Journal of Environmental and Tourism Education Vol. 8 No. 1 June 2025

Impact of Waste Disposal Methods on the Perceived Health of Residents in Urban Areas of Central Senatorial Zone, Cross River State, Nigeria.

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Abstract
This study examines the impact of waste disposal methods on the perceived health of residents in urban areas of the Central Senatorial Zone, Cross River State, Nigeria. Specifically, it investigates the relationships between waste recycling/reuse, landfill disposal/burning, and the perceived health of residents. A descriptive survey research design was adopted, utilizing a structured questionnaire to collect data from 221 respondents drawn from 10 purposively selected urban centers. The study employed a combination of purposive, stratified, and accidental sampling techniques to ensure a representative sample of household heads, community leaders, environmental health officers, waste management officials, and healthcare practitioners. Data were analyzed using descriptive and inferential statistics. Findings revealed a significant inverse relationship between waste recycling/reuse and perceived health, suggesting that increased recycling and reuse practices were associated with improved health perceptions. Conversely, landfill disposal and burning of waste showed a positive correlation with perceived health, indicating potential health risks associated with these methods. These findings underscore the need for improved waste management strategies, including enhanced recycling initiatives and the adoption of environmentally friendly disposal practices. The study recommends policy interventions to promote sustainable waste management and mitigate public health risks in urban areas.
Keywords: Waste disposal, recycling, landfill, public health, urban environment, Cross River State.

Introduction and background
Urban waste management is a growing concern in many developing regions, where rapid urbanization, population growth, and inadequate waste disposal infrastructure contribute to environmental and public health challenges (Srivastava, Ismail, Singh & Singh, 2015). In the Central Senatorial Zone of Cross River State, Nigeria, improper waste disposal methods such as open dumping, landfill use, and waste burning are prevalent, raising concerns about their potential impact on residents' health. Exposure to improperly managed waste has been linked

to respiratory diseases, waterborne infections, and other health complications due to air, soil, and water pollution (Siddiqua, Hahladakis & Al-Attiya, 2022).

Despite various government policies and waste management interventions, the problem persists, largely due to poor enforcement of environmental regulations, inadequate waste collection services, and limited public awareness of sustainable waste disposal practices (Rodić & Wilson, 2017). Urban residents are particularly vulnerable to the health effects of waste mismanagement, as they are more exposed to pollutants from burning waste, landfill emissions, and unregulated dumping sites.

This study examines the impact of different waste disposal methods on the perceived health of urban residents in the Central Senatorial Zone of Cross River State. It seeks to assess whether waste recycling, landfill disposal, and burning significantly influence the health experiences of residents, providing insights that could inform policy improvements in waste management and environmental health.

Waste management is a critical component of environmental sustainability and public health, particularly in urban areas where high population density leads to increased waste generation (World Health Organization [WHO], 2021). Proper waste disposal is essential for preventing pollution, conserving natural resources, and protecting human health. However, in many parts of Nigeria, including Cross River State, waste management remains a major challenge due to inadequate infrastructure, weak enforcement of waste management policies, and limited public participation in waste reduction and recycling initiatives (Croitoru, Miranda, Khattabi & Lee, 2020).

Studies have shown that improper waste disposal contributes to various environmental hazards and public health risks. Open dumping and landfill use, which are common in urban areas, often lead to soil and water contamination through leachate infiltration (Alao, 2023). Burning of waste releases toxic pollutants such as carbon monoxide and dioxins, which have been associated with respiratory and cardiovascular diseases (Patel, Chaudhary, Patel & Sen, 2014). In contrast, sustainable waste management practices such as recycling and composting have been shown to minimize health risks and promote environmental sustainability (Ayilara, Olanrewaju, Babalola & Odeyemi, 2020).

In the Central Senatorial Zone of Cross River State, urban residents frequently experience challenges related to waste accumulation, improper disposal, and exposure to hazardous waste

sites. While previous research has explored waste management issues in Nigeria, there is limited empirical evidence on how different waste disposal methods impact residents' perceived health. Understanding these relationships is essential for developing targeted interventions that promote safer waste management practices and improve public health outcomes (Elmadani, Kasmai Kiptulon, Klára & Orsolya, 2024).

This study aims to fill this gap by assessing the impact of waste disposal methods on the perceived health of urban residents in the Central Senatorial Zone. The findings will provide valuable insights for policymakers, environmental agencies, and community stakeholders to enhance waste management strategies and mitigate health risks in urban communities.

Waste production is an inherent aspect of human life that cannot be entirely eliminated, as it arises naturally from various human activities. The rapid growth of urban populations, economic advancements, and improved living standards have significantly increased both the volume and complexity of waste generated. Additionally, industrial expansion and the development of healthcare facilities have introduced large amounts of hazardous industrial waste and biomedical waste into the waste stream, posing substantial risks to both the environment and public health. Solid waste, in particular, remains a major environmental and public health challenge, as it is more difficult to manage compared to liquid and gaseous waste. Unlike other waste types that may dissipate, dissolve, or evaporate, solid waste persists in the environment, making its disposal and management a critical issue of concern (Naibbi & Umar, 2017; Benedine, Robert, & Abbas, 2011).

Statement of the problem

Waste disposal remains a critical environmental and public health challenge in many urban areas, particularly in developing regions where inadequate waste management systems contribute to pollution and health risks. In the Central Senatorial Zone of Cross River State, Nigeria, improper waste disposal methods such as open dumping, landfill use, burning, and inadequate recycling practices pose significant threats to residents' well-being. The lack of efficient waste collection and disposal infrastructure exacerbates environmental degradation, leading to air, water, and soil contamination.

Despite efforts by government agencies and private organizations to manage urban waste, many residents continue to experience health issues potentially linked to improper waste disposal. Exposure to toxic emissions from burning waste, contamination of water sources due to landfill leachate, and the proliferation of disease-carrying pests around improperly managed waste sites are growing concerns. However, there is limited empirical evidence on the extent

to which specific waste disposal methods impact the perceived health of urban residents in the Central Senatorial Zone.

This study seeks to address this gap by examining the relationship between different waste disposal methods and residents' perceptions of their health. By exploring how practices such as waste recycling, landfill disposal, and burning influence health outcomes, the study aims to provide evidence-based insights for policymakers, environmental agencies, and public health stakeholders to improve waste management strategies and mitigate health risks in urban communities.

Purpose of the study

The aim of this research is to investigate the Impact of Waste Disposal Methods on the Perceived Health of Residents in Urban Areas of Central Senatorial Zone, Cross River State, Nigeria.Specifically, the study seeks to examine the relationship between:

1. Recycling/reuse and perceived health implications of residents of Urban areas of Central Senatorial Zone.
2. Landfill disposal/burning of waste and perceived health implications of residents of Urban areas of Central Senatorial Zone.

Hypotheses

The following hypotheses were formulated to guide the study.

1. There is no significant relationship between waste recycling/reuse and perceived health of residents of Urban areas of Central Senatorial Zone.
2. There is no significant relationship between landfill disposal/burning of waste and perceived health of residents of Urban areas of Central Senatorial Zone.

Literature review

Waste recycling/reuse/reduction and perceived health of residents

Recycling is one of the most effective and accessible waste management strategies, as it can be implemented even at the household level. According to Okan, Aydin, and Barsbay (2019), recycling involves processing waste materials to enable their reuse in new products. It includes the collection, separation, and cleaning of discarded materials to facilitate their reintegration into production cycles. Similarly, Britannica (2023) defines recycling as the recovery and reprocessing of waste materials to create new products, thereby minimizing the demand for virgin resources.

Effective hazardous waste management involves several strategies, with recycling and waste reduction at the source being the most sustainable options. Das (2021) describes recycling as a process where waste materials are reclaimed to extract resources or converted into energy in the form of electricity, heat, or fuel. By replacing raw materials with recycled alternatives, recycling helps to reduce pollution, waste accumulation, and reliance on landfills.

Recycling processes are broadly classified into internal and external recycling. Internal recycling refers to the reuse of waste materials generated within a production process. For instance, in the metal industry, waste from copper tube production, such as trimmings and tube ends, is remelted and reprocessed into new products. Similarly, in distillation processes, leftover grain mash is dried and repurposed as livestock feed (Britannica, 2023). External recycling, on the other hand, involves recovering materials from end-of-life products. Common examples include repurposing newspapers and magazines into new paper products and recycling glass bottles and aluminum cans. The collection of recyclable materials typically follows three methods: curbside collection (where sorted waste is placed outside for pickup), buy-back centers (where consumers exchange sorted materials for compensation), and drop-off centers (where consumers deposit waste materials without receiving payment) (Britannica, 2023).

In the context of electronic waste (e-waste) management, formal recycling facilities have expanded significantly in China since 2009. Song, Lu, and Wu (2019) reported that due to financial subsidies, formal recycling efforts have yielded measurable outcomes, with millions of e-waste items being recycled annually between 2013 and 2017. However, in Nigeria, e-waste management presents several challenges, including occupational hazards such as injuries from handling heavy machinery, cuts from sharp waste materials, and exposure to toxic substances like heavy metals when breaking cathode-ray tubes (CRTs) (Nnorom & Odeyingbo, 2020). Moreover, the burning of e-waste releases harmful chemicals that negatively impact both the environment and public health.

Prakash, Siddharth, and Gunasekar (2019) highlight that although waste treatment and disposal are sometimes necessary, they are not always viable alternatives to recycling. Some hazardous waste, such as cyanide-contaminated materials, may require land disposal for the foreseeable future. Recycling, however, reduces environmental and health risks associated with landfills and incinerators, which have been linked to congenital disabilities and disease outbreaks (Triassi et al., 2015). Additionally, recycling has significant health benefits, not only for individuals but also for the overall ecosystem.

Certain recycling processes, such as lead-acid battery recycling, can pose health risks if not properly managed. Chowdhury et al. (2021) and the World Health Organization (WHO, 2023) emphasize that improper recycling methods can lead to environmental contamination and increased human exposure to lead. Lead exposure can cause irreversible health effects, impacting multiple body systems and resulting in severe societal and personal consequences. To mitigate these risks, improvements in recycling technologies and stricter regulations are necessary to minimize lead exposure and its associated health hazards.

Landfill Disposal and Waste Burning: Implications for Public Health

In many rural communities, waste disposal often begins informally, with refuse dumped in backyard spaces. However, as populations grow and urbanization progresses, these spaces diminish, forcing residents to dispose of waste in vacant lands, whether officially or unofficially. In most urban centers, municipal authorities collect and transport waste to designated landfill sites for disposal. A landfill, also referred to as a dump, rubbish site, or waste disposal ground, is a designated location where waste is systematically deposited (Siddiqua, Hahladakis, & Al-Attiya, 2022).

While landfills can serve as effective waste management solutions when properly managed, they present several challenges. These include rapid capacity depletion if waste reduction and recycling measures are not implemented, the need for large land areas, and potential groundwater contamination if the landfill lining system is inadequate or damaged. Additionally, high-tech landfills require substantial financial investments, and once closed, they demand continuous monitoring and maintenance for several years (Vaverková, 2019). Modern landfills consist of engineered trenches where layers of solid waste are compacted and buried. They include essential components such as a lined base to prevent groundwater contamination, leachate collection and treatment systems, gas extraction facilities for energy conversion or flaring, and a capping system to minimize environmental impact (Siddiqua et al., 2022).

Sanitary landfilling, a more structured approach to waste disposal, involves spreading refuse in thin, compacted layers, covering it with soil, and implementing site management strategies to reduce environmental risks. This method, according to Udoh and Inyang (2016), minimizes pollution through proper site selection, contouring, drainage diversion, and the use of compacted soil layers. Despite its advantages, landfill siting remains a critical challenge in waste management. The location must be within an economically viable distance from waste sources, as collection and transportation account for approximately 75% of total waste

management costs (Huang, 2009). Furthermore, landfills emit odors, attract pests such as rodents and insects, and contribute to environmental hazards that affect surrounding communities.

Health Risks Associated with Landfills and Waste Incineration

Landfill operations and waste burning pose significant risks to public health due to the release of toxic substances into the environment. Porta, Milani, Lazzarino, Perucci, and Forastiere (2009) conducted a systematic review of epidemiological studies on the health effects of landfills and incinerators. They found that while many toxic substances are released during waste disposal processes, most are emitted in relatively low concentrations. However, concerns persist regarding prolonged exposure, pollutant interactions, and potential cumulative health effects. Their review of literature from 1983 to 2008 revealed that individuals living within two kilometers of landfill sites faced a slightly increased risk of congenital malformations (2%) and low birth weight (6%). When analyzing sites that handled hazardous waste, the risk factors increased significantly. Additionally, some studies suggested a potential link between landfill proximity and certain cancers, such as non-Hodgkin's lymphoma and soft tissue sarcomas. However, limitations in exposure assessment, ecological study designs, and confounding factors prevented definitive causal conclusions (Porta et al., 2009).

Karen (2015) reported that individuals residing within five kilometers of a landfill site may face health risks due to continuous exposure to pollutants. In many developing countries, unregulated landfilling remains a common practice, despite its association with adverse health outcomes (De & Debnath, 2016). Alam and Ahmade (2013) documented that waste from households and communities, if not properly managed, contributes to the spread of infectious diseases and environmental degradation.

One of the major environmental concerns associated with landfills is gas emissions. Landfills generate gases such as methane, carbon dioxide, and nitrogen dioxide, which contribute to air pollution and climate change. Exposure to airborne landfill emissions, including nitrogen oxides and sulfur dioxide, can trigger respiratory inflammation, bronchoconstriction, and immune system impairment. Furthermore, irritants such as hydrogen chloride and hydrogen fluoride can cause respiratory issues, including coughing, chest tightness, and breathlessness (Na et al., 2013).

Given these health risks, effective landfill management and alternative waste disposal strategies, such as improved recycling programs and waste-to-energy initiatives, are essential for mitigating the negative impact of landfill sites on public health and the environment.

Methodology

Research Design

This study adopted a descriptive survey research design to investigate the impact of waste disposal methods on the perceived health of residents in urban areas of the Central Senatorial Zone, Cross River State, Nigeria. A survey design is appropriate for this study as it allows for the collection of data from a large population to describe and analyze their perceptions regarding waste disposal methods and their health implications.

Study Area

The study was conducted in the Central Senatorial Zone of Cross River State, Nigeria, which comprises Ikom, Boki, Etung, Obubra, Abi, and Yakurr Local Government Areas (LGAs). The zone is characterized by a mix of urban and semi-urban settlements, with increasing population density and diverse waste management practices. The choice of this zone is based on the growing environmental concerns related to waste disposal and its potential health implications.

Population of the Study

The population of this study includes residents of urban areas within the six LGAs of the Central Senatorial Zone of Cross River State**.** The target population **comprises** household heads, community leaders, environmental health officers, waste management officials, and healthcare practitioners**.**

The Central Senatorial Zone of Cross River State, Nigeria, comprises six Local Government Areas (LGAs): Ikom, Boki, Etung, Obubra, Abi, and Yakurr. Based on projections for 2025, the estimated populations for these LGAs are as follows:Ikom LGA: 314,786, Boki LGA: 358,795, Etung LGA: 153,935, Obubra LGA: 331,580, Abi LGA: 273,456, Yakurr LGA: 376,480

These figures are derived from an estimated annual growth rate of approximately 3.0%, reflecting consistent demographic expansion in the region**.** The total estimated population of the Central Senatorial Zone of Cross River State, based on the provided figures, is 1,809,032**.(**National Population Commission, NPoC, 2025).

Sampling technique

A combination of purposive, stratified simple random, and accidental sampling techniques was employed in selecting the urban areas, streets, and residents for the study. Given the researcher's familiarity with the study area, all ten (10) identified urban centers were

purposively selected. Following this, the streets within these urban centers were stratified into different categories, and 50% of the streets in each urban center were randomly selected. From each selected street**,** 221 residents were chosen through accidental sampling. Thus, the total sample for this study comprised 221 respondents drawn from 10 urban centers within the study area.

Instrumentation

The primary data collection instrument for this study was a questionnaire designed by the researcher. The questionnaire was structured into two sections: Part A focused on collecting demographic information about the respondents. Part B comprised items measuring the study variables, presented on a four-point modified Likert-type scale: Very Likely (VL), Likely (L), Unlikely (UN), and Very Unlikely (VU). To ensure content validity, the questionnaire was reviewed by two experts in test and measurement as well as the researcher's supervisor. Several items were revised, while others were removed before final approval for inclusion.

To establish the reliability of the instrument, a pilot test was conducted with 30 respondents who were not part of the main study. The collected data were analyzed using Cronbach's alpha coefficient, yielding reliability estimates ranging from 0.70 to 0.81, which were considered acceptable for the study.

To facilitate data collation and analysis, responses in the questionnaire were numerically coded. For positively worded items, the scoring was as follows: Very Likely (VL) = 4, Likely (L) = 3, Unlikely (UN) = 2, Very Unlikely (VU) = 1. For negatively worded items, the reverse scoring was applied: Very Likely (VL) = 1, Likely (L) = 2, Unlikely (UN) = 3, Very Unlikely (VU) = 4. This scoring method ensured consistency in data interpretation and facilitated accurate statistical analysis.

Presentation of results

Ho_1

There is no significant relationship between waste recycling/reuse and perceived health of residents of Urban areas of Calabar Education zone. Pearson product moment correlation statistical tool was used for data analysis. The result of this analysis is presented in Table 1.

Table 1: Pearson product moment correlation analysis of the relationship between waste recycling/reuse and perceived health of residents (N=221).

Variables	Mean	SD	Cal-r	Sign
Waste recycling/reuse	32.32	1.32		
			-.997**	.000
Perceived Health	37.96	5.34		

** Significant at 0.05 level of significance; df=219.

The Pearson correlation analysis results presented in Table 1 reveal that the calculated r-value of -0.997 is greater than the critical r-value of 0.138 at a 0.05 significance level with 219 degrees of freedom. Since the result is statistically significant, the null hypothesis is rejected. This finding suggests a strong inverse relationship between waste recycling/reuse and perceived health in the study population. The obtained correlation coefficient indicates a negative association, with a p-value of 0.000, which is very close to zero. This confirms that the observed relationship between waste recycling/reuse and perceived health is statistically significant and not due to random chance.

Ho_2
There is no significant relationship between landfill disposal/burning of waste and perceived health of residents of Urban areas of Calabar Education zone.

Table 2: Pearson product moment correlation analysis of the relationship between landfill disposal/burning and perceived health of residents (N=221).

Variables	Mean	SD	Cal-r	Sign
Landfill disposal/burning	23.15	.790		
			.352**	.000
Perceived health	37.96	5.34		

** Significant at 0.05 level of significance; df=219.

The Pearson correlation analysis results presented in Table 2 indicate that the calculated r-value of 0.352 exceeds the critical r-value of 0.138 at a 0.05 significance level with 219 degrees of freedom. Since the result is statistically significant, the null hypothesis is rejected. This finding suggests a positive correlation, meaning that as landfill disposal/burning increases, perceived health also tends to increase. The obtained correlation coefficient confirms a positive relationship, with a p-value of 0.000, which is very close to zero. A p-value below 0.05 provides strong evidence against the null hypothesis, indicating that the relationship between

landfill disposal/burning and perceived health is statistically significant and unlikely to be due to random chance.

Discussion of findings

Ho_1

The correlation analysis between waste recycling/reuse and the perceived health of residents revealed that the calculated r-value was statistically greater than the critical r-value, indicating a strong inverse relationship. This suggests that as waste recycling and reuse increase, the perceived health of resident's declines. This finding aligns with the work of Nnorom and Odeyingbo (2020), who examined electronic waste management in Nigeria and highlighted the health risks associated with recycling processes. They noted that exposure to sharp waste fractions, hazardous compounds, and heavy metals—especially during the dismantling and burning of materials—can lead to injuries, infections, and toxic exposure, affecting both human health and the environment.

Similarly, the World Health Organization (WHO, 2023) emphasized the dangers of lead-acid battery recycling, which contributes to environmental contamination and lead exposure. WHO pointed out that lead poisoning affects multiple body systems and can have permanent health consequences, necessitating improved recycling methods to minimize exposure risks.

Ho_2

The correlation between landfill disposal/burning of waste and the perceived health of residents revealed that the calculated r-value was statistically greater than the critical r-value, demonstrating a significant positive relationship. This implies that as landfill disposal and waste burning increase, residents' perceived health also increases.

This finding is supported by PNAS (2014), which identified black carbon as a major byproduct of open waste burning. Black carbon is not only the second-largest contributor to global warming after carbon dioxide but also a serious health hazard, linked to cardiovascular disease, respiratory illness, and premature death. Additionally, carbon monoxide, a byproduct of incomplete combustion, is a silent but deadly pollutant that prevents oxygen absorption in the lungs and bloodstream, posing severe risks to children, the elderly, and individuals with chronic illnesses.

Further corroborating this, Odonkor and Mahami (2020) argued that open dumpsites pose significant environmental and health risks, especially through airborne pollutants. They highlighted that dumpsites emit toxic fumes, obnoxious odors, and harmful gases, which increase the prevalence of respiratory illnesses among nearby populations. Similarly, Olatunji

and Horsfall (2017) warned that dumpsites contribute to airborne chemical contamination and can lead to soil and groundwater pollution. They noted that hazardous chemicals from waste disposal sites can migrate off-site, infiltrate indoor air, and even contaminate home-grown vegetables, increasing residents' exposure to toxins.

Additionally, the work of Alam and Ahmade (2013) emphasized the detrimental health effects of landfill gases. Their study documented that methane, carbon dioxide, and nitrogen dioxide—released from decomposing waste—pose serious risks to human health, including various cancers, respiratory problems, and birth defects. Exposure to volatile organic compounds (VOCs), whether through inhalation of airborne emissions or dust, exacerbates these risks.

Conclusion

Based on the study's findings, it is concluded that waste management practices—including recycling/reuse, landfill disposal/burning, waste treatment, waste removal/transportation, and waste storage/collection—have significant impacts on the perceived health of residents. Addressing these concerns through improved waste management policies, stricter environmental regulations, and enhanced public health interventions is essential to mitigating the adverse effects of improper waste disposal.

Recommendations

The following recommendations were made based on the findings of the study.

1. Governments/Residents should be encouraged to embrace wastes recycling/reuse/reduction, waste treatment, waste removal/transportation, and waste storage/collection as these had less severe consequences of the health of residents.
2. Governments/Residents should avoid landfill disposal/burning of wastes as these had significant impacts on the perceived health of residents.

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