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Assessment of the Causes and Impacts of Pollution at the Obosi Automobile Junk Market, Southeastern Nigeria

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***Abstract* - This study investigated pollution at the Obosi automobile junk market in Anambra State, Southeastern Nigeria, through an in-depth field study, a review of relevant literature, and interactions with market occupants. The aim was to identify the causes of pollution within the market, assess its effects on both humans and the environment, and propose strategies for prevention and remediation. The study identified the primary causes of pollution as the lack of proper solid waste management infrastructure, improper disposal of used car oils and lubricants, ignorance, poor recycling habits, high volumes of vehicular traffic, and inadequate drainage systems. The nuisance value of recognizable wastes was ranked in the following order: plastic/rubber wastes > used car oils and lubricants >> metals > solvents and paints > textiles > battery wastes > electronic wastes > glass > food wastes. Waste characterization results showed that plastic/rubber wastes (30%) and used car oils and lubricants (25%) constituted the highest waste nuisance in the market. Findings revealed that pollution in the Obosi automobile junk market has significant impacts on both human health and the environment, underscoring the urgent need to adopt effective pollution control measures and environmentally sustainable remediation strategies. Recommendations included several pollution prevention measures and the application of a combination of eco-friendly, cost-effective, and versatile bioremediation techniques-such as microbial bioremediation, phytoremediation, and Verm remediation-to restore the market to a safe condition while maintaining its economic significance.**
***Keywords*: Pollution, Waste Management, Bioremediation, Environmental Impact, Sustainable Strategies**

I. INTRODUCTION

A. Study Background

Human activities in places such as homes, markets, schools, farms, hospitals, tourist destinations, social events, offices, hotels/restaurants, and industries lead to the large-scale generation of municipal solid waste in cities across the globe. When not properly managed, this waste can pose serious risks to the environment and public health [1]. Onitsha and its environs face significant waste management challenges due to high population density, rapid urbanization, and intense commercial activities [2]. However, waste management infrastructure has not advanced in line with this growth, resulting in a substantial buildup of waste. A common practice in this area is the indiscriminate disposal of waste in open spaces, roadsides, drainage systems, and rivers. Locations such as markets, residential areas, and major streets often have heaps of uncollected waste [3], [4].

The buildup of municipal waste is closely tied to the growth of the human population. Several studies have highlighted that the issue of waste, particularly solid waste, is closely linked to the growing human population and its corresponding human activities-industrial, commercial, domestic, and agricultural. Thus, the rise in human numbers and accompanying socio-economic activities leads to the production of large amounts of municipal solid waste. This convergence with other urban blights is now impacting the urban environment, people's lives, and their livelihoods in dangerous ways [1].

B. Studied Area

The Obosi automobile junk market, located along the Onitsha axis in Idemili North Local Government Area, Anambra State, Southeastern Nigeria, is positioned at the coordinate points 6°06′27″N and 6°47′52″E, as shown in Figure 2. This market is one of the largest automobile junk markets in Nigeria and plays a crucial role in the automotive industry within the region. It serves as a hub for the sale and recycling of used vehicle parts. Buyers and sellers actively engage in the trade of used automobile parts, vehicle repairs, and refurbishments. The market is renowned for its wide range of spare parts for cars, trucks, and motorcycles. However, despite its economic significance, the Obosi automobile junk market faces significant environmental pollution challenges.

II. GEOLOGY AND HYDROGEOLOGY OF THE STUDY AREA

The study area is located within the Anambra Basin of the Benue Trough. The basin is predominantly filled with clastic sediments, comprising several distinct lithostratigraphic units ranging in age from the Upper Campanian to recent times. These lithostratigraphic units have a thickness of up to 2500 m [5] and include the Nkporo Shale, Mamu Formation, Ajali Sandstone, Nsukka Formation, Imo Shale, Ameki Formation, Nanka Sands, Ogwashi-Asaba Formation, Benin Formation, and the Alluvial Plain Sands. The sediments in the basin are

primarily sourced from the Cameroon Massif and the Abakaliki Synclinorium [6].

Obosi is underlain by the Nanka Formation, which is part of the Ameki Group (Figure 1) and was deposited during the Middle Eocene of the Tertiary period. The Ameki Group consists of the Nanka and Nsugbe Formations. The Nanka Formation, estimated to be 305 m thick, is primarily composed of sands and minor calcareous clay/mud with heterolithic features [7], [8], [9]. The Nsugbe Formation, predominantly composed of sands with some conglomerate bands, is estimated to be about 100 m thick [8]. The Nsugbe Formation is considered a lateral equivalent of the Nanka Formation due to its distinct lithological succession, textural characteristics, degree of induration, and its substantial coverage of over 1000 km² [8].

Hydrogeological studies have revealed that groundwater in Onitsha and its environs is sourced from the middle aquifer (>40 m and <90 m), which belongs to the Ameki Group [10]. In Obosi, the main aquifer types include unconfined aquifers in shallow sandy deposits, often recharged by rainfall, and semi-confined aquifers located at deeper levels.

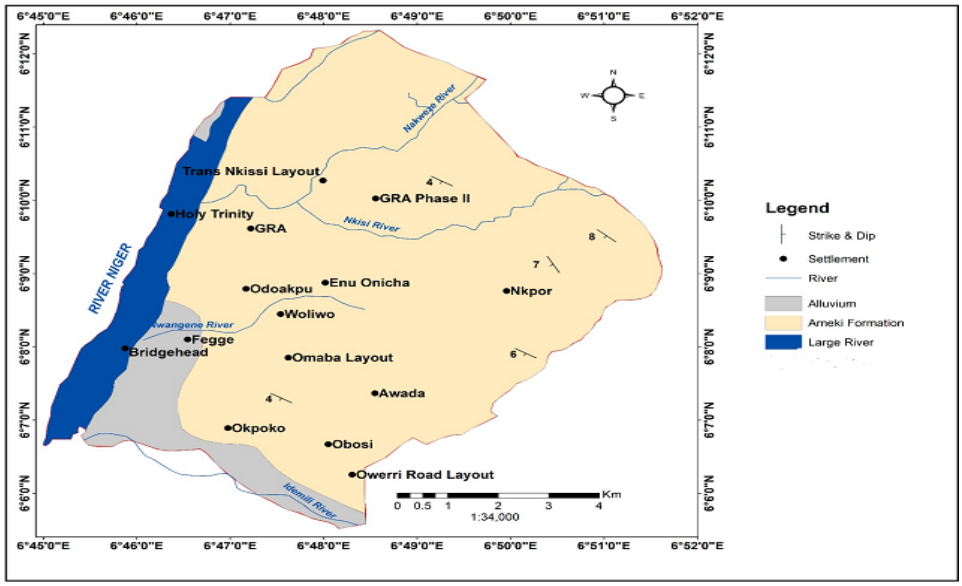

Fig. 1 Geology map of the studied area

A. Relief and Drainage

The area is characterized by plains with elevations ranging from 50 m to 200 m above sea level and experiences annual rainfall between approximately 2500 mm and 4000 mm, with the highest precipitation occurring in April and October. The average relative humidity is around 80%, rising to as high as 90% during the wet season. Obosi is primarily drained by the Idemili River, located in the southern part of the study area, which empties into the River Niger (Figure 2).

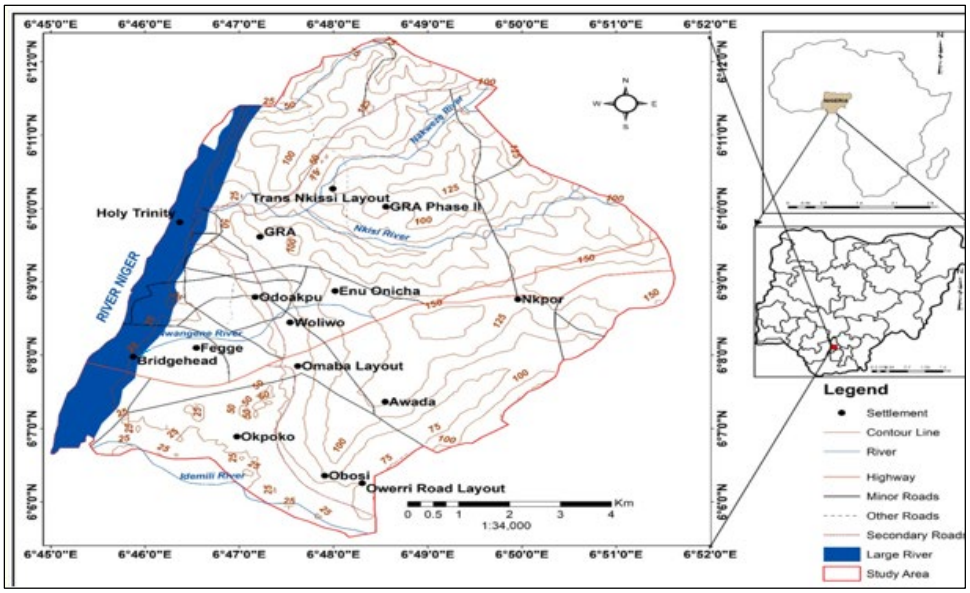

Fig. 2 Location, Topography and Drainage of Onitsha, showing Obosi

III. STATEMENT OF THE PROBLEM

The Obosi automobile junk market faces significant environmental and public health challenges due to uncontrolled pollution. The market, which serves as a hub for vehicle repairs, spare parts sales, and scrap metal trading, generates substantial amounts of waste, including used car oils, metal scraps, plastics, rubber, and other hazardous materials. These wastes are often improperly disposed of, resulting in soil and water pollution, as well as air quality degradation.

A. Aim of The Study

The aim of this study is to investigate the causes and impacts of pollution at the Obosi automobile junk market, as well as to identify pollution prevention measures and remedial strategies.

B. Objectives

1. The following objectives have been defined to aid in achieving the aim of this study:
2. To investigate the causes of pollution in the automobile junk market.
3. To characterize the types of wastes generated.
4. To assess the effects of pollution on both humans and the environment.
5. To identify possible pollution prevention measures.
6. To propose effective remedial approaches.

IV. METHODOLOGY

The sequence of activities to be undertaken to accomplish the stated objectives is illustrated in Figure 3.

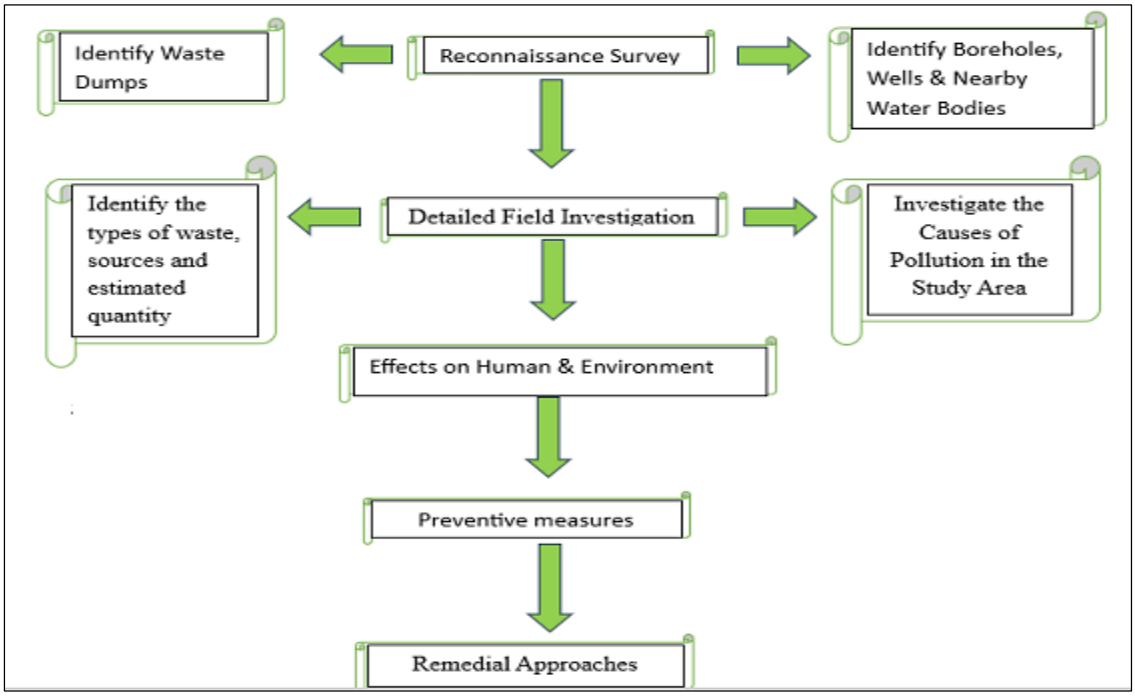

Fig. 3 Workflow

A. Field Investigation

The field investigation will consist of two stages:

1. Reconnaissance Survey

Activities at this stage will include the identification of waste dumps, boreholes, and hand-dug wells within the study area. This will be accomplished through field observations and interactions with the occupants.

2. Detailed Field Study

This stage will involve the identification of the causes of pollution in the Obosi automobile junk market, with a focus on the types of waste, their sources, and an estimation of their quantities. It will also include an assessment of the effects of this pollution on both humans and the environment, as well as the identification of possible preventive measures and remediation approaches.

V. RESULTS AND DISCUSSION

The investigation of pollution at the Obosi automobile junk market was conducted through a detailed field study, literature review, and interactions with the market occupants. The study identified the causes of pollution, including the types of waste, their sources, estimated quantities, and nuisance values. Additionally, the environmental impacts of the pollutants were assessed, and potential pollution prevention measures, along with appropriate remediation approaches, were explored.

A. Causes of Pollution

The studied area, like many large automobile junk markets, poses substantial environmental challenges stemming from the following factors:

1. Lack of Proper Solid Waste Management Infrastructure

The absence of adequate waste management infrastructure, such as sufficient waste collection bins and an efficient waste transportation system within the market, has led to the indiscriminate dumping of refuse along market streets and within drainage systems (Figures 4, 5a & b, 7a). Large quantities of scrap metals, plastic packaging, rubber materials (such as used tires), and discarded vehicle components are left to accumulate. These materials, being non-biodegradable, contribute to long-term environmental pollution.

2. Improper Disposal of Used Car Oils and Lubricants

Oils containing both heavy metals (e.g., lead, zinc, copper, manganese) and organic pollutants (e.g., polycyclic aromatic hydrocarbons) are often poured directly onto the ground after use. Spillage of used oils and lubricants is common in this environment, leading to oil-saturated soils (Figures 6a & b, 7a).

3. Ignorance

The Obosi automobile junk market, as a commercial hub, is mostly occupied by individuals focused on earning a living rather than considering the environmental consequences of their actions. Approximately 30% of individuals are unaware of the environmental impacts of their improper waste disposal habits. While the remaining 70% claim to be aware, they believe it is the sole responsibility of the government to ensure a clean and healthy environment.

4. Poor Recycling Habits

Activities such as dismantling, welding, painting, and refurbishing used engines, which are common in this market, introduce organic pollutants such as volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), heavy metals, and particulate matter into the environment.

5. Traffic-Related Pollution

High volumes of vehicular traffic from transporters, customers, and delivery trucks result in substantial air and noise pollution. This contributes to the release of harmful gases such as carbon monoxide, nitrogen oxides, and other pollutants.

6. Poor Infrastructure and Drainage System

The market lacks adequate drainage systems, leading to flooding during the wet season. These floods spread pollutants over a wider area, exacerbating their environmental impact.

Fig. 4 Build-up wastes within the market

Fig. 5 a & b Waste and leachates containing drainages within the market

Fig. 6 a & b Oil spills within the market

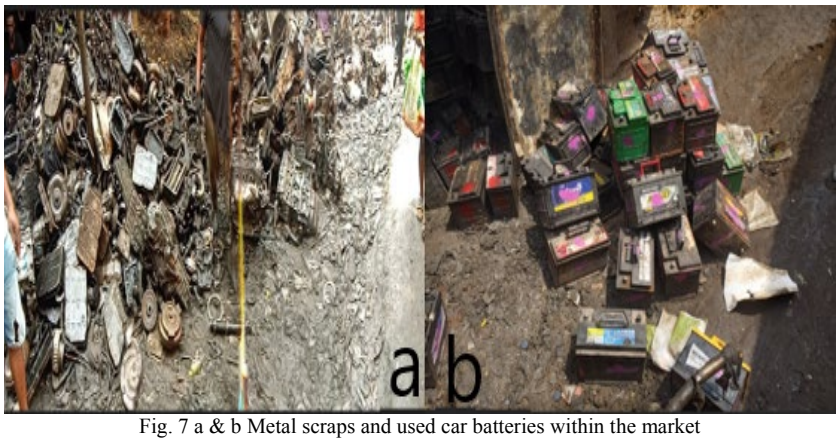

Fig. 7 a & b Metal scraps and used car batteries within the market

B. Waste Characterization

1.Types of Wastes, Sources, and Estimated Quantities

Various types of waste generated in the Obosi automobile junk market include metals, used car oils and lubricants, brake fluids and coolants, solvents and paints, batteries, electronics, plastic bottles, plastic food packs, sachet water packs, polythene bags, food waste, textiles, foams, glass, tires, and fan belts.

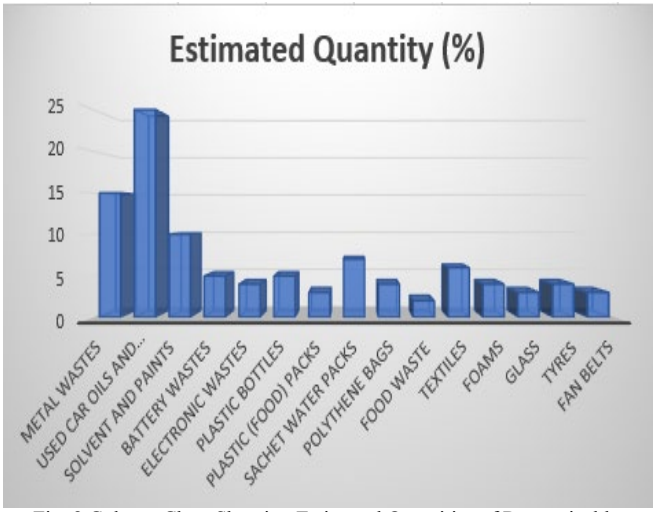

Fig. 8 Column Chart Showing Estimated Quantities of Recognizable Wastes in the Obosi Automobile Junk Market

TABLE I CLASSIFICATION OF OBOSI AUTOMOBILE JUNK MARKET WASTES

Type of Waste	Source	Estimated Quantity (%)
Metal Wastes	Commercial/ Industrial	15
Used Car Oils and Lubricants	Commercial/ Industrial	25
Brake Fluid and Coolants	Commercial/ Industrial	Not Recognized
Solvent and Paints	Commercial/ Industrial	10
Battery Wastes	Commercial/ Industrial	5
Electronic Wastes	Commercial/ Industrial	4
Plastic Bottles	Commercial	5
Plastic (food) Packs	Commercial	3
Sachet Water Packs	Commercial	7
Polythene Bags	Commercial	4
Food Waste	Commercial	2
Textiles	Commercial / Industrial	6
Foams	Commercial / Industrial	4
Glass	Commercial / Industrial	3
Tyres	Commercial / Industrial	4
Fan belts	Commercial / Industrial	3

C. Estimated Recognizable Waste Nuisance Values

This refers to the significance of the classified wastes, determined by their ability to cause recognizable inconvenience or annoyance by creating dangerous or unhealthy conditions that threaten public health. These values are calculated based on the estimated total quantities of recognizable wastes as follows:

Estimated Quantity of Plastic / Rubber Wastes (in %):
Plastic bottles = 5
Plastic (food) packs = 3
Sachet water packs = 7
Polythene bags = 4
Foams = 4
Tyres = 4
Fan Belts = 3

Estimated Total Quantity of Plastic / Rubber Wastes = 30%

Estimated Total Quantity of other wastes (in %):
Metal = 15
Used car oils and lubricants = 25
Solvent and paints = 10
Batteries = 5
Electronics = 4
Foods = 2
Textiles = 6
Glass = 3

TABLE II ESTIMATED TOTAL QUANTITIES OF DIFFERENT WASTES

Type of Waste	Estimated Total Quantity (%)
Plastic / Rubber Wastes	30
Metals	15
Used Car Oils & Lubricants	25
Solvents and Paints	10
Battery Wastes	5
Electronic Wastes	4
Food Wastes	2
Textiles	6
Glass	3

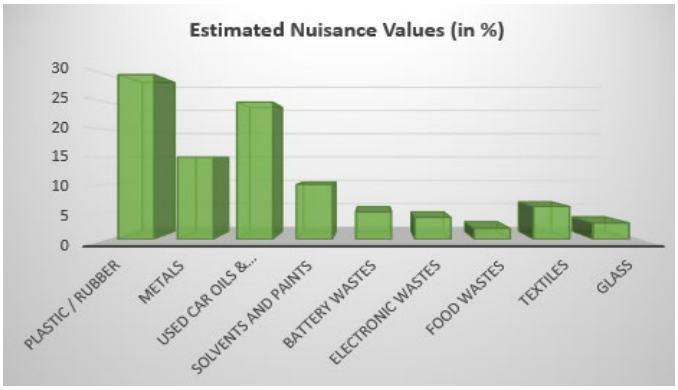

Fig. 9 Column chart showing estimated nuisance values of different recognizable wastes in the market

TABLE III ESTIMATED QUANTITIES OF PLASTIC / RUBBER WASTES

Type of waste	Estimated Quantity (in %)
Plastic Bottles	5
Plastic (food) Packs	3
Sachet Water Packs	7
Polythene Bags	4
Foams	4
Tyres	4
Fan Belts	3

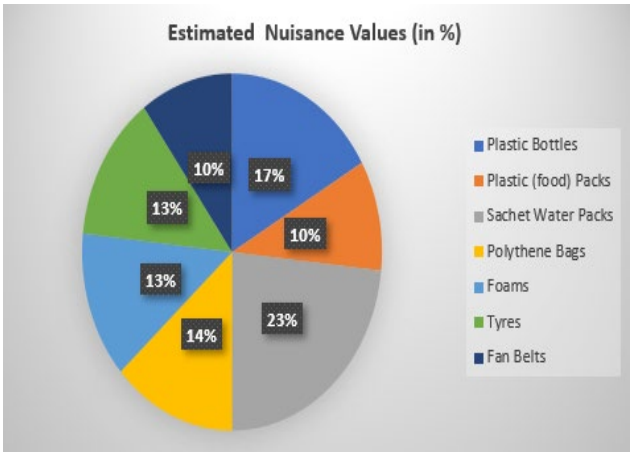

Fig. 10 Pie Chart Showing Estimated Plastic/Rubber Waste Nuisance Values

The waste characterization of the Obosi automobile junk market revealed the following:

1. Plastic/Rubber Wastes: These constitute the highest recognized waste nuisance value within the market (Figure 9).
2. Sachet Water Packs: Among plastic/rubber wastes, sachet water packs account for the highest recognized waste nuisance value within the market (Figure 10).
3. Oils and Lubricants: These represent the second-highest recognized waste nuisance value within the market (Figure 9).
4. Metals: Metals rank as the third-highest recognized waste nuisance value, followed by solvents and paints, textiles, batteries, electronics, glass, and food wastes, in that order (Figure 9).
5. Plastic/Rubber Wastes: The findings emphasize the significant nuisance potential of plastic/rubber wastes in all settings if not properly managed.
6. Waste Management Infrastructure: The results underscore the urgent need for the implementation of proper waste management infrastructure to address the various types of waste, particularly used oils and lubricants.

VI. ENVIRONMENTAL IMPACTS

Environmental impacts refer to the changes or effects caused by activities within the Obosi automobile junk market on the environment. These impacts affect various components of the

environment, including land, water, and air. Similar to other automobile junk markets worldwide, the operations of this market generate significant environmental impacts, which arise from the causes outlined earlier. The key environmental concerns resulting from activities within the market include:

Fig. 11 Poorly sited borehole within the market

A. Environmental Impacts

1. Land and Groundwater Contamination

Activities such as dismantling, welding, painting, and engine refurbishing release various wastes, including paints, solvents, used car oils, brake fluids, and other lubricants. Improper handling and disposal of these wastes lead to their seepage into the soil, introducing heavy metals and organic pollutants. Discarded batteries release toxic substances such as lead, acid, and other chemicals, contaminating soil and groundwater. The shallow, intermediate, and unconfined to semi-confined nature of the aquifer in the studied area [13] enables rainwater to percolate pollutants into the groundwater, contaminating it with heavy metals (e.g., lead, cadmium, mercury) and hydrocarbons (e.g., polycyclic aromatic hydrocarbons).

According to studies conducted in the area [6], the automobile junk market exhibits varying levels of heavy metal pollution in soil and water, ranging from mild contamination to severe pollution. Soil samples showed excessive nickel levels compared to international standards, while water samples contained excessive levels of manganese, iron, copper, and nickel when compared to WHO standards. The metal enrichment order is Nickel > Iron >> Zinc > Copper > Manganese > Lead > Chromium.

Prolonged exposure to spilled oils and chemicals has caused severe soil degradation (Figures 6a & b) in and around the market, reducing soil fertility, disrupting microbial activity, and posing risks to agriculture in nearby farmlands. Poorly sited boreholes, often near polluted drainages [10] or hydrocarbon-contaminated soils (Figure 11), exacerbate these issues.

Furthermore, pollutants such as heavy metals and organic pollutants induce stress responses in microorganisms, including pathogens, resulting in the development and horizontal transfer of antibiotic-resistance genes (ARGs) [11], [12]. This poses a public health risk by contaminating soil and groundwater with ARGs.

1. Surface Water Degradation Rainfall washes pollutants such as used car oils, lubricants, heavy metals, organic pollutants, and toxic chemicals into drainage systems that flow into the Idemili River, ultimately reaching the River Niger [14]. These polluted drainages (Figures 5a & b) discharge wastes and leachates into surface water bodies, degrading water quality and harming aquatic organisms.
2. Air and Noise Pollution High volumes of vehicular traffic from transporters, customers, and delivery trucks contribute to substantial air and noise pollution. Exhaust from poorly maintained vehicles releases harmful gases such as carbon monoxide and nitrogen oxides. Activities like painting and welding introduce volatile organic compounds (VOCs) and particulate matter into the air. Additionally, waste burning, including plastics and wires, releases toxic gases like dioxins and furans, further degrading air quality. The constant noise from vehicle repairs and engine testing contributes to noise pollution.
3. Loss of Biodiversity Spilled oils and lubricants form hydrophobic layers on soil and water surfaces, reducing oxygen availability and impacting soil organisms and aquatic life, supporting only anaerobic organisms. Pollutants such as PAHs, dioxins, furans, and heavy metals accumulate in aquatic organisms, causing toxicity and death. These disruptions harm flora, fauna, and nutrient cycles, leading to biodiversity loss.
4. Effect on Microbial Communities Pollutants like PAHs, benzene, and toluene impose selective pressure on microbial communities, favoring pollutant-degrading microbes (e.g., *Pseudomonas*, *Mycobacterium*, *Bacillus*) and reducing microbial diversity. High pollutant levels inhibit sensitive microbes, disrupt organic matter decomposition, and alter nutrient cycling (e.g., nitrogen and phosphorus cycles). Heavy metals co-select for ARGs in microorganisms, further amplifying public health risks through the spread of ARGs via horizontal gene transfer.
5. Flooding The market lacks proper drainage systems, and available drainages have been converted into waste dumps (Figures 5a & b), blocking water channels and causing flooding during the rainy season. The frequent movement of heavy vehicles compacts soil, while oil spills create hydrophobic surfaces, reducing soil permeability. This results in rainwater accumulation and localized flooding, spreading pollutants over wider areas and increasing environmental impact.
6. Loss of Aesthetics Frequent oil spills (Figures 6a & b) and improper disposal of solid wastes such as used car parts, scrap metals, plastics, and rubber (Figures 4, 7a) create an unsightly and unpleasant environment.

Improper waste disposal in drainages and resulting leachates (Figures 5a & b) emit foul odors, further degrading the market's appearance and aesthetic value.

B. Health Impacts

Dioxins and furans are highly toxic due to their persistent nature in the environment and can cause a range of health problems, including cancer, immune system damage, hormonal dysfunction, and reproductive issues. Lead exposure, commonly associated with discarded batteries, can result in neurological damage, particularly in children. Chromium and cadmium, often found in coatings and engine parts, are known carcinogens. Pollutants such as polycyclic aromatic hydrocarbons (PAHs), dioxins, furans, and heavy metals accumulate in aquatic organisms and magnify through the food chain, ultimately affecting predators, including humans [15].

Prolonged exposure to carbon monoxide, sulfur dioxide, and particulate matter from unregulated burning in the market can lead to respiratory problems such as asthma, bronchitis, cardiovascular diseases, and lung infections among nearby residents and market occupants. Consumption of polluted groundwater can result in waterborne diseases, including cholera, dysentery, typhoid, and skin irritations. Continuous noise from market activities contributes to hearing issues, stress, and sleep disturbances among nearby residents.

The prevalence of antibiotic-resistant genes (ARGs), induced by pollutant-related stress responses in microorganisms [16], [17], poses a significant public health risk in the studied area. When humans are exposed to resistant pathogens in the environment, these pathogens can transfer their resistance genes to previously non-resistant pathogens within the human body. Additionally, the consumption of water contaminated by heavy metals and organic pollutants facilitates the development of resistance genes in pathogens through stress responses [18]. This undermines the effectiveness of antibiotics in treating infections, increasing morbidity and mortality rates, particularly among immunocompromised individuals.

VII. ECONOMIC IMPLICATION

The prevalence of pollution-related illnesses results in higher medical expenses for both market occupants and nearby residents, straining household incomes and local health systems. Additionally, overwhelmed healthcare facilities require increased funding for repairs, capacity expansion, and staff reinforcement. Treating antibiotic-resistant infections involves prolonged hospital stays, the use of costly second- or third-line antibiotics, and intensive care, significantly increasing healthcare costs [19], [20]. Furthermore, the large population within the studied area facilitates the spread of diseases, imposing substantial healthcare costs on both the government and society. Soil and water pollution caused by market activities adversely affect nearby farmlands and water bodies, reducing the livelihoods of farmers and fishermen. Additionally, the accumulation of non-biodegradable waste materials causes long-term environmental damage, requiring substantial resources for cleanup and restoration.

A. Preventive Measures

The following measures should be implemented to prevent further pollution in the Obosi automobile junk market. This will require the combined efforts of market authorities, traders, government agencies, and NGOs to ensure a sustainable and pollution-free environment.

1. Sustainable Waste Management System: Sustainable waste management involves the systematic handling of waste to meet current disposal needs without compromising the ability of future generations to manage theirs [1]. The government should establish recycling facilities for scrap metals, plastics, and used oils within the market to promote proper reuse. Designated bins for hazardous, recyclable, and general wastes should be provided to encourage waste segregation by traders. Additionally, partnerships with local authorities or waste management companies should be established to ensure regular and proper disposal of collected waste.

2. Oil Spill and Hazardous Waste Control: Oil collection tanks should be installed specifically for used oils and lubricants to prevent soil and water contamination. Training sessions should be conducted for traders on the proper handling and disposal of hazardous materials, such as battery acids, brake fluids, and used oils.

3. Drainage and Sewage System: Adequate drainage systems should be constructed within the market to handle runoff and prevent waterlogging, which can carry pollutants into nearby water bodies like the Idemili River. Additionally, wastewater treatment systems should be installed to process wastewater from the market before releasing it into the environment.

4. Awareness and Education: Government agencies and non-governmental organizations within Anambra State should organize frequent workshops to educate traders on the environmental impacts of pollution associated with their operations and the importance of sustainable practices [23]. Environmental signage, such as posters and signs, should be displayed around the market to encourage environmentally friendly practices.

5. Regulatory Frameworks: Existing environmental protection laws should be enforced, including penalties for improper waste disposal and oil spills. A task force should be established within the market to monitor and ensure compliance with pollution control measures [22].

6. Introduction of Green Technology: Green technology should be introduced, including planting trees and shrubs around the market to act as natural air filters and reduce air pollution. Solar-powered systems should be provided to reduce reliance on generators, which contribute to air and

noise pollution. Traders should also be encouraged to use eco-friendly solvents and paints.

7. Collaboration with Stakeholders: Market leaders should collaborate with non-governmental organizations, government agencies, and private organizations to fund and implement pollution control programs. Regular environmental audits, including soil and water testing for heavy metals and organic pollutants, should be conducted to identify and address sources of pollution.

8. Incentives for Compliance: Incentives, such as tax reductions and financial support, should be offered to traders who adopt sustainable practices, such as recycling or proper waste disposal.

B. Remediation Approaches

Remediation refers to the process of removing, reducing, or neutralizing pollutants from the environment to restore it to a safe and usable condition.

This study recommends the application of a combination of eco-friendly, cost-effective, and versatile approaches, such as bioremediation techniques, for the remediation of the Obosi automobile junk market. These measures can transform the market into a model for sustainable practices, reducing its environmental footprint while maintaining its economic significance.

C. Bioremediation Techniques

Bioremediation is an environmental management technique that uses living organisms like bacteria, fungi, or plants to remove, degrade, or neutralize pollutants from the environment. The recommended bioremediation techniques include:

1. Microbial Bioremediation

This involves the use of microorganisms, such as bacteria and fungi, to degrade contaminants. Microbial activity can be enhanced through:

a. Bio-stimulation: The addition of nutrients (e.g., nitrogen, phosphorus) or oxygen to stimulate native microorganisms to degrade hydrocarbons. For instance, applying fertilizers to oil-contaminated soils boosts microbial growth and activity.

b. Bioaugmentation: The introduction of specialized microbial strains to degrade specific contaminants more effectively. For example, hydrocarbon-degrading bacteria can be added to soils contaminated with spilled oils and lubricants. Microorganisms such as *Pseudomonas*, *Bacillus*, and *Mycobacterium* are highly efficient in breaking down oil, grease, and other hydrocarbons. Fungi like *Aspergillus* and *Penicillium* can degrade complex hydrocarbons, while bacteria such as *Thiobacillus ferroxidase* can bioleach metals, making them extractable.

2. Phytoremediation

This technique uses plant species to degrade or remove pollutants from the environment. Specific methods include:

a. Phytoextraction: Plants such as *Typha* or *Phragmites* can absorb heavy metals like cadmium, lead, and mercury. Vetiver grass is effective for lead, while *Brassica juncea* is suitable for cadmium and chromium. These plants absorb heavy metals through their roots, removing them from the environment.

b. Phytodegradation: Certain plants produce enzymes capable of breaking down complex organic pollutants, such as polycyclic aromatic hydrocarbons.

c. Vermiremediation: This technique uses earthworms (*Eisenia fetida*) to treat contaminated soils. The earthworms enhance microbial activity and soil aeration, promoting the breakdown of hydrocarbons and improving soil structure.

D. Additional Recommendations

One critical trait observed in microbial strains used for bioremediation is their resilience, often due to their ability to withstand pollutants through the development of resistance. However, when these strains are used for bioremediation, their resistance genes can be transferred to pathogens in the environment, which can then enter the human system, leading to antibiotic resistance. It is essential to carefully select microbial strains with minimal resistance for bioremediation to prevent the spread of antibiotic-resistance genes (ARGs) within the environment.

VIII. CONCLUSION

This study highlights the urgent need for sustainable interventions to address the environmental and public health challenges caused by pollution at the Obosi automobile junk market. The improper disposal of hazardous materials, including used car oils, metals, plastics, and rubber wastes, has resulted in soil, water, and air pollution. Additionally, activities such as vehicular movement contribute to noise pollution. To mitigate these issues, a collaborative effort involving market stakeholders, local authorities, government agencies, and non-governmental organizations is essential. Addressing these challenges will not only improve the quality of life for market occupants but also preserve the environment for future generations.

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Use of Artificial Intelligence (AI)-Assisted Technology for Manuscript Preparation
The authors confirm that no AI-assisted technologies were used in the preparation or writing of the manuscript, and no images were altered using AI.

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