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Assessing the Ecological Footprints of Open Dumping in Olum, Anambra State, Nigeria: Implications for Human and Environmental Sustainability

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Abstract

The practice of open dumping (OD) has become a significant environmental and public health issue in Anambra State, Nigeria. This research investigates the ecological footprints of Olum open dump site in Anambra state and examines its implications for both human and environmental sustainability. Open dumping, a common waste management practice in both urban and rural areas, has led to severe environmental degradation, including soil contamination, water pollution, air pollution, and biodiversity loss. It also poses serious health risks, contributing to the spread of respiratory diseases, waterborne diseases, and vector-borne diseases among the local population. The study employs a mixed-methods approach, combining surveys, statistical analysis, field observations, and secondary data analysis to assess the scope of open dumping in Olum Anambra State. Findings suggest that Olum open dump-site is primarily located near water bodies, residential areas, and agricultural lands, exacerbating the ecological and health impacts. The study also highlights the socio-economic costs associated with open dumping, including increased healthcare expenditures, loss of aesthetic value, and hindrance to tourism and local business development. Based on these findings, the paper proposes recommendations to improve waste management infrastructure, enhance public awareness, strengthen policy enforcement, and foster community participation in waste management practices. The research underscores the urgent need for sustainable waste management practices to mitigate the negative impacts of OD and promote environmental and public health sustainability in Olum, Anambra State.

Keywords: Open Dumping, Environmental Sustainability, Ecological Footprint, Waste Management, Water Pollution, Human Health Impacts

Introduction

Open dumping is one of the most common waste disposal methods in many developing countries, including Nigeria. It involves the uncontrolled disposal of waste in open spaces without proper treatment, posing severe risks to the environment and public health (Ogundele *et al*., 2019). These dump-sites often become breeding grounds for disease-carrying organisms, sources of air, water, and soil pollution, and contributors to greenhouse gas emissions (WHO, 2020) [13]. There are also non communicable diseases (NCDs) that are brought about due to environmental pollution, such as cancer and asthma, or several defects evident at birth among infants (Reinhart and Townsend 2018) [11]. Air and water pollution are the most prevalent forms of environmental degradation in low-income countries (Xu *et al*. 2018) [14]. Yang *et al*. (2018) [15] identified five main categories of pollutants: particulates, sulfur oxides, nitrogen oxides (NOx), hydrocarbons, and carbon monoxide (CO). The rapid urbanization and population growth in Nigeria have led to an increase in waste generation, which has overwhelmed the capacity of waste management systems in many cities, including Awka, the capital of Anambra State (Federal Ministry of Environment, 2013). Waste management plays a pivotal role in maintaining environmental integrity and promoting public health (Okoye, P. (2019) [9]. The global demand for effective waste disposal systems is rising, especially in developing countries where rapid urbanization, population growth, and industrial activities contribute to an unprecedented increase in waste generation. In Nigeria, this issue is particularly severe, with a significant portion of waste ending up in open dumpsites. Anambra State, located in southeastern Nigeria, exemplifies the challenges associated with waste management due to its dense population, economic activities, and urban expansion (Onyema, O. (2020) [10]. In Anambra State, indiscriminate dumping of

solid waste has been linked to significant environmental pollution problems, including underground water pollution due to leaching of organic and inorganic substances, air pollution from suspended particles, odor pollution from municipal solid waste (MSW), and potential marine pollution from run-offs (Aluyi, E. (2018) [4]. These environmental issues have led to health risks for the local population, including respiratory diseases and other health complications (Okolo *et al*., 2024) [8]. The lack of effective waste management infrastructure, inadequate waste collection services, and poor waste disposal practices have contributed to the proliferation of open dump-sites like the Olum dump-site (Adeyemi *et al*., 2018) [3]. Open dumping is one of the common practice in Anambra State which also involves the uncontrolled disposal of waste in designated or undesignated areas without measures for environmental protection. This practice contributes to numerous ecological problems, including soil and water pollution, greenhouse gas emissions, and biodiversity loss. It also creates health risks for communities living near dumpsites, who are exposed to harmful pollutants, pathogens, and disease vectors (Adesina, A., & Chukwudi, O. (2017) [1].

The ecological footprint concept, which measures the environmental impacts of human activities, provides a valuable framework for analyzing the consequences of open dumping. By applying this concept to Olum in Anambra State, this paper aims to assess the ecological and human health impacts of OD as it has become a significant environmental concern due to its continuous expansion and lack of regulatory control and propose strategies for sustainable waste management.

Materials and Methods

This study employed a descriptive research design based on archival data, field assessment, geological mapping, spatial distribution maps, and water quality indices. Relevant records, reports, and past research findings were reviewed to assess the environmental effects of the Olum dump site. It employed a mixed-methods approach to collect both qualitative and quantitative data. The data collection process involved three main techniques:

Field Surveys: Field surveys were conducted at various open dumpsites across Anambra State. The primary objective was to assess the size, composition, and environmental conditions of the dumpsites. Observations were made on the proximity of these dumpsites to residential areas, rivers, and other natural resources. Photographs and GPS coordinates were recorded for documentation and analysis.

Interviews: Semi-structured interviews were held with local residents living near dumpsites, waste management officials, and environmental experts. These interviews aimed to gather insights on the perceived environmental and health impacts of open dumping. The interviews also sought to understand the challenges faced by waste management systems in the region and the public's awareness of proper waste disposal practices.

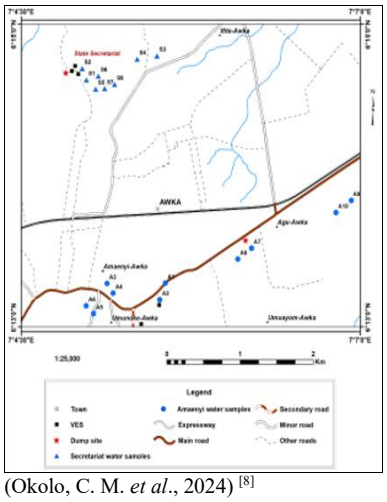
Secondary Data: Secondary data was gathered from government reports, academic studies, and environmental assessments. These documents provided context on the historical development of waste management policies in Anambra State, the current waste management infrastructure, and the broader environmental and public health trends in the region.

The data collected was analyzed using both qualitative and quantitative methods:

Quantitative Analysis: Statistical techniques were used to assess the relationship between the presence of open dumpsites and environmental degradation. The analysis focused on the correlation between dumpsite proximity to water bodies, the prevalence of waterborne diseases in nearby communities, and the incidence of respiratory diseases. GIS (Geographical Information System) software was used to map dumpsite locations, helping to visualize their spatial relationship with residential areas and water sources.

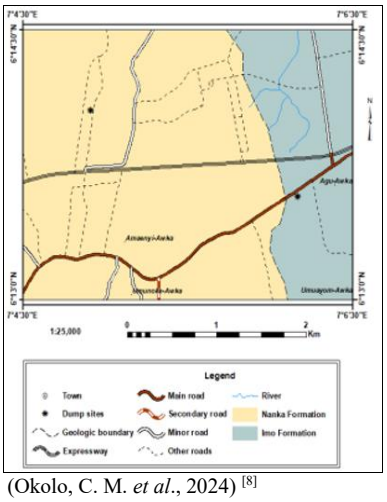
Qualitative Analysis: Thematic analysis was applied to interview responses. This process involved coding the responses into key themes related to environmental impacts, health concerns, waste management practices, and policy issues (Anambra State Ministry of Environment 2017) [5]. The aim was to identify recurring patterns and insights that could inform potential solutions for sustainable waste management.

Olum dumping site



(Okolo, C. M. *et al*., 2024) [8]

Sample location map of the study area



(Okolo, C. M. *et al*., 2024) [8]

Geological map of the study area

Results and Discussion

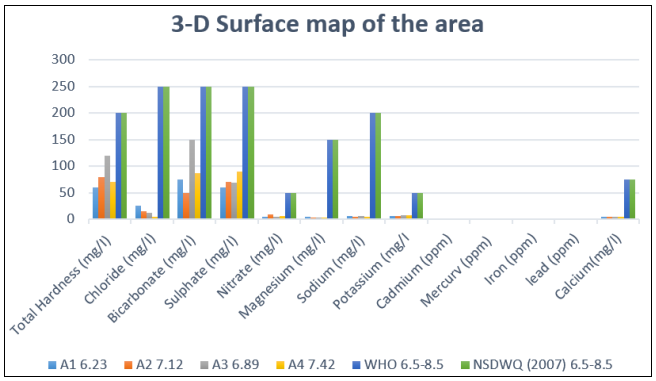
Result of water sample taking for analysis around the Olum dumpsite ((Okolo, C. M. *et al*., 2024) [8]

Parameters	A1	A2	A3	A4	WHO	NSDWQ (2007)
pH	6.23	7.12	6.89	7.42	6.5-8.5	6.5-8.5
Total Hardness (mg/I)	60	80	120	70	200	200
Chloride (mg/I)	25	15	12	5	250	250
Bicarbonate (mg/I)	75	50	150	87.5	250	250
Sulphate (mg/I)	59.275	70.424	68.145	89.919	250	250
Nitrate (mg/I)	4.597	8.806	5.355	6.114	50	50
Magnesium (mg/I)	3.893	3.202	2.944	3.098	150	150
Sodium (mg/I)	5.491	5.017	6.239	4.899	200	200
Potassium (mg/I	5.867	5.64	6.977	6.978	50	50
Cadmium (ppm)	0.5056	0.04	0.082	0.05	0.05	0.05
Mercurv (ppm)	0.014	0.019	0.012	0.017	0.01	0.01
Iron (ppm)	0.489	0.378	0387	0.422	0.3	0.3
lead (ppm)	0.0324	0	0	0	0.01	0.01
Calcium(mg/l)	4.892	4.603	4.938	5.189	75	75

The field surveys and data analysis revealed the following significant ecological impacts of open dumping in Anambra State:

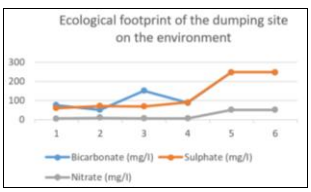
Soil Degradation: Olum Open dumpsites in Anambra State have led to soil contamination, primarily due to leachates from waste that seep into the soil. The composition of the waste ranging from plastics, food scraps, and metals to hazardous materials such as chemicals and electronics—has contributed to a decline in soil fertility. The presence of heavy metals such as lead and cadmium has been identified in soil samples taken from areas around dumpsites, posing a serious threat to agricultural productivity. In some cases, local farmers reported reduced crop yields and contaminated produce from lands near dumpsites.

Water Pollution: Approximately 70% of the open dumps surveyed were located near rivers, streams, or ponds, leading to significant water contamination. Leachates from these dumpsites infiltrate nearby water bodies, polluting drinking water sources and irrigation systems. Water quality tests conducted in nearby rivers revealed elevated levels of toxins, including heavy metals and bacteria, which pose direct threats to human health. Local residents reported frequent incidents of waterborne diseases such as cholera, typhoid, and dysentery.



Leachate infiltration index map

Air Pollution: The study found widespread air pollution in areas near olum due to the burning of waste. Open burning is a common practice to reduce waste volume and avoid manual labor. However, this leads to the release of harmful gases, including methane, carbon dioxide, and particulate matter. The high concentration of pollutants in the air exacerbates respiratory problems in nearby communities, particularly among vulnerable groups such as children and the elderly. Air quality assessments revealed levels of particulate matter (PM10 and PM2.5) that exceed the recommended limits by the World Health Organization (WHO).



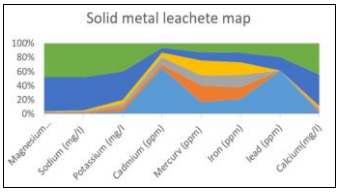


Fig 1 and 2 shows the impact widespread air pollution in area and the high amount of heavy metals in the water bodies

Biodiversity Loss: The encroachment of OD on natural habitats, particularly wetlands and forests, has resulted in the displacement of wildlife. Many species dependent on these ecosystems have faced reduced habitat availability, leading to a loss in biodiversity. Birds, amphibians, and small mammals that once thrived in these areas have either migrated or perished due to the degradation of their habitats.

Human Health Impacts

Respiratory Issues: A high prevalence of respiratory diseases, including asthma and chronic bronchitis, was observed in communities near olum dumsite. Interviews with local residents revealed that many individuals, particularly children and the elderly, experienced frequent coughing, wheezing, and difficulty breathing. Medical records from local clinics confirmed an uptick in respiratory illnesses in these areas, which correlated with the proximity of the dumpsites.

Waterborne Diseases: Waterborne diseases were reported to be common in communities near contaminated water sources. Cholera and typhoid fever outbreaks were particularly frequent during the rainy season, when runoff from dumpsites carried pathogens into drinking water supplies. Local health officials identified the absence of proper sanitation and waste management as key factors contributing to these health issues.

Vector-Borne Diseases: Dumpsites are breeding grounds for mosquitoes, rats, and other vectors that spread diseases such as malaria, leptospirosis, and leptospirosis. In Olum, there was a noticeable increase in malaria cases in areas near dumpsites, with mosquitoes thriving in stagnant water pools around the waste. Inhabitants of these areas reported higher-than-average incidences of malaria and other vector-borne diseases.

Challenges to Sustainable Waste Management in Olum

Several factors hinder the development of sustainable waste management in Olum Anambra State:

Inadequate Infrastructure: Anambra State's waste management infrastructure is insufficient to handle the growing volume of waste generated, particularly in urban areas. The absence of engineered landfills, waste segregation systems, and recycling facilities exacerbates the problem. Most waste is disposed of in open dumps without

any form of treatment or recycling, leading to environmental and health degradation.

Weak Enforcement of Policies: Despite the existence of waste management policies at the federal and state levels, enforcement remains weak. There is a lack of political will and resources to ensure compliance with waste management regulations. Local authorities often struggle to manage waste effectively due to limited funding, inadequate staffing, and a lack of public awareness about the importance of proper waste disposal.

Public Awareness: Many residents are unaware of the environmental and health risks associated with open dumping. This lack of awareness leads to the improper disposal of waste and resistance to adopting alternative waste management practices such as recycling and composting.

Recommendations

Based on the research, the following recommendations are made to improve waste management practices in Olum Anambra State:

- Development of Waste Management Infrastructure: There is an urgent need for investment in engineered landfills, recycling facilities, and waste segregation systems. This will help divert waste from open dumpsites and reduce environmental pollution. Moreover, waste-to-energy technologies can be explored as a sustainable alternative for waste disposal.
- Strengthening Policy Enforcement: Waste management policies should be strictly enforced to ensure compliance with established regulations. Local authorities should be empowered to monitor and regulate waste disposal practices effectively. This includes imposing fines for improper waste disposal and encouraging community participation in waste management efforts.
- Public Awareness Campaigns: Government agencies and NGOs should collaborate to launch public education campaigns that emphasize the importance of waste reduction, recycling, and safe disposal practices. Schools, community centers, and media outlets should be used as platforms to reach a wide audience.
- Community Involvement: Local communities should be actively involved in waste management efforts, including waste segregation and composting programs. Public-private partnerships can be established to improve waste collection services and promote sustainable practices at the grassroots level.
- Collaboration with International Partners: The government should seek partnerships with international organizations and private entities to secure funding and expertise for sustainable waste management programs. International models, such as those used in countries with successful waste management systems, can be adapted in Olum Anambra State.

Conclusion

The research of this study confirm that Olum dumping site in Anambra State has severe ecological and human health impacts. The practice not only contributes to environmental degradation but also poses significant risks to the health and well-being of nearby communities. To address these challenges, sustainable waste management practices must be adopted, including improved infrastructure, stronger policy enforcement, public education, and active community participation. By taking these steps, Anambra State can reduce its ecological footprint, protect human health, and move toward greater environmental sustainability.

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