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Environmental and Economic Sustainability of Solid Waste Management in Muda Lawal Market, Bauchi, Nigeria

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Abstract

Solid waste management (SWM) in urban commercial markets in northern Nigeria remains poorly documented, particularly with respect to economic, rather than solely environmental, sustainability. This study assessed the environmental and economic sustainability of SWM practices in Muda Lawal Market, Bauchi State, Nigeria. A descriptive survey design was adopted. Data were collected from 240 respondents (traders, waste handlers and market authorities) selected by stratified and purposive sampling from a population of 600, with the sample size determined using Yamane's (1967) formula. Structured questionnaires, semi-structured interviews and an observation checklist were used, and data were analysed using descriptive statistics in SPSS. Organic (55.0%) and plastic (27.5%) waste were the dominant fractions, and 95.4% of respondents reported increased waste quantities during peak trading periods. Management practices were informal, disposal-oriented and lacked source segregation, producing a high perceived environmental impact (grand mean = 4.38) characterised by pollution, drainage blockage and disease-vector proliferation. Economically, 61.7% of respondents earned no income from waste-related activities, 88.3% reported financial losses attributable to poor waste management, and 90.8% associated market cleanliness with higher sales. Respondents agreed that stronger policy, infrastructure investment and multi-stakeholder collaboration are required for sustainability (grand mean = 4.47). The study concludes that SWM in Muda Lawal Market is currently both environmentally and economically unsustainable, and recommends source segregation, resource-recovery infrastructure and sustainable financing mechanisms as reform priorities.

Keywords

Circular Economy,
Economic Sustainability,
Environmental Impact,
Muda Lawal Market,
Solid Waste Management



Introduction

Solid waste management (SWM) is a critical environmental, economic and public-health challenge worldwide, particularly in developing countries where rapid urbanisation and expanding commercial activity have outpaced municipal capacity (Mor & Ravindra, 2023; Shah & Coad, 2024). Markets are among the largest generators of solid waste in these settings. They produce heterogeneous streams of organic, plastic, paper and metal waste which, when poorly managed, contribute to soil and water contamination, drainage blockage, disease-vector proliferation and air pollution (Kohli et al., 2024; Njeru, 2023).

Ineffective waste management also carries substantial economic consequences. Waste is increasingly regarded as a potential resource that can generate revenue and employment through recycling, composting and material recovery, rather than as a disposal burden alone (Lee et al., 2024; Park, 2024). In many Nigerian cities, however, fragmented institutional arrangements and weak enforcement of environmental regulation undermine both the environmental and economic sustainability of municipal waste systems (Ezeah & Roberts, 2014).

Muda Lawal Market, one of the largest commercial hubs in the Bauchi metropolis, exemplifies this challenge: source segregation is absent, and organic, plastic, paper and hazardous fractions are collected as a single unmanaged stream with no structured mechanism for recycling or recovery. Ugwu et al. (2020)

The economic dimension of market waste management remains comparatively under-examined in north-eastern Nigeria. This includes the costs borne by traders, the income potential of recoverable waste, and the relationship between market cleanliness and commercial performance. This study addresses that gap by assessing the environmental and economic sustainability of SWM practices in Muda Lawal Market, Bauchi State. The specific objectives were to: (i) determine the types and quantities of solid waste generated; (ii) examine existing waste management practices; (iii) assess the environmental impacts of these practices; (iv) evaluate their economic impacts, including costs and potential benefits; and (v) assess overall environmental and economic sustainability indicators for the market.

Materials and Methods

Study Area

The study was conducted in Muda Lawal Market, one of the largest and most active commercial markets in the Bauchi metropolis, Bauchi State, in northeastern Nigeria. The market forms part of the city's central business district, occupying an urban block bounded approximately between latitude 10.30°N and 10.32°N and longitude 9.83°E and 9.86°E, with over 500 shops and business outlets serving high daily patronage.

Research Design, Population and Sampling

A descriptive survey design was adopted to allow systematic, non-manipulative collection of data on waste generation, management practices and sustainability outcomes. The study population comprised

600 stakeholders: 500 traders, 80 waste handlers and 20 market authorities. A sample size of 240 was determined using Yamane's (1967) formula, $n = N / [1 + N(e^2)]$, with a 0.05 margin of error, and proportionally distributed across strata as 200 traders, 32 waste handlers and 8 market authorities. Traders and waste handlers were selected using stratified random sampling, while market authorities were selected purposively on account of their administrative and regulatory role.

Data Collection Instruments

Primary data were collected using three instruments: structured questionnaires administered to traders and waste handlers, capturing waste types and quantities, management practices, environmental perceptions and cost-related variables; semi-structured interviews with market authorities on policy, financing and enforcement issues; and an environmental observation checklist verifying waste storage, segregation, drainage conditions and disposal practices. Field administration was conducted in English and Hausa by seven trained field assistants. Secondary data were obtained from academic literature, government publications and market administrative records. Instruments were pre-tested, and internal consistency was assessed using Cronbach's Alpha (minimum threshold of 0.70).

Method of Data Analysis

Quantitative data were analysed using descriptive statistics, frequencies, percentages, means and standard deviations, computed in SPSS. Perceptual (Likert-scale) items were interpreted using the following mean-score bands: 1.00-1.49 = Strongly Disagreed; 1.50-2.49

= Disagreed; 2.50-3.49 = Neutral; 3.50-4.49 = Agreed; and 4.50-5.00 = Strongly Agreed. Qualitative data from interviews were analyzed thematically. All 240 questionnaires administered were retrieved, representing a 100% response rate.

Results and Discussion

Socio-Demographic Characteristics of Respondents

Of the 240 respondents, 61.7% were male and 38.3% were female. The predominant age group was 36-45 years (35.4%), followed by 26-35 years (30.0%). Secondary education was the most common qualification (36.7%), and traders constituted 83.3% of the sample, with waste handlers (13.3%) and market authorities (3.3%) making up the remainder. The majority of respondents (38.3%) earned between ₦20,000 and ₦50,000 monthly, reflecting the predominantly low-income profile of market traders in Bauchi State.

Types of Solid Waste Generated

Organic waste was confirmed as the single largest fraction of solid waste generated in Muda Lawal Market (55.0%), followed distantly by plastic waste (27.5%); paper/cardboard, metal, hazardous and other materials together accounted for only 17.5% (Figure 1). This composition is consistent with Ugwu et al. (2020) and Kohli et al. (2024), who similarly report food and organic remnants as the dominant fraction of institutional and commercial waste streams.

Separately, on a perceived-severity item, a combined 85.5% of respondents rated the presence of plastic waste in the market as "high" or "very high" the most skewed distribution among the secondary

waste streams assessed corroborating Garcia-Garcia et al. (2024) on the compounding pollution risk of plastic waste at this scale. An overwhelming 95.4% of respondents reported some

degree of increase in waste quantity during peak trading periods, underscoring that waste generation in the market is highly variable rather than a stable daily flow.

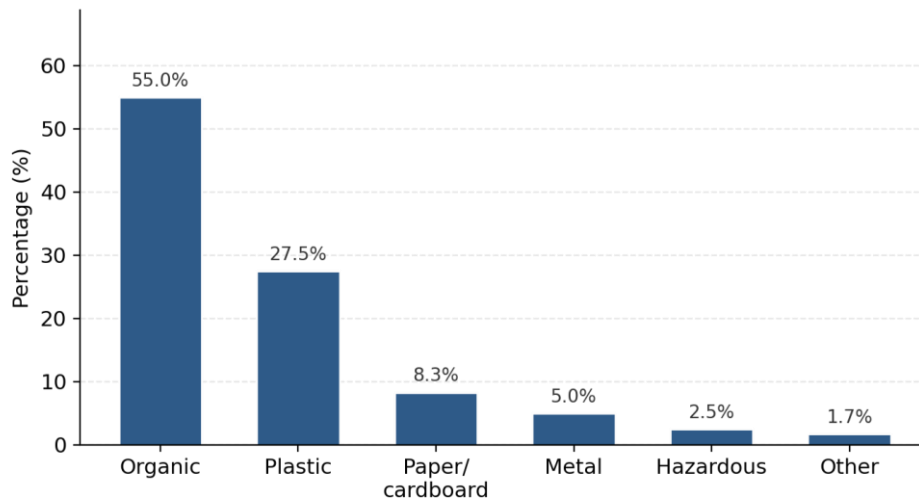


Figure 1: Dominant Type of Solid Waste Generated in Muda Lawal Market
Source: Field Survey, 2026.

Existing Solid Waste Management Practices

Waste in Muda Lawal Market is handled through an informal, labour-intensive arrangement rather than a structured municipal system. Waste moves through four sequential stages: on-site generation and storage at trader stalls (with negligible source segregation), internal collection by informal collectors ("babban bola") to temporary secondary dumpsites ("bingi"), and final off-site evacuation and open dumping by the Bauchi State Environmental Protection Agency (BASEPA).

This linear, disposal-oriented chain lacks the segregation, treatment and recovery stages central to Integrated Solid Waste Management (Mor & Ravindra, 2023), and mirrors the fragmented institutional arrangements and weak enforcement

documented more broadly in Nigerian municipal waste governance by Ezeah and Roberts (2014).

Environmental Impacts of Solid Waste Management Practices

Respondents strongly agreed that current waste management practices generate significant adverse environmental effects, recording a grand mean of 4.38 (Table 1). The clearest visible signs of pollution (mean = 4.55) and disease-vector proliferation (mean = 4.41) were the most strongly endorsed indicators, while drainage blockage (mean = 4.18) was also rated as a recurrent problem. These findings are consistent with Mor and Ravindra (2023) and Njeru (2023), who document similar linkages between poor solid waste disposal, ecological degradation and public-health risk in

comparable low- and middle-income settings.

Table 1: Mean Scores for Environmental Impacts of Solid Waste Management Practice

Statement	Mean	Std. Dev.
Visible signs of pollution due to poor waste management	4.55	0.58
Waste disposal practices contribute to environmental pollution	4.47	0.67
Poor waste management contributes to disease vectors	4.41	0.70
Improper waste disposal is prevalent in the market	4.38	0.72
The surrounding environment is adversely affected	4.29	0.79
Drainage systems are blocked due to improper disposal	4.18	0.83
Grand Mean	4.38	0.54

Source: Field Survey, 2026.

Economic Impacts of Solid Waste Management Practices

Market-level expenditure on waste management was moderate, with 68.0% of markets/associations spending between ₦1,000 and ₦9,999 monthly, but individual cost-recovery was weak: 50.0% of traders paid less than ₦1,000, or nothing at all, towards waste management. Income from waste-related activities was almost entirely absent, with 61.7% of respondents earning nothing from recyclables, compost or reusable materials in the preceding twelve months, confirming that the economic potential of waste as a resource (Park, 2024; Lee et al., 2024) remains largely untapped in the market.

By contrast, 88.3% of respondents reported measurable financial losses attributable to poor waste management, chiefly through damaged goods and reduced patronage, while 90.8% reported that sales increase to some degree when the market is clean, with 65.0% reporting increases of 10% or more. This asymmetry between negligible waste-derived income and substantial reported losses provides the clearest empirical evidence that the market's current waste system generates

net economic costs rather than economic value, consistent with Albizzati et al. (2024), who found that systems reliant on basic collection alone, without integrated recycling or recovery, tend to incur recurrent costs without offsetting revenue.

Environmental and Economic Sustainability Indicators

Respondents strongly endorsed the policy, infrastructural and behavioural changes required for sustainability, recording a grand mean of 4.47 (Table 3). The need to strengthen government policy (mean = 4.63) and to invest in waste management infrastructure (mean = 4.58) were the most strongly endorsed items, followed by community awareness programmes (mean = 4.55) and multi-stakeholder collaboration (mean = 4.47).

These findings align with Sustainable Development Theory (Brundtland, 1987) and the Integrated Solid Waste Management framework, both of which emphasise institutional coordination, technological investment and community participation as prerequisites for sustainable waste outcomes.

Table 2: Mean Scores for Environmental and Economic Sustainability Indicators

Statement	Mean	Std. Dev.
Government policies need to be strengthened	4.63	0.53
Investment in waste management infrastructure is essential	4.58	0.56
Community awareness programmes can improve practices	4.55	0.58
Collaboration between government, traders and private sector helps	4.47	0.64
Economic incentives should be provided for proper disposal	4.39	0.70
Socio-economic factors influence waste management behaviour	4.21	0.80
Grand Mean	4.47	0.48

Source: Field Survey, 2026.

Conclusion and Recommendation

Solid waste management practices in Muda Lawal Market, Bauchi State, are both environmentally and economically unsustainable. The market generates a large, organic- and plastic-dominated waste stream that is managed through an informal, disposal-oriented system lacking segregation, treatment or recovery, resulting in a high environmental impact (grand mean = 4.38) and a net economic cost to traders, who report substantial losses (88.3%) alongside negligible waste-derived income (only 8.3% earning ₦20,000 or more). At the same time, the strong, near-universal association between market cleanliness and increased sales (90.8%) demonstrates that the economic case for reform is both real and already perceived by market participants themselves.

Achieving sustainability in this context requires a shift from the current linear disposal model to an integrated, resource-oriented approach. Based on these findings, it is recommended that:

- (i) BASEPA and market authorities develop and enforce minimum standards for waste storage, segregation and collection frequency;
- (ii) a colour-coded, source-segregation system be introduced for organic, plastic, paper and metal waste, supported by bilingual (English/Hausa) awareness campaigns;
- (iii) a market-based material recovery facility and composting scheme be established, in partnership with the private sector, to convert the market's organic- and plastic-dominant waste stream into revenue;
- (iv) informal waste pickers be formalised into cooperatives with appropriate protective equipment and training; and
- (v) a dedicated, adequately enforced waste-management levy be introduced to close the gap between market-level

expenditure and individual trader contributions identified in this study.

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