leachate), thereby making its way into the water sources which are now contaminated making it unsafe for consumption and dangerous for the aquatic animals. These negative impacts of improper waste management mentioned contributes to the ecological footprint in Benin City.

2.1 Ecological Footprint.

The concept was introduced by Mathis Wackernagel and William Rees at the University of British Columbia in Canada, the Ecological Footprint is now widely used by scientists, government, businesses, institutions and agencies to monitor ecological use and advance sustainable development.

Ecological footprint is the measure of human demand on the earth ecosystem. In other words, it is the area of the earth's surface needed to sustain the level of resources a person uses and the waste the person creates. It is a measure of the productive land and water required to a person alive. By dividing the usable land of the earth by the total population, it is found that there are 1.89 Hectares per person. Although there is suppose to be 1.89 hectares per person, there are some countries where there are drastic ecological overshoot, e.g. Canada has an average of 7.25 hectares per person.

Currently, the world is living in an ecological deficit, meaning that our demand for nature resources exceeds the supply of the earth capacity. To sustain our resource consumption rate at its present day level we would need more than one planet! There has

been ecological overshoot since mid 80s with annual demand on resources exceeding what the earth can regenerate each year. It now takes the earth one year and eight months to regenerate what we use in a year.

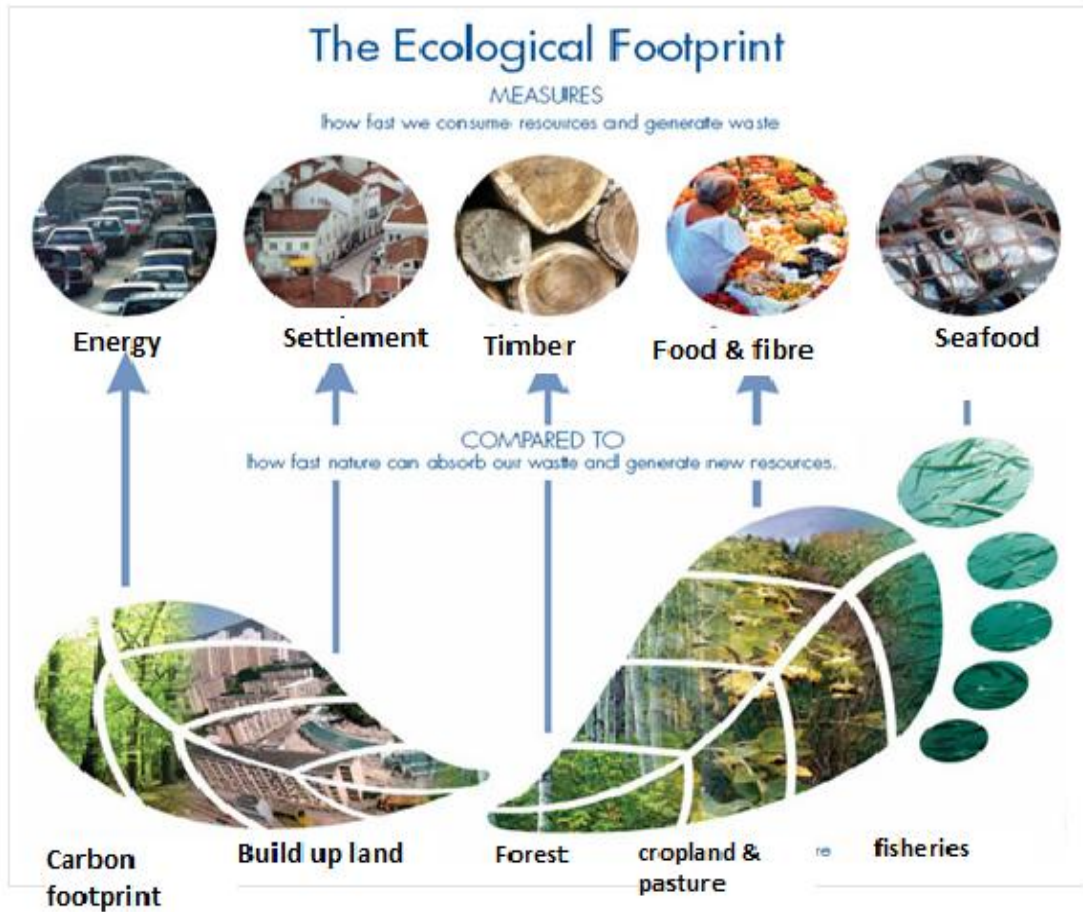


Fig 1 Biologically productive land and water, it reveals what nature provides for human consumption.

Biocapacity: Is the capacity of an area to provide resources and absorb the waste. When the area's ecological footprint exceeds its bio-capacity, un-sustainability occurs. This is divided into six main land types:

Energy Land: The area of forest that would be required to absorb the CO2 emissions resulting from that individual's energy consumption.

Crop Land: The area of cropland required to produce the crops that the individual consumes.

Pasture Land: The area of grazing land required to produce the necessary animal products.

Forest Land: The area of forest required to produce the wood and paper.

Sea Space: The area of sea required to produce the marine fish and seafood.

Built Area: The area of land required to accommodate housing and infrastructure.

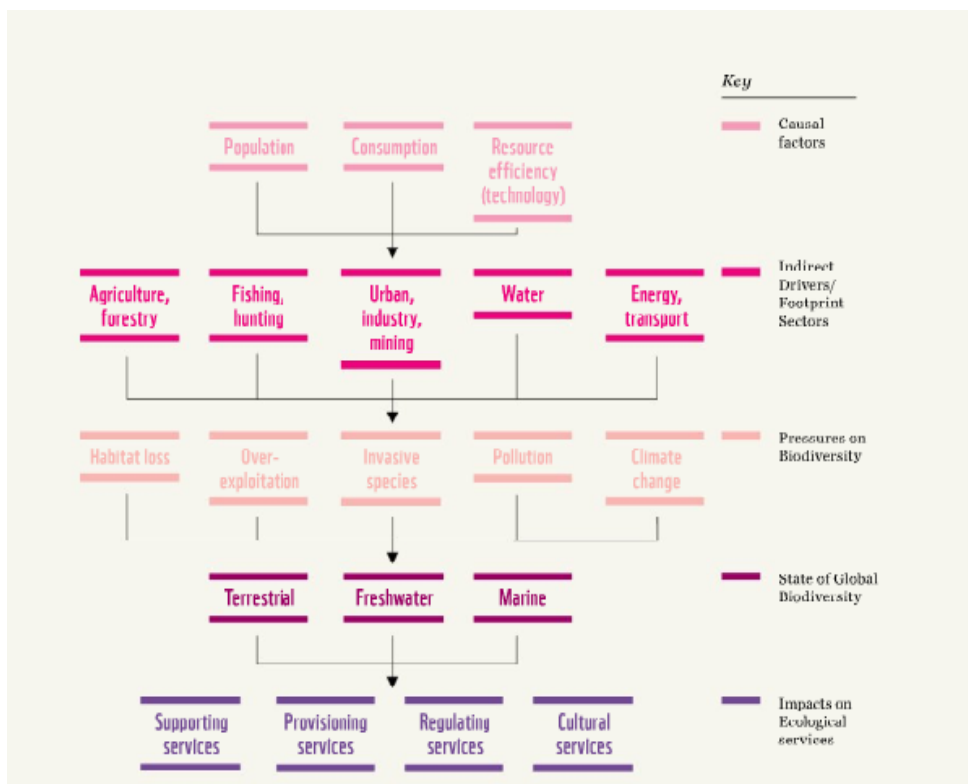


Figure 2 interconnection between, biodiversity, ecosystem health and provision of ecosystem services.

Source (WWF living planet report 2010)

Humanity depends heavily on ecosystem services- but can also put pressure on the biodiversity that support these services. The five greatest direct pressure are:

Habitat loss, alteration and fragmentation: mainly through conversion of land for agricultural, aquaculture, industrial or urban use; damming and other changes to river system irrigation and hydropower.

Over-exploitation of wild species and population: harvesting of animals and plants for food, materials or medicines at a rate above the reproductive capacity.

Pollution: mainly from excessive pesticide use in agriculture and aquaculture; urban and industrial effluents; mining waste; and excessive fertilizer use in agriculture.

Climate change: due to rising levels of greenhouse gases in the atmosphere caused mainly by burning of fossil fuel, forest clearing and industrial processes.

Invasive species: introduced deliberately or inadvertently to one part to another: they then become competitors; predators or parasites of native species.

In large part, these threats stem from human demand for food, drink, energy and materials, as well as the need for space for cities, towns and infrastructures. These demands are largely met by a few key sectors: agriculture, forestry, fisheries, mining, industries, water and energy. In total, these sectors form the indirect drivers of biodiversity loss. The scale of their impact on biodiversity depends on three factors: the total numbers of population or consumer, the amount each person consumes, the efficiency with which natural resource are converted into goods and services. Biodiversity loss can cause ecosystem become stressed or degraded, and even eventually to collapse. (WWF living planet report 2010,pg 12)

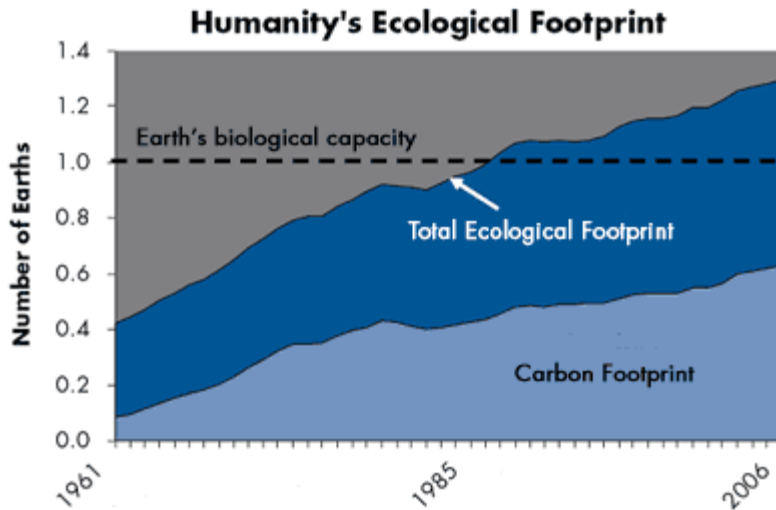


Fig3 ecological overshoot

The above figure shows ecological overshoot already in the 80's. World average is about 1.89 Global hectares per person. The Earth has about 12 billion hectares of bio-productive land – that's about 2 hectares per capital on Earth. However, the amount of bio-productive land needed to produce what is consumed by an average American citizen every year is about 10 hectares.

In other words, if everyone in the world had the same lifestyle as an average American, the world's population would need 5 planets-worth of bio-productive land in order to feed, clothe and shelter everyone.

	UK	Germany	Netherlands	Finland	Indian	Nigeria
Planets needed per/person	5.6	4.4	4.4	6.8	0.7	1.2

2.2 EFFECTS OF ECOLOGICAL FOOTPRINT

The effects of ecological footprints are already obvious, poor air quality, increase in the greenhouse gas emission, depletion of water sources are some examples explained below.

2.3 Poor Air Quality

Pollution and deforestation of trees and plant life have a negative impact on the earth's air quality. Industrial plants, boating equipments and vehicles all emit gases into air that are harmful for both the environment and humans. Air quality also suffers due to human expansion.

2.4 Increase in Greenhouse Gas Emissions

Greenhouse gases are gases emitted into the atmosphere either naturally or through human activities. The fragile balance of natural greenhouses gases plays a factor in the overall climate on Earth. The three common types of greenhouse gases released into the environment by human activities are Methane when oil, natural gas and coal are produced and also from decaying landfill waste.

2.5 Depletion of Water Sources

Despite the Earth being practically covered by water, very little of it is usable. Our global footprint threatens the water resources humanity can use. Pollution of streams and rivers can ruin the entire water resources. Major oil spills and industrial runoff can render a water source unsuitable for human consumption.

As humanity expands, more water sources are needed to hydrate the population and to provide watering for livestock and agricultural lands to feed the increased population.

2.6 CARBON FOOTPRINT

The atmosphere is collectively polluted in order to advance our individual or national wealth. But the picture differs when we see the carbon emission problems as part of an overall resources crunch.

A carbon footprint is a measure of the total greenhouse gas emissions caused by human activities either direct or indirectly.

Carbon footprint makes about 50% of Ecological footprint and others, access to fresh-water resources, food security, forest resources, biodiversity, oil are all under threat; the carbon footprint is the sum of all emissions of CO₂, which are induced by our activities in a given period- usually calculated over a year. The best ways is to calculate the carbon dioxide emissions based on the fuel consumption.

A Carbon footprint is a powerful tool which enables us to understand the impact of our personal behavior on global warming .A great deal of people are surprised when they see the amount of CO₂ their activities create. It is very essential to contribute towards stopping global warming.

2.7 WAYS TO REDUCE OUR FOOTPRINT

Switch Off Appliances. Switching off unused appliances instead of switching to standby can save your electricity bills and help reduce your footprint.

Boiling water. Only fill the kettle with the amount of water you require.

Use a Clothes Line For Drying. Instead of using a tumble dryer – use fair weather days to hang clothes outside – or even dry them near to an indoor heating source such as your radiators.

Shower. If you have showers try to reduce the length of time spent in the shower. You could also change to a less powerful showerhead in order to reduce the amount of water being used.

Turn Thermostat Down. Turning your thermostat down by 1 degree could reduce your energy bills and CO2 emissions by up to 10%.

Driving. Try using foot power for those short trips. Not only are you doing your bit to reduce emissions, you're saving money and keeping fit all at the same time.

Washing Machines. These days most washing machines have a 30 degree option. With new washing liquids able to perform well at lower temperatures there is no need to use hot washes any more. Make sure the washing machine is full – avoiding putting it on just for one or two items. In fact, on odd occasions it may be better to wash by hand instead.

Light Bulbs. Every time you change a light bulb make sure you buy an energy saving one.

Try To Reduce Waste. Think before buying, most of our footprint is down to the things we buy. Our homes are cluttered with items we use probably once. The average drill is used just 15 minutes in its lifetime. Rather than buying something, consider whether you could hire or borrow instead. Buy foods and other consumables that don't use excessive packaging. Try to reuse items as much as possible –Recycle everything you can.

3 GEOGRAPHICAL AND ECONOMIC ASPECTS OF NIGERIA

“Nigeria, the most populous nation in Africa, is situated on the gulf of Guinea in west Africa. Having its boundaries with Niger, Benin, Chad and Cameroon. The lower course of the Niger River flows through the western part of the country into the gulf of Guinea. Swamp and mangrove forests boarder the southern coast; inland are hardwood forests.

The country lies between longitude 10 degrees North and Latitude 8 degrees east within the equator and the tropic of cancer. A former British colony (1900-1960), it was formed by the amalgamation of tribal units which the British government has established trade relations with an attempt to create an administrative structure to formalize their activities through a national government. Following the achievement of a political structure for Africa in the 1950s, the country got independence and was allowed self governance in 1960. The country is endowed with natural resources amongst which are natural gas, petroleum, iron, limestone, clay, chalk, marble, niobium, zinc, arable land etc.

With an estimated population of about 150 million, Nigeria is the largest country in Africa as it has about 15 percent of the total population in the continent with 36 States and 774 Local government areas. The country covers an area of 923.768 sq. km. (356,700 sq. miles).Lagos is the largest city with an estimated 10 million inhabitants according to the United Nations which is highly contested by the state government which claims the estimation was based on the last population census figures which was rejected by the state on the grounds that the figures were underestimated.

3.1 ECONOMIC

Nigeria is the world's eighth largest oil producer and has the seventh largest reserves of natural gas. As a major oil exporter, Nigeria and the West African Gulf region are expected to supply a fourth of oil needs in the United States by the end of this decade. As

noted by the Financial Times (2006), "the region's oil fields have become an important battle ground of influence between China, India, and the US as they struggle to ensure the motor of their future economic growth does not run out of fuel." While major Western oil companies have historically dominated oil investment in the country, Asian oil companies are beginning to make inroads. Recently, China bought a 45 percent stake in one of Nigeria's oil fields for \$2.3 billion. (2) Nigeria has provided priority rights on several oil blocks for state-owned Asian oil companies in exchange for infrastructure investment in power plants, refineries, and railways. However, concerns have been raised about the transparency of such large oil deals.

In the past four years, the pace of economic liberalization and financial sector reforms in Nigeria has accelerated. With the liberalization of the telecom sector, the country has one of the fastest growing cellular telecommunication sectors in the world; and financial sector reforms have increased bank capitalization ten-fold in two years. While Nigeria successfully concluded a debt forgiveness agreement with the Paris Club, the country has also been rated by leading credit rating agencies. In 2005, the International Monetary Fund (IMF) also approved a two-year Policy Support Instrument (PSI) for Nigeria under the IMF's newly created PSI framework, which is intended to support the nation's economic reform efforts (IMF, 2005). The satisfactory review of the benchmarks for the PSI has paved the way for the clearance of the debt to the Paris Club in April 2006 (IMF, 2006a).

Yet, in spite of these positive developments, key challenges lie ahead for Nigeria. As a nascent and fledgling democracy, it occupies a strategic position in Africa and the key to stability in the region. Violence in the oil-rich Niger Delta has affected oil production and exports. Despite oil wealth, Nigeria ranks among the twenty-five poorest countries in the world in terms of social indicators. Investments in social, human and physical infrastructure are also crucial to sustained long-term development.

This paper provides a perspective on Nigeria's global economic position. It provides a comparative analysis of Nigeria's economic standing with other emerging economies.

While Nigeria is often referred to as the giant of Africa, the country's competitiveness can be bench-marked against large countries on the continent and large emerging economies outside Africa. The paper examines the country's linkages to the global economy through trade, labor, and capital. The paper also outlines the challenges to development in the areas of governance, human development, and infrastructure.”

3.2 CLIMATE

Although Nigeria lies wholly within the tropical zone, there are wide climatic variations in different regions of the country. Near the coast, the seasons are not sharply defined. Temperatures rarely exceed 32° C (90° F), but humidity is very high and nights are hot. Inland, there are two distinct seasons: a wet season from April to October, with generally lower temperatures, and a dry season from November to March, with midday temperatures that surpass 38° C (100° F) but relatively cool nights, dropping as low as 12° C (54° F). On the Jos Plateau, temperatures are more moderate.

The terrain ranges from southern coastal swamps to tropical forests, open woodlands, grasslands, and semi-desert in the far north. The highest regions are the Jos Plateau 1,200-2,400 meters above sea level and the mountains along the border with Cameroon.

Average rainfall along the coast varies from about 180 cm (70 in) in the west to about 430 cm (170 in) in certain parts of the east. Inland, it decreases to around 130 cm (50 in) over most of central Nigeria and only 50 cm (20 in) in the extreme north.

Two principal wind currents affect Nigeria. The harmattan, from the northeast, is hot and dry and carries a reddish dust from the desert; it causes high temperatures during the day and cool nights. The southwest wind brings cloudy and rainy weather. The common natural hazard in the country are droughts in the north as a result of its proximity to the Sahara desert and flooding in the south as the country is bounded by the Atlantic ocean.

3.3 ENVIRONMENTAL ISSUES

The country loses an estimated 5 billion dollars annually to poor environmental management practices with most of the damages caused by oil and gas extraction in the Niger Delta region which is located in the southern part of the country with the unwholesome practices of the multinational companies due to the high level of corruption and negligence of their corporate social responsibilities. Gas flares and oil spillages are common features in these areas affecting the flora and fauna and the livelihood of the regional people who are predominantly farmers and fishermen.

The country faces environmental issues like soil degradation, rapid deforestation urban air and water pollution, desertification and oil pollution due the oil extraction and processing activities that result in spillages due to the unwholesome practices of the companies in the oil industry neglecting their corporate social responsibilities.

Grievances over environmental management have contributed to years of instability in the oil-rich Niger Delta region of Nigeria, Africa's biggest oil producer. Figures from the World Bank suggest that \$3 billion of the losses arose from land degradation while deforestation accounts for \$2 billion a year. Crisis management as a result of the effect of these activities has caused loss of lives and huge financial cost to the government and people of the region.

3.4 LEGAL ISSUES

The first major attempt at creating a national law on environmental protection and waste management was the establishment of the Federal Environmental Protection Agency (FEPA). It was established in 1998 by a Decree promulgated by the then military administration for the protection and development of the environment in general and environmental technology, including initiation of policy in relation to environmental research

and technology. The agency was staffed with an array of industrial experts to manage its affairs and was mandated to:

- Advise the Federal Military Government on national environmental policies and priorities and on scientific and technological activities affecting the environment;
- Prepare periodic master plans for the development of environmental science and technology and advise the Federal Government on the financial requirements for the implementation of such plans;
- Promote co-operation in environmental science and technology with similar bodies in other countries and with international bodies connected with the protection of the environment;
- Co-operate with Federal and State Ministries, Local Government Councils, statutory bodies and research agencies on matters and facilities relating to environmental protection; and
- To carry out such other activities as are necessary or expedient for the full discharge of the functions of the Agency under this Act. (FEPA Act 1988 No. 58.)

The decree was amended by the military government in 1992 but despite all the support from the government, the agency stills lags in the enforcement of its objectives and meeting the set goals. The agency has been unable to address the major problems of environmental management and evolve as a way of adjusting to the changing trends and lifestyles of the people. These shortcomings have led to the lack of respect for environmental laws with impunity.

4 BENIN CITY HISTORICAL DEVELOPMENT

Benin City is the capital of Edo state, with a population estimate of 1,147,188. The city is one of the ancient cities of the world known for its craftsmanship. In fact, when the British invaded the old Benin kingdom in 1897, a key reason was the artifacts of Ivory, bronze and iron. The State was formed in 1991 out of the former Bendel State. It occupies a land area of about 17,802 square kilometers making it the 22nd largest in the country.

Edo State is one of the more homogenous states in Nigeria. The cultural and linguistic affinities that exist among the various groups in the state points to this fact. A lot of the communities in the State trace their roots to the ancient kingdom of Benin. Customs, burial rites, diet and traditional modes of dress tend to be similar throughout the State. The political pattern and behavior were based on a system under which both monarchial and republican ideas flourished in an integrated manner. The monarchial (or chieftaincy) system revolved largely on primogeniture, while the republican element was reflected in the free selection by villages and communities of elders.

4.1 Population

Edo state has a population of 4 million people (census 2006 projection). With an annual growth rate of 2.8% while according to the USAID reports, in 2002, Edo State was estimated to have a population of 2.86 million (In 1991, 2.1million, of which 50.13% were males) making it similar in size to Jamaica (2.74m), and larger than Botswana (1.6m) and Trinidad and Tobago (1.1m). The adolescents and young adults (10-24 years of age), account for 32% of the population, making Edo State one of the States in Nigeria with a very high concentration of young people. The State is multi religious and multi ethnic with Christianity, Islam and African Traditional religion as the most dominant.

4.2 ECONOMY – AGRICULTURE

The main crops are rubber, oil palm, cocoa, yam, cassava, maize, rice and plantain. Sugar cane, cashew, oil palm (and its derivative products), groundnuts, soya beans, tomatoes, cotton and tobacco are also produced. Fruit like pineapples, coconuts, oranges, avocados, as well as green leafy vegetables, all grow abundantly in the State. There is also a significant animal husbandry industry, with cows, goats, pigs, rabbits and sheep being the main products. Edo State's riverine areas are prime areas for aquaculture projects. Such major research bodies as the Nigerian Institute for Oil Palm Research (NIFOR) are located in the State, and there is a strong agricultural extension programme. Principal industrial raw materials for agro-allied businesses are rubber, timber, maize and cassava. The main soil types in the State are reddish-yellow kind of ferral-sols, dish clay, lathyrictic clay, and fine hydromorphic soils.

4.3 ECONOMY INDUSTRIES

Edo State is blessed with such industrial mineral resources as quartzite, marble, clay, limestone, chalk, gypsum, gold, petroleum, kaolin and lignite. Benin City is the site for numerous industrial outfits: soft drinks factories, two large breweries (including one of the largest breweries for Guinness Stout outside of Dublin, Ireland), wood and timber processing industries, textile mills, carpet manufacturers, floor tile producers, animal feeds industries, printing and publishing firms, pharmaceutical firms, and so on. A State-owned cement company is located at Okpella (Etsako Local Government Area [LGA]), close to substantial limestone deposits.

4.4 TRANSPORTATION

Benin City, as the State capital, is a major centre of traffic. Routes to Warri and Sapele (both in Delta State; they are major seaports and oil towns); to the eastern cities of Onitsha, Enugu, Calabar and Port Harcourt; and to the western cities of Ibadan, Abeokuta and the former political capital of Lagos, are especially well-travelled. A major federal trunk road runs east-to-west through Benin City, connecting Lagos and the western states, and incorporating the Benin-Shagamu Expressway. The A2 north-south route through Kaduna, Abuja, Lokoja, Auchi, Benin City and Warri, is also well-used. Buses and taxis of the operate on many routes in the main connecting service for all parts of the State. Intra-town services are also provided by the Edo Municipal Transport Service, as well as by the many private transportation companies in Benin City. Benin City has an airport that is serviced by Nigerian Airways, ADC Airlines, EAS Airlines, Arik air, Kabo Air, Aero contractor etc.

4.5 Industrial and Commercial Opportunities in Edo State

Edo State is richly blessed with agro-based and solid mineral resources that could be utilized by potential interested investors. In consideration with the availability of these resources, a number of projects could be set up to manage them. There are existing private and government-owned manufacturing and processing industries in the State, such as Nifor, Edo pharmaceutical, Bendel brewery, bendel cement company, Nigerian bottling Company, Okomu oil, the Bendel feed and Flour mills. Nevertheless, situation of the industrial and commercial activities in the State is fairly low still. In this regard, assistance would be needed from foreign investors in the following areas:

- Petrochemicals
- Fertilizers
- Development of Gele-Gele port
- Cement production
- Ceramics
- Sugar, rubber, timber and fruit juice processing.

5 WASTE MANAGEMENT IN BENIN CITY

The term waste management is the collection, recycling or disposal, processing, transporting and monitoring of waste materials. The term often relates to materials produced by human activities. Waste management is important in order to:

- Reduce the environmental impact of dumping waste, and
- As a means of recovering resources and reducing the production of waste.

The term involves solid, liquid, gaseous or radioactive substances, with a different approach and field of expertise for each.

Waste describes any material lacking direct value to the producer and so must be disposed. The process of generating waste material is known as the waste stream and includes the entire variety of refuse created during domestic, industrial, construction and commercial processes. Depending on the industrial base, litter is likely to vary from country to country. In highly developed countries, (HDCs) the major components of industrial wastes are blast furnace, steel slag and power station ash. Food manufacture and horticulture also contribute to high volumes of industrial waste.

Organic waste from household food remnants and other biodegradable materials are common features in the waste produced by the city inhabitants and these can be personally controlled by discipline and self control but in the absence of feasible control measures, their effect on our planet will be inestimable with developing countries at the worst risk.

The inadequate facilities for the supply of pipe borne water and lack of regular electricity supply creates a huge business potential for the potable water industry which provide employment opportunities for a large number of the citizenry who vend their products across streets, shops and highways and enjoys the patronage of customers.

The water is packaged in polythene bags and plastic bottles which litter the streets and dumps due to the lack of proper enforcement of the laws prohibiting the indiscriminate dumping of refuse and this results in a situation whereby the drainage and water channels are clogged as a result of these activities thereby creating a serious problem of erosion within the city and its environs.

Nigerian cities has been defaced by the mountainous heaps of solid waste which contains industrial contaminants which leaks into the rivers and streams without treatment. This problems had motivated the Federal Government to promulgate Decree 58 for the establishment of Federal Government Protection Agency (FEPA) on the 30 December 1988 (Federal Military Government 1988). Environmental national policy was introduced with its goals

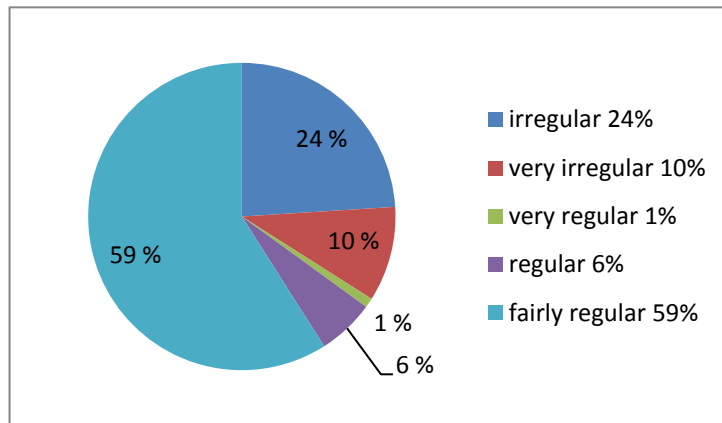
- To raise public awareness and promote understanding of the essential linkage between the environment and development.
- To secure for all Nigerians a quality of environment adequate for their health and well being.
- Additionally, to encourage communities and individual participation in environment protection and improvement efforts.(Agunwamba, J:C 1988. Industrial management)

5.1 PROBLEMS

Despite the establishment of FEPA and a national environmental policy, the environment has not been adequately protected. Interest mainly on aesthetics which is rarely achieved.

Individuals forms the habits of dumping wastes from homes in the yard either at the front or behind the house, where its eventually gets burnt openly, thereby producing unpleasant smell/smoke in the neighborhood.

Waste collection is not regular and carried out in some cities, thereby leaving the public health to jeopardy. Improper sited open dumps have defaced several cities, encouraging spread of odors and disease, uncontrolled recycling of contaminated goods, and pollution of water sources (Adegoke 1989, Singh and others 1995)



Note: “very irregular” = non-collection of refuse for up to a month or months;

“irregular” = non-collection of refuse for several weeks;

“fairly regular” = weekly collection of refuse;

“regular” = every other day collection of refuse;

“very regular” = daily refuse collection.

SOURCE: Ogu, V (1996), Housing and Environmental Services in Benin City, Nigeria, unpublished PhD thesis, University of Cambridge, Cambridge.

There are three active waste dump sites in Edo state, Iguomo, Ikhueniro and Otofure which were aimed in accommodating the waste being generated in the state but due the indiscriminate dumping of waste, even around the refuse dump site instead of the designated area, which eventually encroached into main road, unapproved dump sites, in water ways drainage system, or in open sites which adversely affects environmental friendliness. In fact, solid waste poses various threats to the general public health and adversely affects flora and fauna as well as the environment especially when it is not appropriately collected and disposed (Geraldu, 1995)

However, even when approved waste dump sites are used there are no guarantees that waste is appropriately disposed due to continuous expansion of the site. Thus, the adjacent areas including motor ways, forest plantation, farmlands etc, are encroached upon which has a negative impact on biodiversity conservation (hardy and seatterwaite,1992).

Besides the above mentioned effects of solid waste, they also result in emission of toxic chemical to the atmosphere and to the soil whenever they are degraded or burnt. The

trees absorb these toxins via their roots system which eventually retards their growth rate and consistently results to death (Addison et al, 1991)

The researcher conducted interviews in five residences with an average of six persons per household in Benin City, which makes a total of 30 people. Below were the questions and responses:

Q: what do you understand about waste management?

R: It refers to how waste is taken care of.

Person	1st	2nd	3rd	4th	5th	6th
Age	60-70	50-60	40-51	30-21	20-10	10-6
Responses	100%	100%	100%	100%	100%	0%

90% of respondents knew what waste management was, those who did not were young, and it was because schools don't teach about waste management related course. And this ought to be introduced so that even the kids could have an idea about waste management.

Q: What is waste? And what kind does your household normally generate?

R: Things normally not useful anymore, broken plastics cups chairs, clothes, waste from the kitchen etc.

Person	1st	2nd	3rd	4th	5th	6th
Age	60-70	50-60	40-51	30-21	20-10	10-6
Responses	100%	100%	100%	100%	100%	100%

The above reveals that all the people knew what waste was and also they generate similar waste types from their homes.

Q: What happens to this waste which you get from your home?

R: It goes to dustbin where we set them on fire.

Responses	burning	burning	burning	burning	burning	burning
-----------	---------	---------	---------	---------	---------	---------

Here was a bit of problem as everyone grew up with the habit of openly setting ablaze waste materials from homes with no knowledge of waste compatibility, there has been cases of clashes as a result of complains that the offensive smokes caused from this burning.

Q: How about when you are travelling, in the bus or something what happens to your wastes from say food items?

R: I normally throw them away through the glass (leaving our highways littered with rubbish).

Responses	100%	100%	100%	100%	100%	100%
-----------	------	------	------	------	------	------

The above respondents agrees to have thrown their waste from the window, this is because there is garbage collection point in most transport lines.

Q: Do you know you can turn waste into money?

R: NO, how? Please tell us!

Responses	0%	0%	100%	0%	0%	0%
Response	How	How	How	How	How	How

Here only 10% knew that waste can turned into something useful and others though waste ends as waste which should end being burnt.

Conclusively, the people of the State are literate about waste management, but the government failed by not living up to their responsibility of waste removal. This problem has led individuals to handle their wastes by merely setting it ablaze which subsequently endangers human lives.

Table 1: Dimension of waste dump site and encroached areas (m²)

Location	Depth (m)	Designated area	Encroach area	Encroach %
Iguomo	5	16,500	21,700	60.7
Ikhueniro	4	44,398	8190	22,90
Otofure	16	25,871.64	5846.78	16.4
Total	25	86,769.64	35,736.78	100

Benin City with a population estimate of about 1,147,188 (2006 census projection), the city generates about 573594kg of waste daily. The generation per capital is estimated to be around 0.5kg/person/day.

i.e. 0.5kg/person x 1,147,188 people = 573594kg/day

15% plastics of 573594kg = 86,039kg of plastics/day

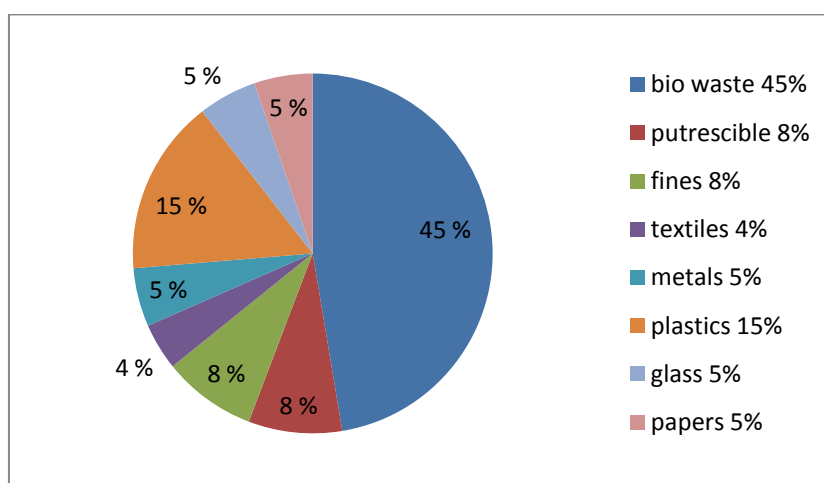


Figure 4 Typical sources of waste in Benin.

Plastics chairs and tables- This form of waste plastics are usually produced from occasions, funerals, weddings, birthday parties and to mention few. Made from polypropylene.

Overhead water tanks- 1500-3000 Liters water storage tank, this tank is strong and durable with high levels of UV protection. Made from medium density polyethylene. But due to poor quality of materials used in suspending this tank, it's normally breaks down over time and tank gets broken.

Gallons- These gallons (20-100 liters) are used for conveying liquids contents, oil, kerosene, water etc.

PETS- This forms a large fraction of the plastics waste streams, main sources are from restaurants, hotels, party venues, etc. used as bottled water, and other beverages.

Sachets water- These forms the largest fractions of the waste streams, usually referred to as pure water, which are actually not pure, because anybody can produce it. While average sized bottled water costs 60 naira, sachet water cost just 10 naira. As the price difference suggests, great number of people prefers to go for the cheaper product.

PIE CHART SHOWING COMPOSITION OF PLASTICS IN BENIN

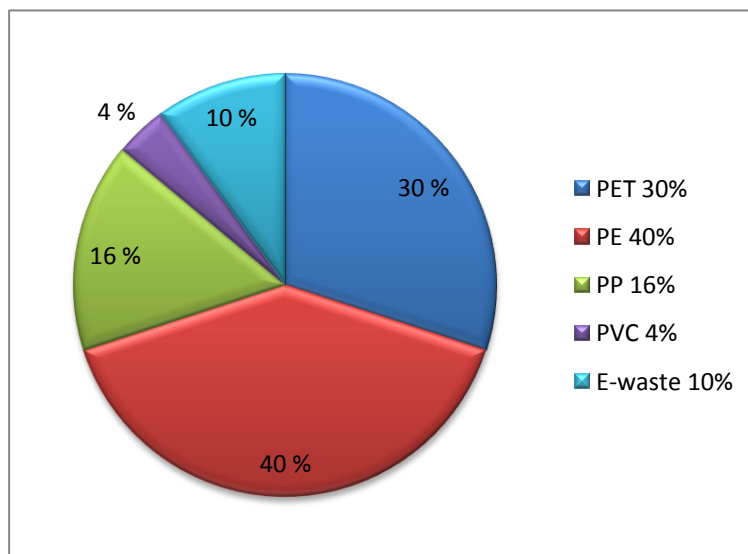









Fig 5 Composition of plastic in Benin

6 QUANTITY OF PLASTIC WASTE REFLECTION IN BENIN CITY

Benin City generates 573594kg of waste daily and 15% are accounted for as plastic waste. Converting this number amounts to 86039kg of plastics which are normally sourced from Hotels, restaurants, ceremonial venues etc. Bottled water, beverages are typical examples of products made from polyethylene terephthalate (Pet) which litters the streets of Benin and it's environ.

Humans have a way of telling the types of plastic in many products, particularly packaging and food containers. Many, but not all, such plastic products have the number code (the resin identification code) often molded or imprinted on the container usually at the bottom.

This coding system was introduced in 1988 by the U.S based Society of plastics manufacturers, but has become relatively standard on certain plastic products sold globally. The primary intention is to allow efficient separation of different plastics types for recycling. The seven plastic resin codes are briefly described below with the view of revealing the name of resin or base material of the plastic.

Recycling number image	Abbreviation	Polymer name	Uses
	PET or PETE	polyethylene	soft drinks, water, juice containers
	HDPE	high density polyethylene	Garbage bags, shampoo bottles, water and juice containers.
	PVC	polyvinyl chloride	Shower curtains, nonfood packages, toys, pipes.
	LDPE	low density polyethylene	Squeezable bottles, bread and frozen food bags.
	PP	polypropylene	Ketchup bottles, medicine and syrup bottles, straws, baby bottles.
	PS	polystyrene	eggs cartons, cd cases, disposable cups, take away food containers
	OTHERS(excludes all other six codes)		contain polycarbonates used in sport water bottles, cell phones, computers etc.

Plastics are organic material having or possessing the capability to flow into desired shape when heat and pressure are applied to it and able to retain the shape after been cooled.

There are basically two types of Plastics, thermoplastics and thermosetting polymers. Thermoplastics are the types that are repeatedly softened and remolded by applying heat and pressure examples of such are polyvinyl chloride PVC, polystyrene PS, polyethylene PET or PETE etc , while thermosetting are the types which cannot be resoftened after being subjected to heat and pressure, epoxy, polyester polyurethane are few examples of thermosets.

Plastics can be categorized by use in different group as:

Commodity- Makes about 85% of daily plastics, they have wide range of applications, having relatively low cost, low physical properties. They are used for consumer product which require low cost, disposability, package or containers related, low stress and low temperature resistance. Examples are polyethylene (PET), polyvinyl chloride (PVC), and polypropylene (PP), polystyrene (PS).

Other plastics 15% accounts for engineering and technical plastics.

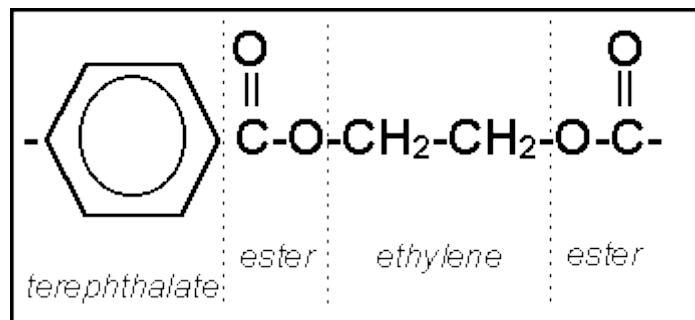
Engineering- It is generally accepted that engineering plastics are materials that have high heat resistance above 100 degrees Celsius. They are used in applications needing high performance in the areas of heat resistance, chemical resistance, fire retardancy or mechanical strength. Polycarbonate (PC) , Nylon (polyamide) , PA6/66 are few examples.

Technical- the high technology plastics have realized only 1% of the market share 22 years after the forecast. This is because the prices of high technology plastics remain quite high. While commodity plastics dominate the market share.

6.1 Polyethylene terephthalate

PET (also referred as PETE) is a type of polyester material for fiber, injection molded parts, also blow-molded jars and bottles. Special grades are available with needed properties for different uses.

PET has a long-chain molecule consisting of repeating units, they are usually supplied by the resin manufacturers in the form of small pellets of about 0.05g. PET has a recycle code as #1 normally imprinted on the bottom of plastics bottles.



General Properties of PET

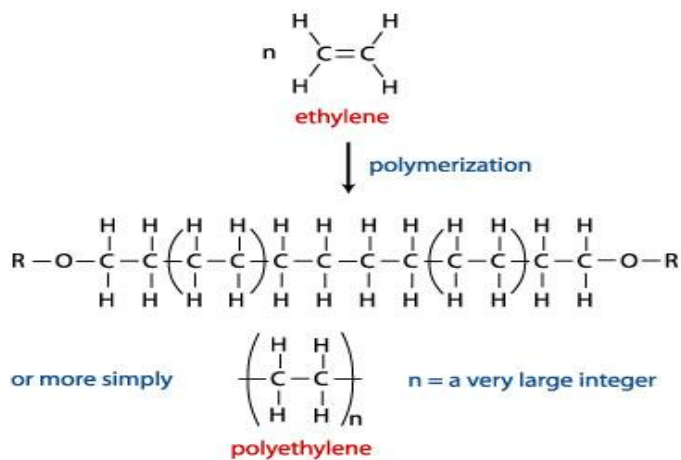
- PET is a hard, cheap, inexpensive
- Stiff, strong, dimensionally stable.
- Absorbs very little water.
- It has good gas barrier properties and good chemical resistance except to alkalis (which hydrolyze it)
- It can be highly transparent and colorless but thicker sections are usually opaque and off-white.

Merits of PET

- Good Resistance- Offers the best chemical performance of any mainstream polymer in package today.
- Recyclable- Excellent environmental profile due to single material, PET is made from the same three elements carbon, oxygen and hydrogen. Used PET bottles can be washed, granulated into flakes and reshaped as PET bottles.
- Design Flexibility- Suitable for containers of all shapes, designs, sizes and colors.
- No leakage- A total closure integrity is possible because of the injection molded neck finish. The absence of a weld lines in the base means that PET bottles can't leak.
- Purity- Products taste good. PET complies with international food contact regulations.
- Good barrier- Due to the low permeability of PET to oxygen, carbon dioxide and water means it protects and maintains the integrity of product giving a good shelf life.
- Crystal clear- product looks good, pure and healthy. Sparkling PET bottles attract attention. Brilliant glass-clear presentation of your products.
- The low permeability of PET to oxygen, carbon dioxide and water means that it protects and maintains the integrity of products giving a good shelf life.

6.2 PE Plastics

Polyethylene Plastic sometimes known as “polythene” was discovered in early 30’s by Eric Fawcett and Reginald Gibson in (ICI) Imperial Chemical Industries, this material metamorphosed in two forms, low density polyethylene LDPE and high density polyethylene HDPE with 4 and 2 recycling code symbols respectively.



2.1 General Properties Of PE

- ✓ Toughness , heat resistance
- ✓ Excellent chemical resistance
- ✓ Low coefficient of friction
- ✓ Easy to process
- ✓ Excellent electrical insulating properties.

6.3 Polypropylene (PP)

Polypropylene is a plastic polymer which was discovered in 1954. It is used in many different settings, both in industry and in consumer goods. It can be used both as a structural plastic and as a fiber.

This polyolefin is readily formed by polymerizing propylene with suitable Catalysts, generally titanium tetrachloride and aluminum alkyl. Due to extensive research, five main variations of polypropylene emerged as: homopolymers, impact (block) copolymers, random copolymers, rubber modified blends and speciality copolymers.

Applications

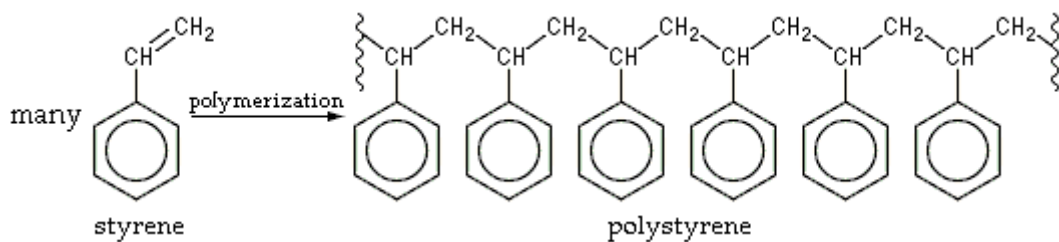
- Automobile Applications
- Film
- Household goods
- Containers
- Appliances
- Packaging
- Electrical/Electronic applications
- Automobile interior parts.

Properties

- Homopolymer
- Good Processability
- Food Contact Acceptable
- High Stiffness
- Good Impact Resistance
- Copolymer.

6.4 Polystyrene (PS) Plastics

Polystyrene is an aromatic polymer that was first discovered by Edward Simon in 1839 in Berlin, it is produced from the aromatic monomer styrene, which is a liquid hydrocarbon that is commercially manufactured from petroleum by the chemical industry. Polystyrene is one of the most widely used types of plastics.



Polystyrene has a recycling symbol code number "6" and takes long to biodegrade and often excess in the form of pollution in the atmosphere, particularly the ocean and shores. Solid form is used for example, CD, DVD cases, computer housing, and smoke detector housing and disposable cutlery.

Properties of Polystyrene:

They are generally flexible, comes in form of moldable solids. Has a density 1.05 g/cm³, young's modulus 3000-3600MPa, a melting point of 240 °C
And tensile strength 46-60 MPa.

7 PLASTIC RECYCLING

Plastics pose serious environmental problems. Although they are naturally not dangerous, they consume large area of space in landfills and they are made from a non renewable resources, namely fossil fuels. Due to these reasons it extremely important that recycling should be done where possible.

Recycling is the third of the 3R's of the waste hierarchy **Reduce, Reuse, and Recycle**. It involves processing used materials into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to virgin production.

Benefits of Recycling

Reduce cost of managing new products – Economic Benefits Creation of Employment

Reduces depletion of natural resources – It Increase the life span of the Landfill Site

Reduces water pollution, air pollution and the green house gas emission that is responsible for global warming.

7.1 THE RECYCLING PROCESS

Step 1- Plastic collection

Plastics for recycling are mainly of two sources: post consumer plastics and post industrial plastics. As the name implies, post consumer plastics are those already used up by people and disposed. Post industrial plastics are the types rejected from industries due to defects (offcuts, damaged batches etc) these plastics are either collected directly from the industries or by local councils, squashed into bales and sold to a recycler.

Step 2 - Manual Sorting

In theory, every type of plastic can be recycled. The resin coding system help ease the sorting, similar color of product could also be used in sorting. The critics of the manual sorting are that it is not reliable and too expensive.

Step 3 – Chipping

Each sorted stream of plastic is then sent separately to a chipper. This is a cylinder of blades that cut the plastic materials into tiny pieces.

Step 4 - Washing

The chips are then washed to remove glue, paper labels, dirt and any remnants of the product they once contained.

Step 5 - Pelleting

This is done by melting the chips and extruding them out first through a fine grill to remove any solid dirt or metal particles that have made it through the treatment thus far

and then through a die of small holes. If the plastic was simply allowed to extrude from these holes it would come out as spaghetti-like strings and quickly tangle together. However, it is sprayed with water as it comes out (to prevent the plastic from sticking together) and cut off by rotating knives to give small, oval pellets.

Turning plastic waste to wealth: Plastics contribute to the increasing volume of solid waste in Benin. In 2004, plastics amounted to about 15 % of the total waste generated in Benin. In the plastic waste streams, polyethylene and polypropylene form the largest fractions, followed by Polyethylene terephthalate (PET) which are presently not being processed. Lesser amounts of a variety of other plastics are also found in the plastic waste streams.

In Benin, recycling of plastics involves mechanical recycling processes whereby plastics are shredded to smaller particles and are converted to pellets. These pellets are sold to other recycling companies in Lagos, Oyo and Anambra States for further processing. Increasingly, it is becoming difficult for the Project to meet high market demands for Pellets.

The most known recycled plastics families are thermoplastics. These materials have the capabilities to melt and flow when heat is applied and solidifies when cooled. If they are heated at high temperatures they melt and recapture the ability to flow, these properties makes them suitable for their reuse or recycling.

In order to making recycling of plastics a success, a few factors are necessary

- Large quantity of used plastics
- Collection point
- Sorting and Separation (imprinted resin code helps in this case)
- Reprocessing, this includes melting process and subsequently making out new products.

8 TYPES OF RECYCLING PROCESSING.

There are four types of recycling processes that usually occur: primary, secondary, tertiary and quaternary recycling.

Primary recycling- is the recycling of materials and products containing alike features of the original products.

Secondary recycling- this allows higher mixture of combination levels in plastics, when this process is used it yields products such as fencepost and any products that can be used in the substitution of wood, concrete and metals.

Tertiary recycling- this process involves the production of basic chemicals and fuels from plastics, this is reoccurring owing to the fact the need to adapt to the high levels of waste contamination.

Quaternary recycling- This process uses the energy from burning. The process is the most common and widely used in recycling, the main reason why this is widely used is due to its high heat content of most plastics; incinerator used goes up to 1000 degrees.

8.1 Recycling setback

A common problem with recycling plastic is that plastics are often made up of more than one kind of polymer or additives to give added strength which often makes recovery difficult.

Sources of waste plastics

Industrial waste (or primary waste) can often be obtained from large plastics processing, manufacturing and packaging industries. Rejected or waste material usually has merit of recycling as this will be clean, thus the amount of material available is sometimes small.

Commercial waste is often available from workshops, craftsmen, supermarkets and wholesalers. A lot of these plastics available from these sources are mainly PE, often contaminated.

Agricultural wastes are mainly from farms and nursery gardens which are usually in the form of packaging (plastics containers or sheets) or construction materials.'

Municipal waste can be collected from residential areas (domestic or household waste), parks, streets, party site, collection depots and waste dumps. In Nigerian cities this type of waste is common.

Identification of different types of plastics

There are several simple tests for distinguishing between the common types of polymer so to ease separation process.

Water test- after adding a few drops of liquid detergent to water put in a small piece of plastic and observe if it floats.

Burning test- Hold out a piece of plastic in a tweezers or on the back of a knife and apply a flame, does the plastic burn? What color, if it burn?

Fingernail test- Can a sample of plastic be scratched with a fingernail?

Test	PE	PP	PS	PVC
Water	Floats	Floats	Sinks	Sinks
Burning	Blue flame, with yellow tip	Yellow flame	Yellow, sooty flame	Yellow, burning stops if flame is removed.
Smell after burning	Like candle wax	Like candle wax, less strong	Sweet	Hcl acid
Scratch	Yes	No	No	No



Figure 6 Map of Africa

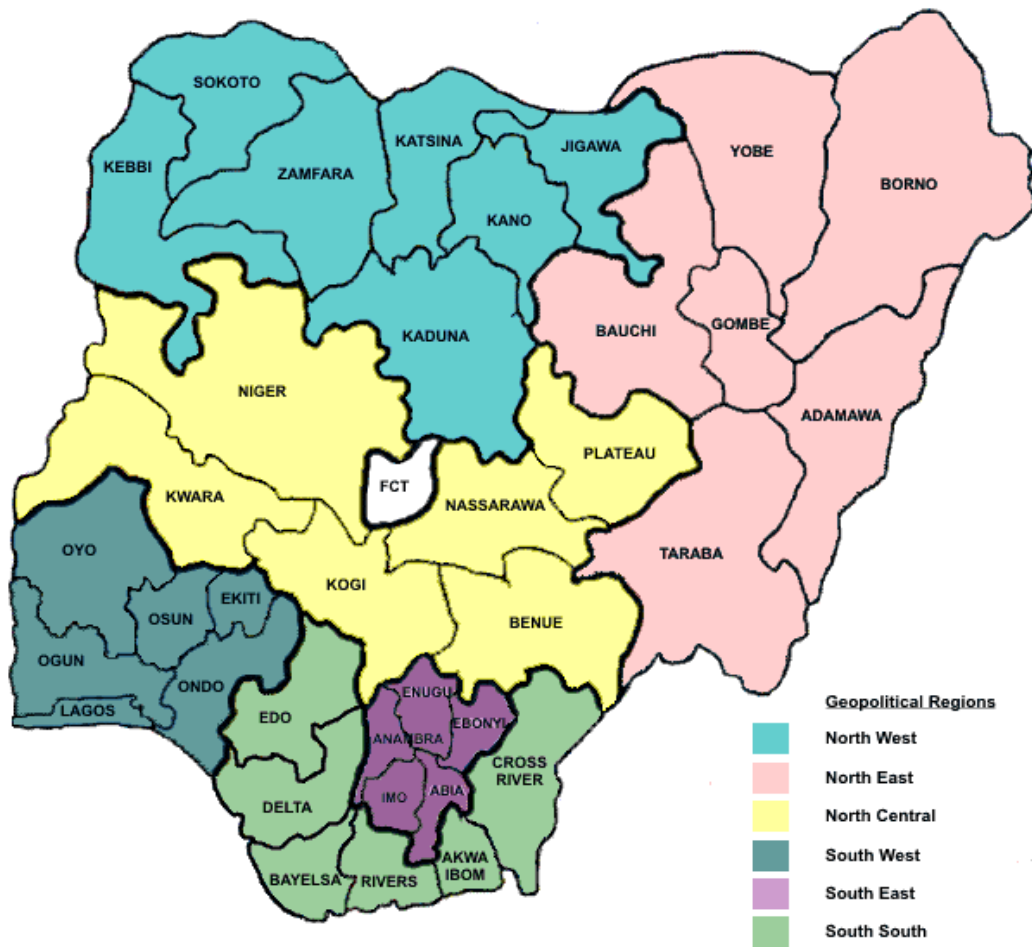


Figure 7 Map of Nigeria.

This is a map of Nigeria, a country in Africa, showing the provincial divide, town, cities and capitals located within the province. This map shows some of the major cities in Nigeria.

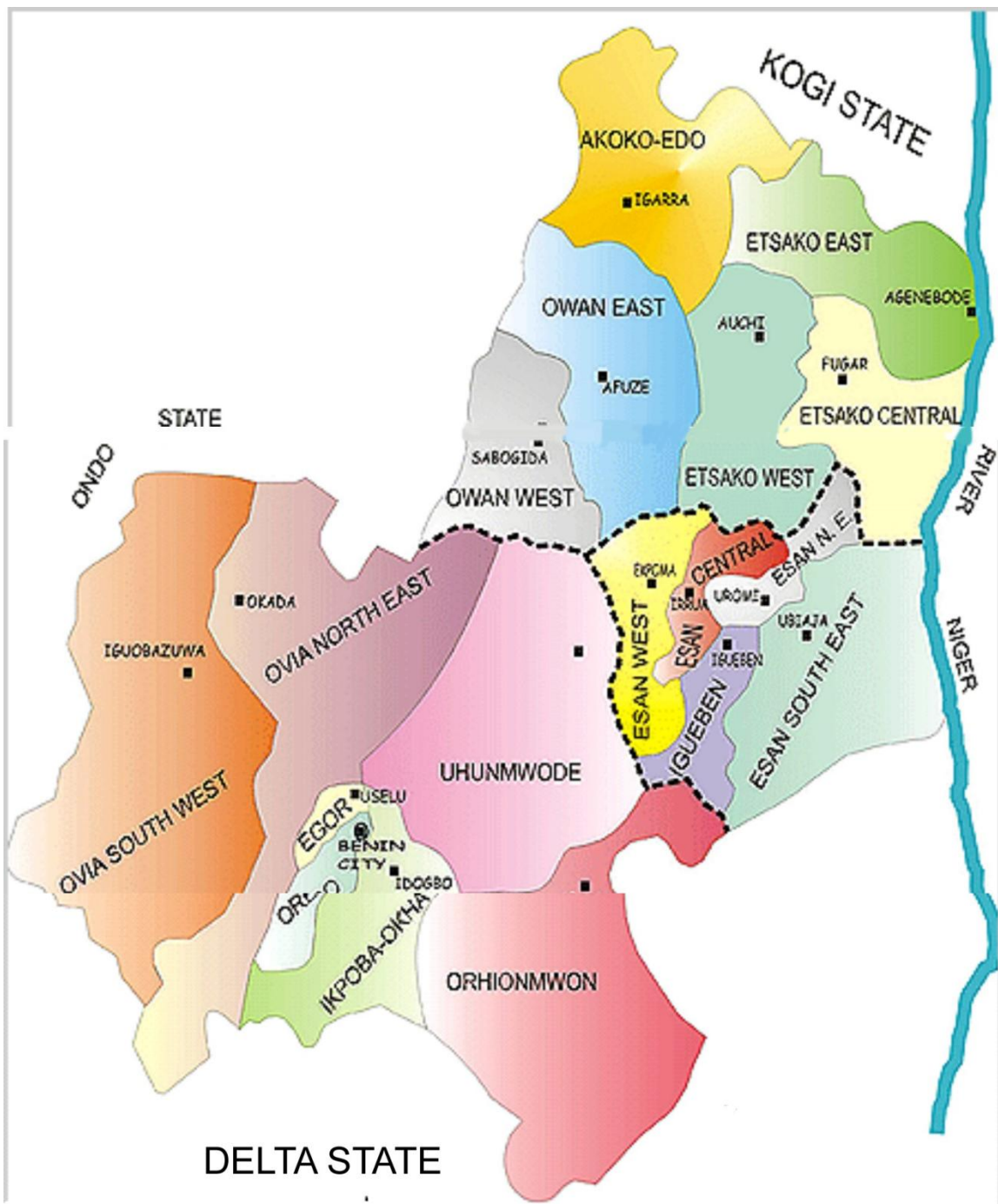


Figure 8 Map of Edo State

9 CONCLUSION AND RECOMMENDATION

A main challenge confronting the global community today is to make the industrial economy more like the biosphere, that is, more of a closed system. This would save energy, reduce waste and pollution and minimize cost. In fact, it would enhance sustainability whereby employment generation and cost recovery will surface. Waste generation is a daily affair. If proper approach are employed and well managed ought not to pose a problem.

Proper waste management enforcement in Benin City, like wise any part of the world cannot be over emphasized, as it is linked with vermin control which is dangerous to health, avoids environmental pollution, creates employment and reveals the beauty of a city. The researcher hereby appeal to the various authorities that are responsible for the waste handling processes to ensure an endless efforts are being induced, as this will tend to correct the ugly trend of the menace in the State.

Recommendations

- Government should introduce waste management course in the school curriculum, so as to create the awareness early enough to school pupils so as to combat the problems associated with waste right from the grass root.
- The government should encourage plastics recycling, because of its relatively large quantity in Benin City; well collected plastics waste (except PVC) can be used as alternative fuel in the cement industries; because of its high calorific content.
- Transport lines should provide a waste bins in their various vehicles to stop passengers from dropping off their wastes via the windows, which litters our highways.
- The public should be generally educated regarding waste minimization techniques at home. The success of waste reduction largely relies on education, increases public awareness and individual willingness towards changing their wasteful habits. For this reason, waste education must be implemented.

- Source separation (waste bins which should clearly state what types of waste allowed) activities should be implemented at household level in order to minimize the cost of separation at the recycling plants and to enhance the quantity and quality of the recyclables.
- The waste to wealth activities in some state should include the production of plastic lumber. Plastic lumber is also one of the major products manufactured using mixed waste plastic collected. Plastic lumber is currently used in products such as marine piling, pier and dock surfaces, fences and park benches. Plastic lumber is designed to outlast conventional wood products and is claimed to possess beneficial properties such as high strength, durability and resistance to rot.
- Through proper and organized Scavenging leads to, job creation, reduce poverty, conserve natural resources, protect the environment, save cities collection, transportation and extends the life of disposal sites. So owing to these facts, it should be properly coordinated for the purpose of deriving maximum economic benefits from such activities and also for the health and safety of those involved, and in addition to that, scavengers should be respected for their job.
- Composting as a method of reducing/ converting waste into something useful should be practiced and encouraged as its beneficial to the environment. Its merits includes: extension of the life of disposal sites, prevents pollution at the disposal site, reduces substantially the volume of waste for disposal and
- Lastly, it prevents methane generation (greenhouse gas) that is responsible for global warming.



Figure 9 waste bin

The government should provide residence with this type of waste bins, which should be emptied on weekly interval.



Figure 10 waste truck.

This waste truck can be used in conveying waste to various dumpsites for further process.



Fig 11 Unapproved dumpsite.

The government should impose strict law and enforce it, so as to ban people to desist from dumping refuse indiscriminately, the picture reveals also the most common type of waste mainly from sachet water made from PE, and also bottled water from PET.

10 REFERENCES

The science and engineering of materials by Donald R. Askeland, Pradeep P. phule

Polymeric materials: structure, properties, applications By G. W. Ehrenstein

Article Source: <http://EzineArticles.com/2458302>

<https://www.cia.gov/library/publications/the-world-factbook>

<http://www.krepublishers.com/02-Journals/JHE/JHE-23-0-000-000-2008-Web/JHE-23-1-000-000-2008-Abst-PDF/JHE-23-1-053-08-1650-Omofonmwan-S-I/JHE-23-1-053-08-1650-Omofonmwan-S-I-Tt.pdf>

<http://geography.about.com/library/cia/blcnigeria.htm>

http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_basics_overview/

<http://www.highbeam.com/doc/1G1-179285478.html>

<http://lifewithoutplastic.com/en/about-plastic/plastic-types.html>

<http://www.lotfi.net/recycle/plastic.html#1>

http://www.recyclenow.com/why_recycling_matters/how_is_it_recycled/plastics/index.html

<http://en.wikipedia.org/wiki/Polystyrene>

<http://www.klobex.org/journals/afs/afs10/afs1010109002.pdf>

<http://edopeopleforum.com/index.php?topic=233.0>

<http://nzic.org.nz/ChemProcesses/environment/14E.pdf>

<http://www.energylatest.co.uk/CARBON-FOOTPRINT.html>

<http://www.ides.com/info/generics/39/Polypropylene-PP>

http://www.nationmaster.com/graph/env_was_gen-environment-waste-generated

Article Source: <http://EzineArticles.com/2458302>

