INDUSTRIAL ACTIVITIES RELATED TOXIC WASTES AND PERCEIVED ENVIRONMENTAL IMPACT IN TRANS-AMADI PORT HARCOURT CITY, NIGERIA

Jatab-Esther Nmachi

Department of Environmental Management
Faculty of Social Sciences
Ignatius Ajuru University of Education

t.girlenv@gmail.com

ABSTRACT

This study explored industrial activities related toxic wastes and perceived environmental impact in Trans-Amadi Port Harcourt City, Nigeria. The objectives of the study were to determine the perceived types of toxic wastes generated by the industries as well as identify the perceived environmental impact of the industrial activities. The descriptive survey design was adopted in the study The study population consisted of 988 adults out of which 395 representing 40% were selected using the convenience sampling technique. Data collection instrument was a structured questionnaire reflecting the study variables. Direct delivery and retrieval approach was employed in the data collection process which lasted for a period of two weeks on alternate days. Data analysis was done using descriptive statistics of mean and standard deviation. The Statistical Product and Service Solution (SPSS) version 23 was employed in the analytical process. Results were presented in tables in better appreciation of study findings. Results revealed that the major types of toxic waste emitted from industries include carbon monoxide, sulphur dioxide, heavy metals, hydrocarbons, black soot and smog; the environmental impact of industrial wastes include water and air pollution with consequent depletion of natural resources and threat to human and animal lives. The study concluded that toxic wastes from industrial activities exerts significant harmful effects on the environment and sustenance. It was recommended that government and communities should institute stringent measures to discourage the discharge of toxic waste into the environment.

Key words: Industrial, Activities. Toxic Waste, Environmental, Impact, Trans-Amadi Port Harcourt City, Nigeria

INTRODUCTION

Although industries have proved to be very helpful to our society, it has various drawbacks and one of the most important ones is pollution caused by industrial waste. According to Sahay (2022), wastes generated by manufacturing or various industrial processes are known as industrial wastes. Some industrial wastes may be toxic and hazardous like industrial effluent, carbon dioxide and sulphur dioxide. Waste generation process affects all living things. Human activities and process undergo a cycle which generates waste of varying sizes. The production and conversion of materials and substances and consumption of the products within an urban setting or a municipality produces waste.

Industrial waste management is an important issue plaguing Nigerian industries, unfortunately, occupational health and safety practices remain in their infancy when compared to what obtains in more developed societies. Many industries in Nigeria do discharge their waste water into surface water bodies (oceans, seas and streams) more often than not without any form of remediation or treatment at source (Agagu, 2009). Waste generation process affects all living things.

Industrial wastes are mostly hazardous and by implication, pose a threat or potential risk to human health and the environment if not properly managed. Hazardous wastes contaminate soil, water and air. The pollution of these three key components tied to the existence of mankind undoubtedly creates a precarious relationship detrimental to sustainable growth and development. Health impact include exposure to toxic chemicals through air, water and soil media; exposure to infection and biological contaminants, stress related to odour, noise, vermin infestation and visual amenity, risk of fires, explosions and seepages, spills, accidents and transport induced emission.

Residents around an industrial area are undoubtedly exposed to a wide array of hazards of varying magnitude depending on the operations of the industry within their area. For instance, a resident residing in the vicinity of a mine may be endangered by - exposure to heat, unstable lighting condition and deoxygenated air, etc., while an individual residing around an asbestos – production plant may be exposed to such air pollutants like toluene and benzene (Ana et al., 2005). Industrial pollution directly affects health through the serious chemicals they discharge courtesy of the nature of the industry. These chemicals, resident in the environment beyond a specified limit will most definitely have hazardous adverse effects on human health. These effects take a toll on the normal functions of the heart, blood, kidneys, reproductive organs, lungs, liver, etc.

The Niger Delta, being Nigeria's major centre of wealth (crude oil Preserves) has some areas of interest as focal points of which Port Harcourt is one, and as a result, harbours industries and businesses of varying activities. Unfortunately, some of these activities have resultant effects that do not bode well for the teeming residents of the city. Around 2015, residents of Port Harcourt woke up to a cloud of black soot hanging in the air. Reports consist of many issues including stains of black soot on window nets, clothes hung outside the house, black stains on items and floors

inside the house; and worse of all, a barrage of health issues related to air pollution. Given the fore going, this study examined industrial activities related toxic wastes and perceived environmental impact in Trans-Amadi Port Harcourt City, Nigeria.

Statement of the Problem

Nigeria's favourable climatic conditions and abundance of natural resources have made this sector a promising source for employment, poverty reduction, and food security. Along with other sectors, Nigeria has prioritized the industrial and service sectors to accelerate economic growth. As rapid industrialization is taking place, industries are correspondingly expanding all over the country especially in the oil rich regions of Nigeria including, Port Harcourt.

Although the industrial sector contributes significantly to Nigeria's economic growth and development, unplanned rapid industrialization is having a detrimental impact on natural resources. Industrialization is one of the main reasons for environmental pollution and industrial pollution is wreaking havoc on the environment, destroying natural resources. Natural and anthropogenic practices are increasingly depleting resources, which is alarming. Industrial waste if not properly managed could have a substantial impact on human lives and overall health status. The problem of this study therefore is to explore industrial activities related toxic wastes and perceived environmental impact in Trans-Amadi Port Harcourt City, Nigeria.

Aim and Objectives of the Study

The purpose of this study was to examine industrial activities related toxic wastes and perceived environmental impact in Trans-Amadi Port Harcourt City, Nigeria.

The specific objectives of the study include to:

1. Determine the perceived types of toxic wastes generated by the industries located within Port Harcourt City
2. Identify the perceived environmental impact of the industrial activities.

Research Questions

The following research questions were answered in this study:

1. What are the perceived types of toxic wastes generated by the industries located within Port Harcourt City?
2. What is the perceived environmental impact of the industrial activities?

LITERATURE REVIEW

Industrial Waste

Industrial waste is defined as waste generated by manufacturing or industrial processes. The types of industrial waste generated include cafeteria garbage, dirt and gravel, masonry and concrete,

scrap metals, trash, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and similar wastes. Industrial waste - which may be solid, liquid or gas held in containers - is divided into hazardous and non-hazardous waste. Hazardous waste may result from manufacturing or other industrial processes. Certain commercial products such as cleaning fluids, paints or pesticides discarded by commercial establishments or individuals can also be defined as hazardous waste. Non-hazardous industrial wastes are those that do not meet the EPA's definition of hazardous waste - and are not municipal waste. Industrial waste has been a problem since the industrial revolution.

Industrial waste may be toxic, ignitable, corrosive or reactive. If improperly managed, this waste can pose dangerous health and environmental consequences. In the United States, the amount of hazardous waste generated by manufacturing industries in the country has 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.

Here in Nigeria, the introduction of many new products for the home and office - computers, drugs, textiles, paints and dyes, plastics - also increased hazardous waste, including toxic chemicals, into the environment. These, too, must be managed with extreme care to avoid adverse environmental or human health impacts.

Types of Industrial Waste

Industrial waste can be hazardous or non-hazardous. Both, however, can cause substantial damage to the environment if not properly managed. Below are some common types of industrial waste that can be hazardous to human life and the environment.

Solid waste: Though the term "industrial waste" includes several different types, one of the most common is **industrial solid waste**. Each year, American industries generate and dispose of about 7.6 billion tons of industrial solid waste. According to the Resource Conservation and Recovery Act, solid waste can be generated by manufacturing processes such as: electric power generation, the use of agricultural chemicals and inorganic chemicals, iron and steel manufacturing, water treatment, plastics and resins manufacturing and many of the other manufacturing processes outlined above

Toxic waste: Industrial waste can also be **toxic or hazardous waste**. If not managed properly, this type of industrial waste can cause harm to humans, animals and the environment by contaminating waterways, such as rivers and lakes. This type of industrial waste is generally a by-product of other materials generated at factories, hospitals and manufacturing facilities. It's important to note that waste laws can vary from state to state. For example, in many states, asbestos is not considered a hazardous waste. However, in California, it is. If the waste weighs more than 50 pounds in total, transportation by a certified **hazardous waste disposal company** is required. Unfortunately, this is not strictly the case in Nigeria.

Chemical waste: Chemical waste mostly contains harmful chemicals. This does not mean, however, that it is classified as hazardous. For it to be considered hazardous, it must have an ignitability, corrosivity, reactivity or toxicity characteristics.

Secondary Waste: The EPA's Sustainable Materials Management effort also has placed an emphasis on reusing **secondary materials** that are considered to be non-hazardous, such as scraps and residuals that result from the production process. Examples of secondary types of waste include: coal combustion, spent foundry sand, construction materials when infrastructure is demolished

Categories of Industrial Waste

Industrial waste can further be categorized into biodegradable and non-biodegradable.

Biodegradable: Those industrial wastes which can be decomposed into non-poisonous matter by the action of certain microorganisms, they are the biodegradable wastes. They are even comparable to house wastes. These kinds of waste are generated from food processing industries, dairy, textile mills, slaughterhouses, etc. Some examples are paper, leather, wool, animal bones, wheat, etc. They are not toxic in nature, and they do not require special treatment either. Their treatment processes include combustion, composting, gasification, bio-methanation, etc.

Non-biodegradable: Those industrial wastes which cannot be decomposed into non-poisonous substances are the non-biodegradable wastes. Examples are plastics, fly ash, synthetic fibres, gypsum, silver foil, glass objects, radioactive wastes, etc. They are generated by iron and steel plants, fertilizer industries, chemical, drugs, and dyes industries. It is estimated that about 10 to 15 percentage of the total industrial wastes are non-biodegradable and hazardous, and the rate of increase in this category of waste is only increasing every year. These wastes cannot be broken down easily and made less harmful.

Hence, they pollute the environment and cause threat to living organisms. They accumulate in the environment and enter the bodies of animals and plants causing diseases. However, with the advancement in technology, several disposals, and reuse methods have been developed. Wastes from one industry are being treated and utilized in another industry. For example, the cement industry uses the slag and fly ash generated as waste by steel industries. Landfill and incineration are other methods which are being resorted to, for the hazardous wastes after prior treatment.

Industrial waste and human health

It is no longer news that these industrial toxic wastes are inimical to the wellbeing of humans. Since the term of industrialization, the impact (adverse) on the health of workers and residents have taken a turn for the worst. Health issues previously unknown to man or rare to occurrence have taken centre – stage as they have almost or already have become common place in the health issues reported and recorded, with alarming increases promised in the future. It is no wonder life expectancy is now on an all-time low. Some of these illnesses attributed to industrial toxic waste

are: respiratory illnesses, renal diseases, cardiac disturbances, skin diseases, eye problems, just to mention a few.

Wang (2005) indicates that industry is not only the direct user of various resources and energies, but also the main sources of water pollution whereas; Drechsel et al. (2010), assert that untreated wastewater may contain a range of pathogens including bacteria, parasites, viruses, toxic chemicals such as heavy metals and organic chemicals from industry and other sources. Industrial waste discharge leads to physical and chemical stressors like changes of water quality, while biochemical oxygen demand (BOD) and the aesthetic appearance of the marine water may be affected by loss of clarity due to suspended solids in the discharge or by surface oil sheen (EPA, 2004).

Although the level of industrialization in Nigeria is low, untreated industrial wastes causes significant levels of localized effects since industrial effluents are discharged untreated or partially treated into nearby water bodies (CEP, 2006). About 80% of the industries in Nigeria, including agro-industries, chemical factories, breweries, soap and steel manufacturing establishments are located in the Southern region of the country. This causes numerous effects on water resources adjacent to the water sources where industrial effluents are discharged.

Toxic waste and the environment

Toxic waste in known to be harmful to both the Environment and to humans. It could take any form – liquid, solid or gaseous. The liquid form, it mixes with water to form acids that pose great danger to both flora and fauna who absorb these poison and store, passing them on in the food chain design to those who take them in. In the form of solid, these toxic wastes contribute to a change in the chemical composition of the soil which in turn can alter the topography of the space, - having introduced foreign elements to the lithosphere. In the gaseous form, these toxins mix with the air forming a new composition that alters the healthy state of the air, while impacting gravely on the respiratory organs of humans, animals etc.

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Theoretical Framework

Protection Motivation Theory

The study is anchored on the protection motivation theory. This theory was propounded by Piyapong Janmaimool in 2016. This theory explains individuals' engagement in industrial hazardous waste management based on the application of protection motivation theory (PMT). Industrial hazardous waste management include waste avoidance, green purchasing, reuse and recycle, and waste disposal behaviors. The protection motivation theory (PMT), proposes a conceptual framework to explain factors predicting risk preventative behaviors. PMT assumes that individuals' and cooperative's decision to participate in risk preventative behaviors is made based on their motivation to protect themselves from threats such as environmental pollution,

global climate change, and nuclear explosion. People balance different risks and potential benefits. The decision is made based on the results of threat appraisal and coping appraisal. Threat appraisal is a cognitive process that individuals use to estimate the level of threat. It includes two important elements: assessment of the perceived severity of the threat and the perceived probability of receiving adverse impacts from the threat (vulnerability).

Considering the amount of hazardous waste generation per capita per day during the past 10 years, the statistical records from the Bangkok Metropolitan Administration (BMA) illustrate the increasing trend of hazardous waste generation from 1.18 kg per capita per day in 2005 to 1.28 kg per capita per day 2015. Many scholars have asserted that industries should alter their operations to successfully reduce their environmental impact. Several environmental problems (e.g., air pollution, water pollution, and odours) caused by waste disposal are consequences of industrial activities; therefore, companies' engagement in industrial hazardous waste management should be widely promoted. This study applies PMT to explore how companies' hazardous waste affects human and environmental health seeing that it is equally expensive to set up very proper and efficient waste management machinery and adhere to its demands. Industries here will rather bribe their ways through than dispose of their waste safely but expensively.

The Port Harcourt Local Government Area was selected as a case study because it has faced serious industrial waste management problems owing to the desire of businessmen to set up in the city and cash into the high population, the consequences evident in increasing amounts of effluent discharges and gas flaring over the years. Questionnaire surveys will be administered to residents in the city to ascertain the impacts of industrial waste on their wellbeing.

Empirical Review

Types of Toxic Wastes Generated by the Industries

Olaoke and Oyinlola (2017), conducted a study to examine the effects of industrial waste management on workers' health status in selected industries. Descriptive survey research design was adopted for this study. The study population comprised industrial workers in Ibadan, Oyo State. A purposive sampling technique was used to take a total population of 270 employees. The major instrument used for the collection of data was a questionnaire tagged "Industrial Waste Management and Workers Health Status Questionnaire (IWMWHSQ)". Four research hypotheses were formulated and were analysed by using simple percentages, ANOVA, Multiple Regression and Pearson Moment Correlation Analysis at 5% level of significance. Findings revealed that there is a positive significant relationship between incineration and workers' health status ($r=0.323$, $N=250$, $P<0.05$). It also revealed a positive significant relationship between recycling and workers' health status ($r=0.240$, $N=250$, $P<0.05$). There was positive significant relationship between workers' safety practices and workers' health status ($r=0.160$, $N=250$, $P<0.05$). There was also a positive significant relationship between workers' occupational health attitude and workers' health status ($r=0.168$, $N=250$, $P<0.05$). Based on the findings of the study, it was recommended that the

government should put policies in place to check industries which engage in demeaning waste management practices that damages workers' health because, despite compensations that are being paid by some organisations, employees' health can never be bought.

Mwenda (2014) carried out a study to assess the levels of industrial pollutants and their effects on water resources and livelihoods along Msimbazi sub catchment. Specifically, the study determined the types and abundance of pollutants discharged by industries, levels of industrial pollutants and their effects on water resources and livelihoods. It also reviewed important aspects of the implementation of the relevant aspect of Tanzania National Industrial Policy on cleaner production and how they relate with industrial pollutants. Primary and secondary methods of data collection were used. Primary methods of data collection such as in situ measurements, laboratory analysis of water samples, structured questionnaires, interview guides as well as observation. Secondary data were collected from the National Bureau of Statistics (NBS). Different documentations were reviewed to compare data collected through primary methods. Data were analyzed using both quantitative and qualitative methods. The quantitative techniques included descriptive statistics such as cross-tabulation, frequencies, percentages and means which was done using Statistical Packages for Social Sciences (SPSS) software version 18.0 and Microsoft Excel 2007. Qualitative data was analyzed using Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. The results show that the types and abundance of pollutants discharged by industries along the sub catchment were higher and to some points exceeding the World Health Organization (WHO) and Tanzania Bureau of Standards (TBS) standards. Pollutants such as COD was found to be the highest at Vingunguti with the COD of 2451.57mg/l and Tabata 1 recorded 879.39mg/l. Turbidity was higher at Vingunguti with 674NTU and Kigogo 2 which had 357NTU exceeded the TBS and WHO acceptable levels. DO was exceeding the standards in stations like Vingunguti and Kigogo1 which had 0.00mg/l. DO was within the standards at upstream from the industries station. Chromium concentration was higher at Tabata 2 and Kigogo 2 and it was within the standards at the station upstream from the industries. Furthermore, the results show that industrial pollutants were found to be affecting the water resources in terms of quality where the water quality parameters in some stations were exceeding the WHO and TBS permissible limits also livelihoods were found to be affected by the industrial pollutants in terms of health, agriculture and settlement. Moreover, the study found that industries are still discharging pollutants into the sub catchment area despite the implementation of the Tanzania National Industrial Policy. The study recommends improvement of law enforcement in order to control industrial pollutants. Further; the authorities like NEMC should ensure that industries adopt efficient technology such as Effluent treatment Plants (ETP's) in order to minimize the effects of industrial pollutants into water resources and livelihoods.

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Fazzo et al., (2017) conducted a study to evaluate the evidence of the health impact of hazardous waste exposure, applying transparent and a priori defined methods. The population was made-up of people living near hazardous waste sites, the indices were; Exposure: exposure to hazardous waste; Comparators: all comparators; Outcomes: all diseases/health disorders. The association between 95 health outcomes (diseases and disorders) and residential exposure to hazardous waste sites was evaluated. Health effects of residential hazardous waste exposure, previously partially unrecognized, were highlighted. Sufficient evidence was found of association between exposure to oil industry waste that releases high concentrations of hydrogen sulphide and acute symptoms. The evidence of causal relationship with hazardous waste was defined as limited for: liver, bladder, breast and testis cancers, non-Hodgkin lymphoma, asthma, congenital anomalies and anomalies of the neural tube, urogenital, connective and musculoskeletal systems, low birth weight and pre-

term birth; evidence was defined as inadequate for the other health outcomes. The results, although not conclusive, provide indications that more effective public health policies on hazardous waste management are urgently needed. International, national and local authorities should oppose and eliminate poor, outdated and illegal practices of waste disposal, including illegal trans boundary trade, and increase support for regulations and its enforcement.

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METHODOLOGY

This study adopted the survey research design. The descriptive survey design is efficient and simple to administer, and it also ensures ease of access to details. For clarity purposes, the descriptive survey design helped the researcher to collect details, summarise and analyse results. The study population consisted of 988 adults out of which 395 representing 40% were selected using the convenience sampling technique. Data collection instrument was a structured questionnaire reflecting the study variables. Direct delivery and retrieval approach was employed in the data collection process which lasted for a period of two weeks on alternate days. Data analysis was done using descriptive statistics of mean and standard deviation. The Statistical Product and Service Solution (SPSS) version 23 was employed in the analytical process. Results were presented in tables in better appreciation of study findings.

RESULTS AND DISCUSSION

This section presents the study findings based on the study objectives and research questions. Out of the 395 questionnaires administered, 367 were retrieved indicating 92.9% return rate.

Table 1: Perceived Types of Toxic Wastes generated by the Industries Located within Port Harcourt City (n=367)

SN	Items	$\bar{X}$	SD	Remark
1	Carbon monoxide (Co) is emitted exceedingly by industries within my residential area.	3.4437	1.41665	Agreed
2	Sulfur dioxide (SO_2) is emitted highly by the companies within my residential area.	2.7109	1.50930	Agreed
3	Heavy metals are emitted in large concentrations by industries within my residential area.	3.4688	1.45774	Agreed
4	Hydrocarbons are emitted in large concentrations by industries within my residential area	2.8281	1.09479	Agreed
5	Black soot and smog are seen on surfaces where I live	3.8281	1.89002	Agreed
	Grand mean	**3.2546**	**1.36962**	Agreed

Criterion mean=2.50

Table 1 shows the responses from the respondents on the types of toxic wastes being emitted from the industrial areas within the zone of Port Harcourt City. All five (5) items in the table had mean score greater than the criterion mean of 2.50 indicating that the major types of toxic waste emitted from industries include carbon monoxide, sulphur dioxide, heavy metals, hydrocarbons, black soot and smog

Table 2: Perceived Environmental Impact of Industrial Activities (n=367)

SN	Items	$\bar{X}$	SD	Remark
1	Industrial activities are associated with discharge of toxic wastes into water bodies	3.1797	1.50293	Agreed
2	One of the major impact of industrial activities on the environment is air pollution	3.1484	1.24287	Agreed
3	Toxic wastes from industrial activities could deplete natural resources	3.0625	1.22153	Agreed
4	Human and animal lives are treated by poor management of waste from industrial activities	3.7910	1.10272	Agreed
	Grand mean	**3.2954**	**1.26751**	Agreed

Table 2 shows the perceived environmental impact of industrial activities. All four items in the table had mean score greater than the criterion mean of 2.50 showing that the environmental impact

of industrial wastes include water and air pollution with consequent depletion of natural resources and threat to human and animal lives.

Discussion of Findings

The study findings revealed that the major types of toxic waste emitted from industries include carbon monoxide, sulphur dioxide, heavy metals, hydrocarbons, black soot and smog. This implies that carbon monoxide, sulphur dioxide, heavy metals, hydrocarbons, black soot and smog ranks high amongst the types of toxic waste emitted from industries. These results are in consonance in with the submission of Olaoke and Oyinlola (2017) and Fazzo et al (2017) that there are high concentrations of hydrogen sulphide, heavy metals, hydrocarbons, carbon monoxide, other gases and effluents from industries constituting toxic waste in the ambient environment.

Results from study showed that the environmental impact of industrial wastes include water and air pollution with consequent depletion of natural resources and threat to human and animal lives. These findings are in line with the assertion of Mwenda (2014) that industrial pollutants exert significant harmful effects on human health, natural resources and overall livelihoods

CONCLUSION

Industrial waste can also be toxic or hazardous waste. If not managed properly, toxic industrial waste can cause harm to humans, animals and the environment by contaminating waterways, such as rivers and lakes. Toxic industrial waste is generally a by-product of other materials generated at factories, hospitals and manufacturing facilities. This study on industrial activities related toxic wastes and perceived environmental impact in Trans-Amadi Port Harcourt City, Nigeria concludes that the major types of toxic waste emitted from industries include carbon monoxide, sulphur dioxide, heavy metals, hydrocarbons, black soot and smog; the environmental impact of industrial wastes include water and air pollution with consequent depletion of natural resources and threat to human and animal lives.

RECOMMENDATIONS

Based on the study findings, the following are hereby recommended:

1. Environmental protection agencies should institute measures to monitor and control the activities of manufacturing and related industries as way of reducing the prevalence of toxic waste pollution in the society.
2. Government should formulate as well as implement policies on environment protection in relation to industrial activities.

3. The health sector should plan and implement behavioral intervention programmes and campaigns directed at reducing the incidence and overall menace of pollution emanating from poor toxic waste management by industries.

4. Community leaders should as much as possible discourage the discharge of toxic wastes into the environment.

5. Members of the community should as much as possible avoid residing in areas proximal to manufacturing industries.

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