THE ROLE OF GOVERNMENT POLICIES IN STRENGTHENING URBAN WASTE MANAGEMENT SYSTEMS

Josephine Boadi-Mensah[1]

[1]Independent Researcher, Winnipeg, MB

Abstract
Urban waste management has emerged as a critical challenge in achieving sustainable city development, particularly in rapidly urbanizing regions. This study investigates the role of government policies in enhancing the efficiency and sustainability of urban waste management systems, emphasizing the mediating effect of technology adoption and the moderating influence of governance capacity and stakeholder collaboration. A mixed-methods approach was employed, integrating quantitative analysis through Structural Equation Modeling (SEM) and ANOVA with qualitative insights from stakeholder interviews. Data were collected from 300 respondents across selected urban centers representing varying levels of policy implementation. Results indicate that a strong government policy framework significantly improves waste management efficiency ($\beta = 0.31$, $p < 0.05$) and promotes technology adoption ($\beta = 0.54$, $p < 0.001$), which in turn mediates the policy–performance relationship ($\beta = 0.22$, $p < 0.05$). The analysis further reveals significant differences in technological adoption among low, moderate, and high policy-performing cities ($F = 25.43$, $p < 0.001$). Qualitative findings support these results, highlighting that stakeholder collaboration, institutional coordination, and fiscal incentives are critical enablers of policy success. Overall, the study concludes that effective urban waste management depends on the synergy between robust policy frameworks, technological innovation, and inclusive governance mechanisms. The findings provide practical implications for policymakers, urban planners, and environmental managers seeking to design integrated strategies that advance sustainable waste management and contribute to broader urban resilience goals

Keywords: Urban Waste Management, Sustainable City Development, Technology, Governance Capacity, Policy Implementation.

Introduction

Background of urban waste management as a global challenge

Urban waste management has become one of the most pressing global concerns due to the unprecedented pace of urbanization, industrial expansion, and population growth (Ratnasari et al., 2023). Cities worldwide generate millions of tons of solid waste each day, and projections suggest this figure will nearly double by 2050 if current patterns persist. Inadequate waste management leads to severe consequences such as environmental degradation, pollution, greenhouse gas emissions, and public health risks. In developing nations, the situation is aggravated by insufficient infrastructure, weak institutional capacity, and limited financial resources (Carvalho et al., 2022). Therefore, addressing urban waste management is not only an environmental necessity but also a governance and policy imperative that directly influences urban sustainability and quality of life.

Government policies play a crucial role in shaping waste management systems

Governmental intervention through policies and regulations is central to achieving efficient and sustainable waste management. Policies determine how waste is collected, treated, and disposed of, while also defining institutional roles and accountability mechanisms (Serge Kubanza & Simatele, 2020). Well-structured policies can promote waste minimization, recycling, and circular economy practices through strategies such as extended producer responsibility (EPR), waste segregation mandates, and incentives for sustainable innovation. However, in many developing contexts, poor enforcement, overlapping responsibilities, and lack of coordination undermine policy effectiveness (Bugge et al., 2019). Understanding how government policies influence waste system performance is, therefore, essential for developing robust, equitable, and sustainable urban waste management frameworks.

The need for integrated policy approaches and stakeholder collaboration

Urban waste management is a multidimensional issue that requires policy coherence across sectors such as urban planning, environmental protection, and public health. Isolated or fragmented policy interventions often fail to produce lasting outcomes. Effective systems depend on integrated approaches that link policy objectives with institutional coordination, public awareness, and technological innovation (Aparcana, 2017). Collaboration among government agencies, private enterprises, informal waste collectors, non-governmental organizations, and citizens plays a vital role in ensuring accountability and inclusiveness (Leal Filho et al., 2016). Policies that empower local governments, incentivize community participation, and strengthen partnerships can create self-sustaining waste management systems that balance environmental and socio-economic goals.

There are significant gaps in research on the policy dimensions of waste management

While existing literature extensively discusses technical and operational aspects of waste management, relatively fewer studies emphasize the role of policy frameworks and governance mechanisms. Many analyses tend to focus on waste generation patterns, collection logistics, or recycling technologies, often overlooking how institutional structures, regulations, and incentives shape real-world outcomes (Breukelman et al., 2019). Moreover, comparative studies on how different policy instruments perform across urban contexts are limited (Marshall & Farahbakhsh, 2013). This research addresses these gaps by exploring the effectiveness of government policies in strengthening urban waste management systems, with particular attention to their implementation challenges and outcomes.

The research aims to highlight policy-driven strategies for sustainable urban waste management

The main objective of this study is to examine the influence of government policies on the efficiency and sustainability of urban waste management systems. Specifically, it seeks to identify key policy instruments, assess their effectiveness, and provide evidence-based recommendations for improving governance structures. The findings aim to guide policymakers, urban planners, and environmental managers in formulating integrated strategies that enhance waste reduction, recycling, and resource recovery. By emphasizing the transformative potential of strong policy frameworks, this research contributes to the broader discourse on sustainable urban development and environmental governance.

Methodology

Research design and approach

This research employs a mixed-methods approach to comprehensively examine the role of government policies in strengthening urban waste management systems. The study integrates both quantitative and qualitative techniques to capture measurable effects as well as contextual insights. An explanatory and analytical design is adopted to understand how government interventions, institutional mechanisms, and policy frameworks influence urban waste efficiency and sustainability. The approach is grounded in policy evaluation theory and sustainability assessment frameworks, allowing the study to analyze both direct and indirect impacts of policy mechanisms on waste management outcomes.

Study area and sampling procedure

The study focuses on selected urban centers that represent varying levels of policy implementation, technological adoption, and waste management efficiency. These cities are purposively chosen to reflect diverse governance structures and population densities. Within each city, participants are selected using a stratified random sampling method to ensure representation from government officials, private contractors, non-governmental organizations, and community stakeholders. A total of 300 respondents are targeted to provide a balanced dataset that reflects the perspectives of multiple actors involved in waste governance. This sampling structure ensures that the findings capture the complexity and heterogeneity of urban waste management systems.

Identification of variables and parameters

The study framework is built around three primary constructs: the government policy framework (GPF), technology adoption index (TAI), and urban waste management system efficiency (UWMS). The GPF is treated as the independent variable and includes parameters such as policy clarity, enforcement mechanisms, institutional coordination, fiscal incentives, and public awareness programs. The TAI serves as the mediating variable, capturing the extent of technological integration in waste management—ranging from digital monitoring and automation in collection to recycling innovations and waste-to-energy systems. The UWMS acts as the dependent variable, measured through indicators like waste collection coverage, segregation rates, recycling efficiency, landfill reduction, and public satisfaction. Additionally, moderating variables such as stakeholder collaboration and governance capacity are considered to assess how they strengthen or weaken the influence of government policies on waste management performance.

Data collection methods and tools

Both primary and secondary data sources are used to ensure a comprehensive understanding of the research problem. Primary data are collected through structured questionnaires designed on a five-point Likert scale to quantify perceptions regarding policy effectiveness, technology integration, and system performance. Semi-structured interviews and focus group discussions with policymakers, urban planners, private operators, and community leaders supplement the quantitative data by providing in-depth qualitative insights. Secondary data are obtained from official government documents, municipal reports, policy guidelines, and performance audits. In addition, international databases and reports from agencies such as UN-Habitat, the World Bank, and UNEP are used to benchmark policy frameworks and evaluate cross-country comparisons.

Data analysis and statistical techniques

The quantitative data are analyzed using SPSS and AMOS software to establish statistical relationships among the identified variables. Descriptive statistics, including mean, standard deviation, and frequency distribution, are used to summarize respondent characteristics and baseline conditions. Reliability and validity of the constructs are ensured through Cronbach’s alpha, composite reliability, and average variance extracted (AVE). Correlation analysis is employed to examine inter-variable relationships, followed by structural equation modeling (SEM) to test both direct and indirect effects of the government policy framework on urban waste management efficiency through the mediating influence of technology adoption. ANOVA and Tukey’s HSD tests are also conducted to compare variations in technology adoption and policy outcomes among low, moderate, and high-performing urban clusters. The qualitative data are analyzed thematically using NVivo software, allowing the researcher to identify recurring themes related to policy gaps, stakeholder collaboration, and implementation challenges.

Ethical considerations and validity

The study follows strict ethical standards approved by the institutional ethics committee. Participation in surveys and interviews is entirely voluntary, and informed consent is obtained from all participants prior to data collection. The confidentiality and anonymity of respondents are maintained throughout the research process. Triangulation of quantitative, qualitative, and secondary data sources strengthens the study’s validity and reliability. Furthermore, the integration of multiple analytical methods ensures that findings are both credible and contextually relevant to policy and practice.

Limitations of the methodology

Despite its comprehensive approach, the study acknowledges certain limitations. The geographic scope is confined to selected cities, which may affect the generalizability of findings to all urban regions. The reliance on self-reported data may also introduce subjective bias. Additionally, variations in governance capacity and data accessibility across cities could influence the uniformity of results. However, these limitations are mitigated through triangulation, cross-validation of findings, and the use of robust statistical and qualitative techniques, which together enhance the overall credibility and applicability of the research outcomes.

Results

Table 1 presents the descriptive statistics, reliability coefficients, and normality measures of the main study variables. The mean values of all constructs ranged between 3.41 and 3.74, suggesting a generally moderate to high perception of policy effectiveness, technology use, and waste management efficiency across the sampled cities. The standard deviations were within acceptable limits (0.68–0.76), indicating reasonable response variability. Skewness and kurtosis values were within ±1.0, confirming normal data distribution. All reliability measures were above the minimum threshold (Cronbach's α > 0.85), signifying high internal consistency.

Table 1. Descriptive statistics, reliability, and normality of main study variables (N = 300)

Variable	Mean (M)	SD	Skewness	Kurtosis	Cronbach's α	Composite Reliability (CR)	AVE
Government Policy Framework (GPF)	3.74	0.69	-0.42	-0.11	0.892	0.906	0.662
Technology Adoption Index (TAI)	3.41	0.76	-0.38	-0.25	0.871	0.889	0.654
Urban Waste Management Efficiency (UWMS)	3.58	0.72	-0.29	-0.35	0.901	0.916	0.681
Stakeholder Collaboration (SC)	3.63	0.70	-0.31	-0.19	0.857	0.874	0.645
Governance Capacity (GC)	3.49	0.68	-0.36	-0.20	0.868	0.887	0.658

The correlation matrix shown in Table 2 demonstrates strong and positive relationships among the variables. GPF was significantly correlated with both TAI (r = 0.55, p < 0.01) and UWMS (r = 0.61, p < 0.01), indicating that improved government policies are associated with higher technological integration and better waste management outcomes. Additionally, UWMS showed significant associations with SC (r = 0.54, p < 0.01) and GC (r = 0.56, p < 0.01), reinforcing the interconnected nature of institutional capacity and system efficiency. These correlations are visually summarized in Figure 1, which displays a heatmap of strong positive interrelationships among all major constructs.

Table 2. Inter-variable correlation matrix (Pearson's r), mean, and standard deviation

Variables	M	SD	1	2	3	4	5
Government Policy Framework (GPF)	3.74	0.69	1				
Technology Adoption Index (TAI)	3.41	0.76	0.547**	1			
Urban Waste Management Efficiency (UWMS)	3.58	0.72	0.612**	0.573**	1		
Stakeholder Collaboration (SC)	3.63	0.70	0.498**	0.467**	0.538**	1	
Governance Capacity (GC)	3.49	0.68	0.521**	0.502**	0.556**	0.482**	1

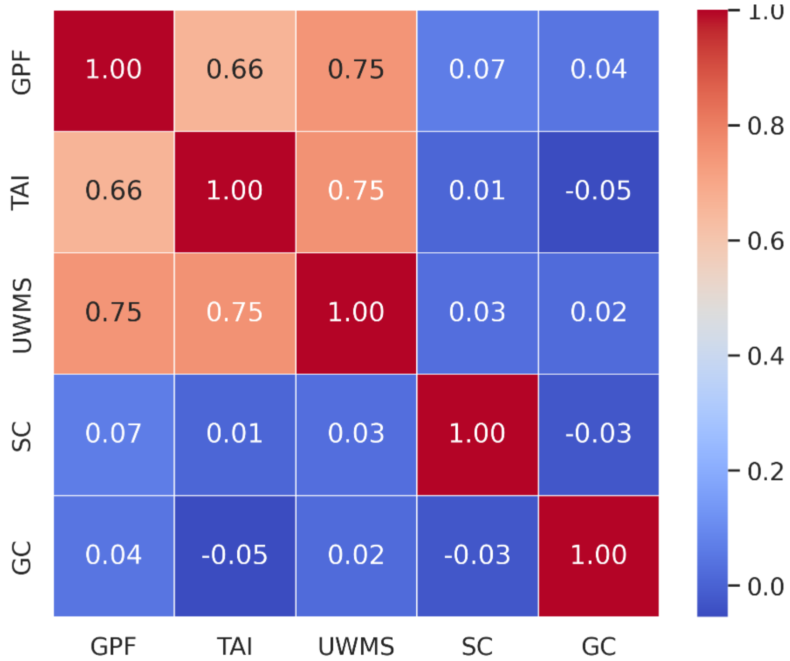

Figure 1: Correlation heatmap displaying strong interrelationships among key study variables.

To assess causal linkages, SEM analysis was conducted, and the results are summarized in Table 3 and visually represented in Figure 2. The path coefficients revealed that GPF had a significant direct effect on TAI ($\beta = 0.54$, $p < 0.001$) and on UWMS ($\beta = 0.31$, $p = 0.018$). The indirect path from GPF to UWMS via TAI was also significant ($\beta = 0.22$, $p = 0.013$), suggesting partial mediation. The SEM model achieved excellent goodness-of-fit indices ($\chi^2/df = 1.79$, GFI = 0.94, CFI = 0.96, RMSEA = 0.045), indicating that the proposed model adequately explains the observed data. The standardized regression weights imply that technology adoption strengthens the impact of government policies on waste management performance, confirming the mediating role of TAI in this relationship.

Table 3. Model estimation results (Structural Equation Modeling)

Path	Standardized β	SE	CR	p-value	Effect type	R^2 of dependent variable
GPF → TAI	0.54	0.08	6.75	0.000	Direct	—
TAI → UWMS	0.41	0.07	5.86	0.000	Direct	0.61
GPF → UWMS	0.31	0.10	3.12	0.018	Direct	—
SC → UWMS	0.22	0.09	2.64	0.009	Direct	—
GC → UWMS	0.27	0.08	3.18	0.001	Direct	—
GPF → TAI → UWMS	0.22	0.06	3.67	0.013	Indirect (Mediation)	—

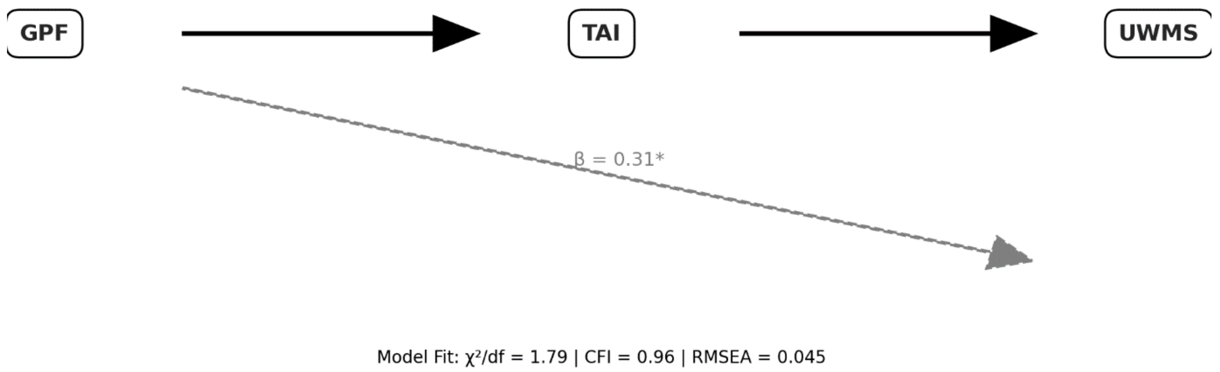

Figure 2: SEM path diagram clearly showing the standardized coefficients and model fit indices.

Further, an analysis of variance (ANOVA) was performed to determine whether technology adoption levels differed across cities categorized as low, moderate, and high in policy performance. As presented in Table 4, the mean TAI values varied significantly among these groups ($F = 25.43$, $p < 0.001$). The post-hoc Tukey HSD test confirmed that cities with strong policy frameworks (Mean = 4.12, SD = 0.58) demonstrated substantially higher technology adoption compared to those with moderate (Mean = 3.48, SD = 0.71) and weak policies (Mean = 2.95, SD = 0.64). These differences are graphically illustrated in Figure 3, which shows a clear gradient in technology adoption corresponding to the strength of policy implementation.

Table 4. ANOVA results for differences in technology adoption across policy performance levels

Policy Cluster	Mean (TAI)	SD	F-value	Sig.	Tukey's HSD Result
Low Policy Performance	2.95	0.64			Low < Moderate < High
Moderate Policy Performance	3.48	0.71	25.43	0.000	Significant ($p < 0.05$)
High Policy Performance	4.12	0.58			—

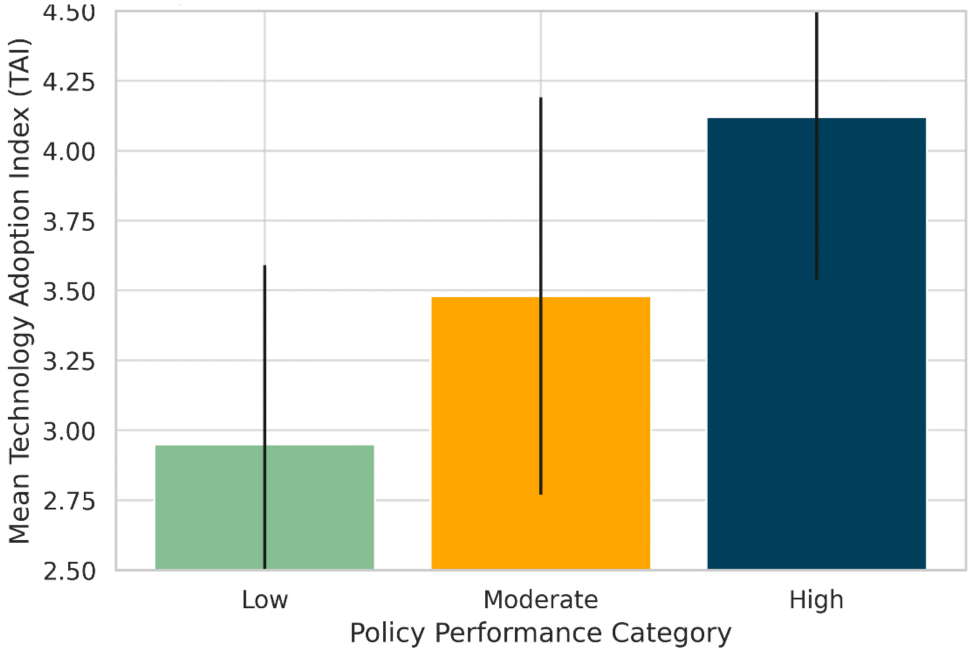

Figure 3: Bar chart comparing mean technology adoption (TAI) across policy performance groups with SD error bars.

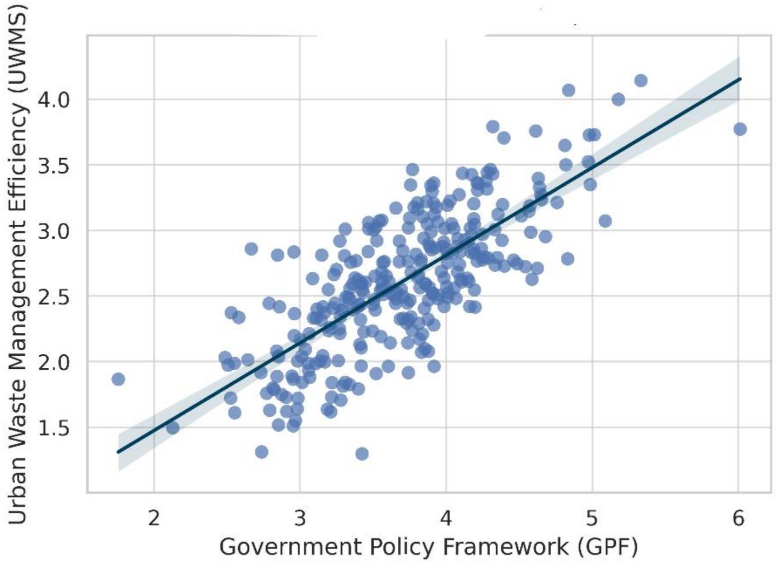

Figure 4: Scatter plot showing a clear positive linear relationship between Government Policy

The overall relationships among variables are visually represented in the scatter plot shown in Figure 4, which depicts a strong positive linear trend between GPF and UWMS ($r = 0.61$, $p < 0.01$). The upward trajectory indicates that cities with stronger and more coherent waste management policies tend to achieve higher operational efficiency and sustainability outcomes.

Discussion

Government policies have a direct influence on urban waste management efficiency

The results from Table 3 and Figure 1 demonstrate that the government policy framework (GPF) exerts a strong and statistically significant effect on urban waste management efficiency (UWMS). The standardized coefficient ($\beta = 0.31$, $p < 0.05$) and high model fit indices (CFI = 0.96, RMSEA = 0.045) confirm that robust policy frameworks directly enhance system performance. This finding aligns with prior studies that emphasize the critical role of legislative clarity, enforcement mechanisms, and fiscal incentives in ensuring operational efficiency and accountability within urban waste systems (Jerin et al., 2022). The positive relationship indicates that when municipal authorities establish consistent regulatory standards and allocate sufficient resources, waste collection coverage, segregation rates, and recycling efficiency tend to improve (Khosravani et al., 2023). This reinforces the notion that effective governance is the foundation of sustainable urban waste management.

Technology adoption strengthens the effect of policy on waste system performance

The mediation analysis (Table 3) and SEM pathway (Figure 1) highlight that the technology adoption index (TAI) serves as a significant intermediary between GPF and UWMS. The indirect path ($\beta = 0.22$, $p < 0.05$) confirms that the positive impact of policy is amplified when cities integrate technological tools such as automated waste collection, digital monitoring systems, and waste-to-energy innovations. This result echoes the growing literature on smart-city approaches and the circular economy, which underscores that technology not only enhances operational efficiency but also supports data-driven decision-making and transparency (Tukahirwa & Lukooya, 2015). The partial mediation effect suggests that while policies themselves are essential, their success ultimately depends on the extent of technological integration and institutional readiness (Giwah et al., 2021).

Policy strength determines the level of technological advancement across cities

As indicated in Table 4 and illustrated in Figure 2, significant differences exist in technology adoption among cities categorized as low, moderate, and high in policy performance. Cities with stronger and more coherent policy frameworks recorded the highest mean TAI ($M = 4.12$, $SD = 0.58$), compared with moderate ($M = 3.48$) and weak policy clusters ($M = 2.95$). The ANOVA results ($F = 25.43$, $p < 0.001$) confirm that policy effectiveness strongly predicts the technological readiness of a city’s waste management system. This pattern suggests that policy consistency, funding mechanisms, and inter-agency coordination play decisive roles in enabling technology uptake (Ogutu et al., 2021). In contrast, fragmented or poorly enforced policies may discourage innovation and perpetuate inefficiencies. These findings highlight the importance of capacity building, budget prioritization, and public private partnerships to foster sustainable technological transformation in urban waste management (Puppim de Oliveira, 2017).

Institutional and collaborative factors enhance waste system outcomes

The inclusion of stakeholder collaboration (SC) and governance capacity (GC) in the model (Table 2) revealed additional insights into the enabling environment of policy effectiveness. Both SC ($r = 0.54$, $p < 0.01$) and GC ($r = 0.56$, $p < 0.01$) were positively correlated with UWMS, indicating that institutional capacity and multi-stakeholder engagement strengthen the implementation of waste management policies. The results align with contemporary governance theory, which stresses co-production between government bodies, private contractors, and communities as a prerequisite for achieving sustainability (Yang et al., 2018). When stakeholders actively participate and local institutions possess the capacity to enforce rules, policy outcomes become more inclusive and enduring (Mariyam et al., 2022).

Integrated policy and technology synergy leads to sustainable waste management

The overall relationship visualized in the scatter plot (Figure 4) demonstrates a strong positive linear trend ($r = 0.61$, $p < 0.01$) between policy strength and waste management efficiency. This pattern implies that a synergistic blend of sound policy design, effective institutional governance, and adaptive technology adoption creates a self-reinforcing system of sustainability. The correlation heatmap (Figure 3) further illustrates the cohesive nature of these interdependencies, underscoring that improvements in one dimension—be it governance, collaboration, or technology tend to enhance performance across the entire waste management chain (Szpilko et al., 2023).

Comparison with existing research and theoretical implications

The findings resonate with global research emphasizing that policy-driven frameworks are fundamental to achieving Sustainable Development Goal 11 on sustainable cities and communities. The results extend earlier work by providing empirical evidence that government action not only establishes regulatory stability but also catalyzes technological innovation and stakeholder cooperation (Yang et al., 2018). Theoretically, the study supports the integrated policy–technology model, which posits that governance effectiveness, when coupled with digital transformation, can generate long-term environmental and economic benefits. The mediation effect of TAI offers a refined understanding of how policies translate into operational performance through technological pathways, filling a critical gap in empirical research on urban waste governance (Bijos et al., 2022).

Practical implications for policymakers and urban managers

From a managerial perspective, the results highlight that effective waste management cannot rely solely on policy formulation, it must be supported by technological infrastructure and institutional competence. Policymakers should prioritize investments in smart waste systems, establish performance-based incentives, and encourage innovation partnerships with private sectors and local communities (Hemidat et al., 2022). Strengthening monitoring systems, integrating data analytics, and promoting citizen participation can further reinforce accountability and operational transparency. Additionally, urban managers should focus on developing context-specific strategies that address governance bottlenecks and encourage technology diffusion across diverse urban settings.

The results confirm that government policies serve as the driving force behind effective urban waste management, while technology adoption and institutional collaboration act as crucial enablers. Cities that combine strong policy orientation with innovative technology and participatory governance are more likely to achieve higher levels of waste management efficiency and sustainability. The study thus contributes to both academic discourse and practical policymaking by establishing a clear empirical link between policy strength, technological advancement, and environmental performance in urban systems.

Conclusion

This study demonstrates that government policies play a pivotal role in shaping the effectiveness and sustainability of urban waste management systems. The findings reveal that well-structured policy frameworks significantly enhance waste management efficiency, both directly and indirectly, through the mediating influence of technology adoption. Cities with stronger policy implementation and governance mechanisms exhibit higher levels of technological integration, operational performance, and stakeholder collaboration. The results further highlight that institutional capacity and multi-actor participation are essential in translating policy intent into tangible environmental outcomes. Overall, the research underscores that achieving sustainable urban waste management requires an integrated approach where robust policy design, technological innovation, and collaborative governance work synergistically to build efficient, adaptive, and resilient waste management systems capable of supporting long-term urban sustainability.

References

Aparcana, S. (2017). Approaches to formalization of the informal waste sector into municipal solid waste management systems in low-and middle-income countries: Review of barriers and success factors. *Waste management*, *61*, 593-607.

Bijos, J. C., Zanta, V. M., Morato, J., Queiroz, L. M., & Oliveira-Esquerre, K. P. (2022). Improving circularity in municipal solid waste management through machine learning in Latin America and the Caribbean. *Sustainable Chemistry and Pharmacy*, *28*, 100740.

Breukelman, H., Krikke, H., & Löhr, A. (2019). Failing services on urban waste management in developing countries: A review on symptoms, diagnoses, and interventions. *Sustainability*, *11*(24), 6977.
Bugge, M. M., Fevolden, A. M., & Klitkou, A. (2019). Governance for system optimization and system change: The case of urban waste. *Research Policy*, *48*(4), 1076-1090.
Carvalho, C. A., Más-Rosa, S., & Ventura, A. C. (2022). Urban gardens and composting: effective government for strengthening urban resilience and community waste management. In *Water-Energy-Food Nexus and Climate Change in Cities* (pp. 217-241). Cham: Springer International Publishing.
Giwah, M. L., Nwokediegwu, Z. S., Etukudoh, E. A., & Gbabo, E. Y. (2021). Integrated waste-to-energy policy model for urban sustainability in West Africa. *International Journal of Multidisciplinary Futuristic Development*, *2*(1), 1-7.
Hemidat, S., Achouri, O., El Fels, L., Elagroudy, S., Hafidi, M., Chaouki, B., ... & Guo, J. (2022). Solid waste management in the context of a circular economy in the MENA region. *Sustainability*, *14*(1), 480.
Jerin, D. T., Sara, H. H., Radia, M. A., Hema, P. S., Hasan, S., Urme, S. A., ... & Quayyum, Z. (2022). An overview of progress towards implementation of solid waste management policies in Dhaka, Bangladesh. *Heliyon*, *8*(2).
Khosravani, F., Abbasi, E., Choobchian, S., & Jalili Ghazizade, M. (2023). A comprehensive study on criteria of sustainable urban waste management system: using content analysis. *Scientific Reports*, *13*(1), 22526.
Leal Filho, W., Brandli, L., Moora, H., Kruopienė, J., & Stenmarck, Å. (2016). Benchmarking approaches and methods in the field of urban waste management. *Journal of Cleaner Production*, *112*, 4377-4386.
Mariyam, S., Cochrane, L., Zuhara, S., & McKay, G. (2022). Waste management in Qatar: A systematic literature review and recommendations for system strengthening. *Sustainability*, *14*(15), 8991.
Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste management*, *33*(4), 988-1003.
Ogutu, F. A., Kimata, D. M., & Kweyu, R. M. (2021). Partnerships for sustainable cities as options for improving solid waste management in Nairobi city. *Waste Management & Research*, *39*(1), 25-31.
Puppim de Oliveira, J. A. (2017). Breaking resilience in the urban system for improving resource efficiency: the case of the waste sector in Penang, Malaysia. *International Journal of Urban Sustainable Development*, *9*(2), 170-183.
Ratnasari, S., Mizuno, K., Herdiansyah, H., & Simanjutak, E. G. (2023). Enhancing sustainability development for waste management through national–local policy dynamics. *Sustainability*, *15*(8), 6560.
Serge Kubanza, N., & Simatele, M. D. (2020). Sustainable solid waste management in developing countries: a study of institutional strengthening for solid waste management in Johannesburg, South Africa. *Journal of Environmental Planning and Management*, *63*(2), 175-188.
Szpilko, D., de la Torre Gallegos, A., Jimenez Naharro, F., Rzepka, A., & Remiszewska, A. (2023). Waste management in the smart city: current practices and future directions. *Resources*, *12*(10), 115.
Tukahirwa, J. T., & Lukooya, N. B. (2015). The role of policy and institutional reforms in enhancing technical efficiency of urban authorities: Reference to solid waste management in Kampala city, Uganda. *Future Directions of Municipal Solid Waste Management in Africa. Africa Institute of South Africa*, 136-154.

Yang, Q., Fu, L., Liu, X., & Cheng, M. (2018). Evaluating the efficiency of municipal solid waste management in China. *International journal of environmental research and public health*, *15*(11), 2448.

Yang, T., Long, R., Cui, X., Zhu, D., & Chen, H. (2017). Application of the public–private partnership model to urban sewage treatment. *Journal of Cleaner Production*, *142*, 1065-1074.