

The Influence of Waste Management Practices on Operational Efficiency and Cost Reduction in Public Secondary Schools

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ABSTRACT

Waste management has emerged as a significant yet frequently under-examined aspect of institutional administration in public secondary schools, particularly within resource-constrained contexts such as sub-Saharan Africa. This paper presents a systematic review of published literature examining the influence of waste management practices on operational efficiency and cost reduction in public secondary schools. Drawing on peer-reviewed studies, policy documents, and institutional reports from Africa, Asia, and other developing regions, the review synthesizes evidence on waste generation patterns, common management practices, and their operational and financial consequences for school institutions.

The paper is anchored in the circular economy (reduce, reuse, recycle) framework and general systems theory, which together explain how waste management functions as an institutional subsystem capable of shaping the efficiency and cost profile of the wider school system. Findings indicate that inadequate segregation, disposal, and collection practices contribute to sanitation hazards, disrupted teaching and learning time, and elevated operational costs, while structured practices such as source segregation, composting, and recycling partnerships are consistently associated with improved efficiency and measurable cost savings. The review also identifies persistent contextual barriers in low- and middle-income countries, including weak policy enforcement, inadequate infrastructure, and limited budgetary allocation to waste services.

The paper concludes with recommendations for school administrators and policymakers, including the institutionalization of waste segregation, strengthened public-private recycling partnerships, and greater budgetary prioritization of waste management within school operations budgets.

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Introduction

Public secondary schools are complex institutional systems that generate substantial quantities of solid waste through daily administrative, instructional, and food-service activities. Organic matter, paper, plastics, and packaging materials accumulate continuously across classrooms, staffrooms, dining areas, and school grounds, and a review of waste composition in educational institutions found that organic waste accounts for approximately thirty percent of total school waste, followed by paper and cardboard at roughly twenty-three percent and plastics at eighteen percent. Left unmanaged, these waste streams create sanitation hazards, disrupt the physical learning environment, and impose avoidable operational and financial burdens on already constrained public education budgets.

The relationship between how an institution manages its waste and how efficiently it operates is not merely incidental. A study of solid waste management practices in a Zimbabwean secondary school found that the absence of adequate refuse bins and reliance on open burning contributed to persistent odor problems, pest infestation, and spillage of solid waste around school premises [1]. Similarly, research conducted in public secondary schools

in Nairobi and Kajiado Counties, Kenya, established that the status of waste management practices, including the provision of dustbins and the manner of waste disposal, had a measurable effect on the quality of teaching and learning [2]. These findings suggest that waste management is not a peripheral custodial task but an operational variable that intersects with instructional time, health and safety, and institutional resource allocation.

In many low- and middle-income countries, municipal and institutional waste management systems remain underdeveloped. Governments in low-income countries allocate only about twenty percent of local budgets to waste management, and a large proportion of waste in these settings is dumped or burned in the open rather than formally collected and processed. Within this context, public secondary schools frequently lack the infrastructure, funding, and technical guidance required to manage waste in ways that support, rather than undermine, institutional operations.

Zambia offers an instructive context for examining these dynamics. The country's waste governance architecture has evolved through the National Solid Waste Management Strategy of 2004, the Environmental Management Act of 2011, and the Solid Waste Regulation and Management Act of 2018, each reiterating the waste hierarchy principle that disposal should be a last resort after reduction, reuse, and recycling [3]. Despite this policy architecture, implementation has been constrained by unclear stakeholder roles,

limited infrastructure, and underdeveloped local recycling markets, with responsibilities shifting between the Zambia Environmental Management Agency and local authorities, thereby exposing public secondary schools to these systemic gaps.

Statement of the Problem

Despite a growing body of literature on municipal and household solid waste management in African contexts, comparatively little scholarly attention has been directed toward the specific institutional consequences of waste management practices within public secondary schools, particularly their influence on operational efficiency and cost reduction. Existing school-focused studies have tended to emphasize environmental awareness, curriculum integration, or health outcomes, leaving the operational and financial dimensions of school-level waste management comparatively underexplored. This gap limits the ability of school administrators and policymakers to make evidence-based decisions about resource allocation for waste services.

Purpose and Objectives of the Paper

This paper examines, through a systematic review of existing literature, how waste management practices influence operational efficiency and cost reduction in public secondary schools. Specifically, the paper seeks to:

- Examine the waste management practices commonly reported in public secondary schools and comparable institutional settings.
- Analyze how these practices influence institutional operational efficiency.
- Assess the relationship between waste management practices and cost reduction in school operations.
- Propose a theoretically grounded framework and practical recommendations for strengthening waste management in public secondary schools, with particular reference to the Zambian context.

Significance of the Paper

This paper contributes to the limited body of literature connecting institutional waste management to operational performance in the education sector. Its findings are intended to inform school administrators responsible for day-to-day operations, Ministry of Education officials engaged in policy formulation, and researchers seeking to extend empirical inquiry into waste management as a dimension of educational administration and institutional effectiveness, particularly within the Zambian and broader sub-Saharan African context.

Literature Review

Waste Generation and Composition in School Institutions

School institutions generate heterogeneous waste streams shaped by feeding programs, instructional materials, and grounds maintenance. A phenomenological study of biodegradable waste practices in schools in Negros Oriental found that food scraps, paper products, and garden waste constitute the dominant categories of school-generated waste, with unmanaged accumulation contributing to pollution, greenhouse gas emissions, and inefficient use of institutional resources [4]. Although public secondary schools generate waste at a smaller scale, their profiles are similar—compounded by limited capacity to manage them.

Waste Management Practices Commonly Reported in Schools

The literature identifies a range of waste management practices in school settings, from basic provision of dustbins and manual collection with municipal pickup or on-site disposal to more

advanced practices such as source segregation, composting, and formal recycling partnerships. For instance, a case study in India demonstrated that structured waste management not only reduced overall waste but also decreased greenhouse gas emissions [5]. Composting has been highlighted as a low-cost, low-tech approach that diverts organic waste from open dumping and generates useful compost for school grounds.

At the policy level, the circular economy concept—prioritizing reduction, reuse, and recycling—has gained attention as a guiding framework for both institutional and municipal waste systems in Africa [3]. This hierarchy suggests that the most effective waste management practices begin with minimizing waste generation at the source, followed by reuse within the institution, with recycling and disposal as subsequent steps.

Waste Management and Operational Efficiency

Operational efficiency refers to how well an institution converts its resources—staff time, physical space, and materials—into designated outputs with minimal waste. In the context of waste management, efficiency is often measured by how effectively resources are converted into waste diversion and proper disposal outcomes [6]. In schools, inefficient waste management can lead to disrupted routines such as overflowing bins, odor issues, pest infestations, and unplanned interventions by staff, ultimately detracting from instructional time and overall operational performance.

Conversely, structured waste management systems with predictable collection schedules and clearly designated disposal areas reduce disruptions and free up administrative capacity, thereby improving overall operational efficiency.

Waste Management and Cost Reduction

Although less documented in school settings, the financial benefits of effective waste management have been noted in contexts such as Zambia. Source segregation and the supply of clean, sorted recyclable materials can reduce transportation and raw material costs through partnerships with recycling companies (WeSEPO, as cited in Zambian solid waste service documentation) [7]. Moreover, efficient waste management helps avoid indirect costs associated with poor sanitation, pest control, emergency clean-ups, and potentially even municipal penalties.

With local governments allocating limited budgets for waste management services, public secondary schools are further incentivized to develop internal waste reduction and segregation strategies as an effective cost-management tool.

Contextual Challenges in African and Zambian School Settings

Several challenges persist in African contexts. Studies have identified inconsistent integration of waste-related environmental issues within school curricula and noted that unclear by-laws, inadequate infrastructure, and underdeveloped recycling markets continue to hamper effective waste management in Zambia [8, 9]. Public secondary schools thus operate in environments where broader municipal and regulatory gaps directly affect their waste management outcomes.

Research Gap

Although there is substantial literature on environmental and municipal waste management issues, few studies have specifically examined how waste management practices affect the operational efficiency and cost structures of public secondary schools,

particularly in the Zambian context. This paper seeks to fill that gap by providing a conceptual mapping of the interrelations among waste management practices, operational efficiency, and cost reduction.

Theoretical Framework

The Circular Economy and Waste Hierarchy Framework

The circular economy framework conceptualizes waste not as an inevitable by-product of institutional activities but as a resource stream that can be minimized, recovered, and reintegrated into productive use. Central to this approach is the waste hierarchy—prioritizing reduction, reuse, recycling, recovery, and disposal in that order [3]. In public secondary schools, adopting reduction and reuse strategies is viewed as more beneficial in achieving operational and financial gains, especially in resource-constraint settings.

Systems Theory

General systems theory, as advanced by von Bertalanffy, views organizations as open systems comprising interdependent subsystems that exchange inputs, processes, outputs, and feedback [10]. Public secondary schools are such open systems, and the waste management subsystem significantly influences overall operational performance. When waste management functions effectively, it supports greater institutional efficiency; when it fails, the resulting disruptions can cascade to affect other critical subsystems.

Integrated Conceptual Model

By integrating the circular economy and systems theory perspectives, this paper conceptualizes waste management practices as pivotal inputs into a school's operational system. Practices emphasizing reduction and reuse result in the greatest efficiency and cost benefits, whereas reliance on inadequate practices such as open burning leads to higher indirect costs and operational disruptions.

Methodology

Research Design

This paper employs a qualitative, desk-based systematic literature review. This design facilitates the synthesis of both empirical and policy literature on school waste management, operational efficiency, and cost reduction across varied geographic and institutional contexts. The resulting conceptual framework provides a basis for guiding future empirical inquiries and policy initiatives in Zambia.

Search Strategy and Sources

Literature was identified using academic databases and repositories such as Google Scholar, ResearchGate, MDPI, Frontiers, and various institutional and governmental repositories. Key search terms included "waste management", "schools", "operational efficiency", "cost reduction", "circular economy", and "Zambia." Additional relevant sources were obtained from reference lists in retrieved studies and governmental publications on solid waste management in African contexts.

Inclusion and Exclusion Criteria

Sources were included if they were peer-reviewed articles, institutional or governmental reports, or academic conference papers published in the last decade that addressed waste management in school or similar institutional settings, or discussed waste management policy and operational outcomes in Zambia or comparable African regions. Studies focusing solely on industrial or household waste management, or lacking clear authorship and provenance, were excluded.

Data Analysis

The identified sources were organized thematically around key constructs: waste generation and composition, management practices, operational efficiency, cost implications, and contextual barriers. A narrative synthesis approach was used to integrate findings, highlight areas of convergence and divergence in the literature, and relate these insights to the proposed theoretical framework.

Discussion

Prevailing Waste Management Practices in Public Secondary Schools

The literature indicates that many public secondary schools, particularly in African contexts, rely on basic waste management practices such as the use of dustbins and municipal collection or open burning. More structured practices like systematic segregation, composting, and partnerships with recycling services are less common, largely due to limitations in funding, technical capacity, and policy enforcement.

Effects on Operational Efficiency

Evidence suggests that waste management significantly influences overall operational efficiency. Disruptions such as overflowing bins, odor issues, and pest infestations can divert staff attention and reduce teaching time. Conversely, structured waste management practices support smoother operations through the creation of predictable routines and reduced need for ad hoc interventions.

Cost Implications

Structured waste management, especially through source segregation and recycling partnerships, has been linked to cost savings. In Zambia, for example, schools that supply clean recyclable materials have benefitted from reduced collection charges. Additionally, effective waste management minimizes indirect costs associated with health and sanitation failures, emergency clean-ups, and reputational damage.

Policy and Institutional Enablers and Barriers

While Zambia's legislative framework supports the reduce-reuse-recycle hierarchy, implementation challenges remain [3]. Unclear institutional mandates, insufficient recycling infrastructure, and underdeveloped markets for recovered materials create significant implementation gaps. Thus, while top-down policies are essential, school-level leadership and local partnerships are also critical.

Implications for Public Secondary Schools in Zambia

The synthesis of literature suggests that Zambian public secondary schools could benefit significantly from adopting structured waste management strategies that emphasize waste reduction and segregation. By addressing internal operational inefficiencies and fostering partnerships with local recycling operators, schools can achieve measurable cost savings and enhance their overall functionality.

Conclusion and Recommendations

The literature review confirms that waste management is not a neutral custodial function but a critical operational subsystem affecting both efficiency and costs in public secondary schools. Inadequate practices lead to sanitation hazards, disrupted teaching, and increased costs, while structured practices such as source segregation, composting, and recycling partnerships are associated with operational improvements and cost savings.

Based on the synthesis of current evidence, the following recommendations are proposed:

- School administrators should institutionalize source segregation by designating clear collection points and delineating responsibilities among staff and students.
 - Public secondary schools should explore and formalize partnerships with local recycling operators, similar to models already in operation in Zambian urban centers.
 - Ministries of Education and local education authorities should explicitly include waste management infrastructure and operating costs in school budgets rather than treating them as residual expenses.
 - Policymakers need to clarify and enforce institutional mandates for waste regulation at both school and local levels.
 - School-based composting programs should be piloted and scaled, given their low-cost potential to divert organic waste and yield compost for school grounds.
 - Further empirical research, particularly involving primary data from Zambian public secondary schools, is necessary to quantify the specific benefits of improved waste management practices on operational efficiency and cost reduction.
3. Clube RKM, Hazemba M (2024) From waste to resource: Demystifying the policy challenges and identifying opportunities for a circular economy in Zambia. *Frontiers in Sustainability* 5.
 4. Romero CD (2025) Understanding sustainable waste management: A phenomenological study on biodegradable waste practices in schools in Negros Oriental. *Social Science Lens: A World Journal of Human Dynamics and Social Relations*: 4: 127-137.
 5. Mehta S, Bhattacharya A, Rathi B (2020) Waste management practices in schools: A case study of an Indian school. *Journal of Cleaner Production* 259: 120912.
 6. Bolingbroke D, Ng KT W, Vu HL, Richter A (2021) Quantification of solid waste management system efficiency using input–output indices. *Journal of Material Cycles and Waste Management* 23: 1015-1025.
 7. Solid waste management services in Zambia. WeSEPO <https://wesepo.com/services/>.
 8. Dalu MTB, Cuthbert RN, Muhali H, Chari LD, Manyani A (2020) Is awareness on plastic pollution being raised in schools? Understanding perceptions of primary and secondary school educators. *Sustainability* 12: 6775.
 9. Global Partnership for Results-Based Approaches (GPRBA). (n.d.). Zambia: Solid waste management. World Bank Group. <https://www.gprba.org/activities/zambia-solid-waste-management>.
 10. Von Bertalanffy L (1968) General system theory: Foundations, development, applications. George Braziller.
 11. Review of waste management in higher education institutions (2024) A review of waste management in higher education institutions: The road to zero waste and sustainability. *Recycling* 11: 293.

Treating waste management as a priority operational area, rather than a peripheral environmental concern, offers public secondary schools a cost-effective pathway to improved efficiency and a more sustainable use of limited educational resources.

References

1. Chatira-Muchopa B, Tarisayi KS, Chidarikire M (2019) Solid waste management practices in Zimbabwe: A case study of one secondary school. *TD: The Journal for Transdisciplinary Research in Southern Africa* 15: 1-5.
2. Njau ST, Onyango G, Itigi F (2024) Waste management practices and effect on teaching and learning in public secondary schools in Nairobi and Kajiado Counties, Kenya. *Environment and Ecology Research* 12: 492-501.

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