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Socio-Environmental Impacts and Perceived Health Risks of Open Waste Burning in Jos South LGA, Nigeria

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Abstract

Municipal solid waste (MSW) management remains a critical environmental and public health challenge across many peri-urban communities in Sub-Saharan Africa, where inadequate waste collection infrastructure and weak institutional capacity often necessitate unsustainable disposal practices. Among these, the open burning of municipal solid waste persists as a widespread method of waste management, contributing significantly to environmental degradation, atmospheric pollution, and adverse health outcomes. This study investigates the socio-environmental impacts, perceived public health risks, and policy implementation challenges associated with open waste burning in Jos South Local Government Area (LGA), Nigeria. A mixed-methods research approach was adopted, integrating quantitative and qualitative techniques to provide a comprehensive assessment of the problem. Primary data were collected using a cross-sectional survey, key institutional stakeholder interviews, and direct field observations. The sample size ($n = 100$) was determined using the Krejcie-Morgan sampling model to ensure statistical representativeness. The findings reveal that 57% of respondents engage in open waste burning on a regular basis, with most households burning waste at least once per week. The practice is predominantly driven by deficiencies in formal waste collection and disposal systems, identified by 70% of respondents as the principal motivating factor, alongside limited institutional response and inadequate enforcement of environmental regulations. Survey participants further associated prolonged exposure to open waste burning with increased incidences of respiratory-related health complaints, highlighting the potential public health implications of continued reliance on this disposal method. To address these challenges, this study proposes a transitional waste management framework comprising decentralized community-based waste banks, integrated Public-Private Partnerships (PPPs), and localized legislative interventions. The proposed framework aligns with the objectives of the United Nations Sustainable Development Goals (SDGs 3, 11, and 13), promoting improved public health, sustainable urban development, and climate action.

Keywords

Environmental Health Risks; Municipal Solid Waste; Open Waste Burning; Policy Implementation Gaps; Sustainable Development Goals (SDGs).

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INTRODUCTION

Anthropogenic climate change and local air pollution crises are increasingly driven by unmonitored short-lived climate pollutants (SLCPs) originating from municipal structural failure. While global climate mitigation architectures heavily emphasize commercial industry and transportation decarbonization, the open burning of municipal solid waste contributes to greenhouse gas emissions and local air pollution. Uncontrolled combustion releases significant volumes of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and black carbon (Wiedinmyer et al., 2014), contributing to declining air quality while multiplying the atmospheric heat-trapping capacity. The World Bank's Environmental and Social Standards (ESS3 and ESS4) mandate resource efficiency, pollution minimisation, and community health protection frameworks. Concurrently, UN Sustainable Development Goals (SDG 11: Sustainable Cities; SDG 13: Climate Action) demand immediate infrastructure upgrades to eliminate urban environmental health hazards (Hoorweg & Bhada-Tata, 2012; Kaza et al., 2018). Although Nigeria has adopted various international environmental agreements and established regulatory measures through the National Environmental Standards and Regulations Enforcement Agency (NESREA), effective implementation and enforcement at the municipal level remain inadequate. In peri-urban landscapes like Jos South Local Government Area (LGA), Plateau State, Nigeria, rapid population growth has overwhelmed existing municipal waste services. As a result, open burning has become a common waste disposal practice for waste volume mitigation. This paper contributes to understanding by providing a localized assessment of the socioeconomic drivers,

perceived health impacts, and institutional challenges associated with open waste burning in Jos South LGA.

THEORETICAL FRAMEWORK & LITERATURE REVIEW

This research integrates three (3) distinct socioeconomic and environmental architectures to capture the multi-scalar dynamics of municipal solid waste mismanagement:

- Environmental Risk Transition Theory (Smith & Ezzati, 2005): Projects how communities transition across developmental curves. Jos South represents a 'slow environmental transition' phase, where conventional traditional hazards (unregulated waste combustion, open dumping) persist alongside modern technological externalities (e-waste imports, specialized clinical waste mixing), generating multiple environmental risks for residents.
- Bronfenbrenner's Ecological Systems Theory (Bronfenbrenner, 1979): Dissects systemic drivers across nested layers: the Microsystem reveals path-dependent domestic routines; the Mesosystem charts community market networks driving localized burning spots; the Exosystem highlights local government administrative bottlenecks; and the Macrosystem captures cultural perceptions that may influence waste disposal practices.
- Modified Environmental Kuznets Curve (EKC): Postulates that environmental pollution peaks before declining with economic modernization. This study establishes that in Sub-Saharan developing contexts, a passive income-pollution threshold does not trigger automatic environmental remediation (United Nations Environment Programme [UNEP], 2019); rather, explicit policy enforcement mechanisms and alternative infrastructure

investments are required to alter the curve (Ferronato & Torretta, 2019).

MATERIALS AND METHODS

A mixed-methods research design was adopted across six wards of Jos South LGA: Bukuru,

Du, Gyel, Kuru, Vwang, and Zawan wards. The target population was evaluated using the Krejcie and Morgan finite sample size determination formula:

$$n = [\chi^2 NP(1-P)]/[e^2(N-1) + \chi^2 P(1-P)] \quad (1)$$

where; n = sample size, N = population size, P = population proportion (0.5), e = margin of error, χ^2 = chi-square value at 95% confidence level

Accounting for a finite regional pool (N = 400,000) and a designated exploratory margin of error (e = 0.09-0.10), the sample matrix established a representative cohort of 100 household members and key institutional actors (Krejcie & Morgan, 1970). Primary field data were collected through stratified random household questionnaires paired with purposive selection of key informants (health workers, environment inspectors, students and other residents). The questionnaire instrument was validated through expert review within the Department of Sustainable Environmental Studies, while a pilot test was conducted to ensure clarity and reliability of responses.

Ethical considerations including informed consent, anonymity, and voluntary participation were strictly observed during data collection. Quantitative metrics were tabulated via SPSS v25.0 utilizing descriptive frequency models and inferential chi-square analytics ($\alpha=0.05$). Qualitative narratives underwent thematic analysis using NVivo software to map behavioral justifications, while field observations helped identify areas where open waste burning was common

The study primarily relied on self-reported responses and observational assessments; therefore, findings should be interpreted

within the context of exploratory environmental research.

RESULTS AND DISCUSSION

Socioeconomic Drivers and Prevalence of Open Waste Burning

The findings indicate that open waste burning remains a common waste disposal practice among households in Jos South LGA. The high proportion of respondents engaging in weekly or daily burning suggests that the practice has become normalized due to inadequate waste management infrastructure. The lack of regular waste collection services reported by respondents demonstrates that residents often rely on self-managed disposal methods to prevent waste accumulation around homes and business premises.

The predominance of plastics, paper products, textiles, and organic waste within the waste stream further increases environmental concerns because these materials release harmful pollutants when burned in open spaces. Plastics, in particular, are known to emit toxic substances such as dioxins, furans, and particulate matter when subjected to uncontrolled combustion.

Table 1. Community-Level Waste Typology and Combustion Frequency Matrix

Ward	Burning Frequency/Week	Predominant Waste Type
Bukuru	5	Plastics, Food Residues, Paper, Textiles
Du	3	Plastics, Agricultural Residues, Cardboard
Vwang	4	Plastics, Clinical Packaging, Biomass
Gyel	4	Plastics, Household Organic Waste
Zawan	5	Plastics, Industrial Scraps, Paper
Kuru	4	Plastics, Household Organic Waste

Source: Field Survey, 2025.

The findings support the Environmental Risk Transition Theory, which suggests that communities in developing regions continue to experience traditional environmental risks due to limited infrastructure and institutional capacity. Similar observations have been reported by Ferronato and Torretta (2019), who found that inadequate waste management systems remain a major driver of open waste burning across many developing countries.

Furthermore, the significant relationship between access to waste collection services and waste burning practices indicates that improving municipal waste collection could substantially reduce the prevalence of open burning in the study area.

Perceived Environmental Impacts of Open Waste Burning

Respondents expressed concern regarding the environmental effects of open waste burning.

Common observations included excessive smoke generation, unpleasant odours, reduced air quality, and environmental nuisance within residential areas. These perceptions suggest that open burning contributes significantly to environmental degradation at the community level.

Field observations confirmed the presence of smoke plumes and ash deposits around common burning locations, particularly near markets and residential clusters. Such conditions may affect visibility, reduce aesthetic quality, and contribute to local atmospheric pollution.

The findings are consistent with previous studies which have identified open waste burning as a major source of greenhouse gases and air pollutants. According to Wiedinmyer et al. (2014), open burning contributes significantly to emissions of carbon dioxide, methane, black carbon, and other pollutants that influence both local air quality and global climate change.

The environmental concerns reported by respondents highlight the need for sustainable waste management alternatives that prioritize waste reduction, recycling, and controlled disposal methods.

Perceived Health Risks Associated with Open Waste Burning

A substantial proportion of respondents associated exposure to waste-burning smoke with respiratory discomfort, coughing, breathing difficulties, eye irritation, and headaches. Although this study relied on perceptions rather than clinical diagnosis, the consistency of responses across wards suggests widespread public concern regarding potential health impacts.

Respondents perceived women and children as potentially more vulnerable due to their frequent involvement in household waste handling activities. Previous studies have reported associations between prolonged exposure to particulate matter and respiratory or cardiovascular conditions.

Table 2. Community Suggested Interventions for Reducing Open Waste Burning

Suggested Intervention	Frequency	Percentage (%)
Improved waste collection services	82	82.0
Increased public awareness campaigns	74	74.0
Provision of waste bins	69	69.0
Stronger law enforcement	63	63.0
Establishment of recycling centres	58	58.0
Community sanitation programmes	51	51.0

Source: Field Survey, 2025.

Perceived Health Implications of Open Waste Burning

The findings of this study are consistent with previous research that has documented the adverse health implications associated with exposure to air pollutants generated from waste combustion. Studies by Brook et al. and Schraufnagel et al. reported significant associations between exposure to ambient air pollution and a wide range of adverse health outcomes, particularly respiratory and cardiovascular disorders. In the present study, respondents frequently associated open waste burning with respiratory discomfort, coughing, eye irritation, and related health concerns, suggesting a strong community perception of the potential health risks posed by the practice. Although the present investigation did not include clinical or epidemiological assessments to establish direct causal relationships, the findings indicate that reducing the prevalence of open waste burning could contribute to improved environmental quality, enhanced public health, and an overall improvement in community well-being. Given that the study relied primarily on self-reported responses, the observed health effects should be interpreted as perceived health risks rather than medically verified outcomes.

Public Awareness and Community Perception

The study revealed varying levels of public awareness regarding the environmental and health consequences of open waste burning. While a majority of respondents acknowledged that waste burning generates smoke, unpleasant odours, and atmospheric pollution, many demonstrated limited understanding of the long-term ecological, climatic, and health-related implications associated with prolonged exposure to combustion-derived pollutants. This knowledge gap may partly explain the

continued acceptance and widespread use of open burning as a routine waste disposal practice. In many households, open burning is perceived as a convenient, inexpensive, and immediate solution to waste accumulation, particularly in areas where formal waste collection and disposal services are either inadequate or completely absent. The persistence of such perceptions highlights the importance of targeted environmental education and community sensitization programmes. Strengthening public awareness through sustained information campaigns, community engagement initiatives, and environmental literacy programmes could significantly influence behavioural change and encourage the adoption of more sustainable waste management practices.

Regulatory and Institutional Challenges

The findings further demonstrate substantial discrepancies between existing environmental regulations and their practical implementation within Jos South Local Government Area. Although national environmental policies and regulatory frameworks prohibit indiscriminate waste disposal and uncontrolled waste burning, most respondents reported limited enforcement activities and minimal regulatory presence within their communities. The low level of awareness regarding environmental regulations suggests ineffective communication and insufficient outreach between regulatory agencies and local populations.

Furthermore, institutional constraints such as inadequate waste management infrastructure, insufficient technical personnel, limited operational funding, poor logistical support, and weak environmental monitoring capacity continue to undermine the effective implementation of environmental policies. These limitations reduce the ability of

relevant authorities to enforce compliance and promote sustainable waste management practices. The results reinforce the widely accepted view that the effectiveness of environmental policies depends not only on the existence of legislation but also on the availability of adequate institutional capacity, stakeholder participation, public awareness, and robust enforcement mechanisms. In the absence of these supporting structures, regulatory frameworks are unlikely to achieve their intended outcomes. The governance and implementation challenges identified in this study are consistent with the observations of the United Nations Environment Programme, which identified weak institutional frameworks, inadequate financing, and limited enforcement capacity as major impediments to effective municipal waste management across many African urban centres.

CONCLUSION AND RECOMMENDATIONS

This study evaluated the socio-environmental impacts, perceived health implications, and policy implementation challenges associated with the practice of open municipal solid waste (MSW) burning in Jos South Local Government Area, Plateau State, Nigeria. The results demonstrate that open waste burning remains a common and persistent waste disposal strategy among residents, primarily driven by inadequate waste collection and disposal infrastructure, limited access to alternative waste management options, economic constraints, and insufficient institutional support mechanisms.

The findings highlight substantial environmental concerns linked to the practice, including atmospheric pollution, persistent smoke emissions, offensive odours, and general environmental degradation. Furthermore, a significant proportion of respondents

associated exposure to waste-burning emissions with adverse health effects such as respiratory discomfort, coughing, eye irritation, and other related ailments. Although these observations are based on community perceptions rather than clinical assessments, they underscore a high level of public awareness regarding the potential health and environmental consequences of uncontrolled waste combustion.

The study also identified critical deficiencies in environmental governance and waste management policy implementation. These include low levels of public awareness of existing environmental regulations, inadequate enforcement of waste management policies, limited technical and financial capacity of municipal authorities, and weak stakeholder engagement. Collectively, these challenges continue to hinder the development of an efficient and sustainable waste management system within the study area.

To mitigate the prevalence of open waste burning, this study recommends strengthening municipal waste collection and transportation infrastructure, enhancing environmental regulatory enforcement, expanding public environmental education and awareness campaigns, promoting community-based recycling and composting initiatives, and fostering Public-Private Partnerships (PPPs) to improve waste management service delivery. Additionally, the establishment of decentralized waste recovery and resource-recycling centres would provide viable alternatives to open burning while creating economic opportunities for local communities. The implementation of these measures will contribute significantly to improved environmental quality, reduced public health risks, enhanced urban sustainability, and the

attainment of the United Nations Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

RECOMMENDATIONS

- Improve municipal waste collection coverage to ensure regular and efficient waste disposal services across all communities.
- Establish community recycling centres to promote waste segregation, recycling, and resource recovery.
- Intensify environmental awareness campaigns to educate residents on the environmental and health risks of open waste burning.
- Strengthen enforcement of NESREA regulations through regular monitoring and compliance activities.
- Promote public-private partnerships to support sustainable waste management and improve service delivery.
- Provide adequate waste bins and designated collection points to discourage indiscriminate waste disposal and open burning.

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