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RESEARCH ARTICLE

Resilient City Strategies for Urban Waste Management: A Case Study of Lubuklinggau City, Indonesia

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Abstract

Urban waste management in Lubuklinggau City, Indonesia, encounters systemic challenges, including limited service coverage, insufficient infrastructure, low levels of public participation, and weak integration between technical regulations and spatial planning. This study explores context-specific strategies aimed at strengthening urban resilience within waste governance systems. Utilizing an exploratory mixed-methods approach, the research integrates SWOT analysis with the Analytical Hierarchy Process (AHP) to identify and prioritize strategic alternatives. Data were collected through field observations, reviews of regional regulations, spatial planning documents, and institutional reports. Twelve strategic options were developed from internal and external factors, then organized hierarchically and weighted through pairwise comparison. Findings indicate that the highest-priority strategy involves accelerating the formulation of technical regional regulations aligned with spatial and fiscal planning frameworks (priority weight = 0.229), followed by the development of a controlled landfill system supported by public-private partnerships (PPP) and corporate social responsibility (CSR) initiatives. The AHP model achieved a consistency ratio of 0.054, confirming the model's logical validity. The study concludes that regulatory reform, cross-sectoral coordination, and community-based initiatives are critical to enhancing the adaptive capacity of medium-sized cities. These findings offer theoretical contributions to resilient city frameworks and practical insights for urban regions facing institutional and environmental challenges.

Keyword: Waste Management, Resilient City, Spatial Planning, Policy Strategy, SWOT-AHP Analysis

Introduction

The escalating volume of waste in Indonesian cities presents a major obstacle to achieving sustainable development goals. Population growth and urban expansion have not been matched by proportional improvements in waste management capacity, particularly in developing cities (Ajrina et al., 2024; Lasaiba & Lasaiba, 2024). This disparity contributes to environmental degradation and heightens the risk of ecological disasters. Moreover, the inadequacy of adaptive waste management systems hinders progress toward achieving resilient city indicators within the broader framework of sustainable urban development (Meerow et al., 2016; Wijayanti, 2013).

Lubuklinggau City, an autonomous region in South Sumatra, spans 401.50 km^2 and is projected to have a population exceeding 246,046 by 2024 (BPS Lubuklinggau, 2025). The city faces increasing environmental pressure due to a daily waste generation of approximately 180 tons (Alfansyah et al., 2024; Anggraini et al., 2023). However, the current system accommodates only 77% of this volume, leaving around 40 tons uncollected each day (Ajrina et al., 2024). This unmanaged waste poses significant risks of environmental contamination and contributes to socio-ecological vulnerability. Additionally, waste transportation services cover only about 65% of the city's area, revealing spatial disparities in service distribution (Anggraini et al., 2023; Alfansyah et al., 2024).

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The city's waste management performance is further constrained by limitations in technical infrastructure. The Petanang landfill has exceeded its capacity since 2015, while its replacement in Lubuk Binjai continues to operate using open dumping practices in Cell E (Pamungkas et al., 2021). Although Cells C and D are planned for development as controlled landfills in accordance with SNI 19-2454-2002 standards, implementation has remained suboptimal due to technical and budgetary constraints (Rahmawati et al., 2021; Rahayu et al., 2017). The current fleet includes only 17 dump trucks, which is insufficient to handle the city's waste load (Ajrina et al., 2024; Lubuklinggau City Government, 2019). Additional infrastructure such as temporary disposal sites (TPS) and recycling facilities remains inadequate. These deficiencies underscore the limited resilience of the existing urban waste management system.

The challenges in Lubuklinggau are not solely technical, but also institutional and social. Stakeholder mapping studies indicate that waste management policies remain centralized and government-dominated, with limited collaboration from communities and the private sector (Sartika & Yogopriyatno, 2024). Existing literature underscores the importance of collaborative governance between state and non-state actors as a precondition for building resilient urban systems (Sari et al., 2024; Mukaromah & Kusumastuti, 2021). Furthermore, low public awareness regarding independent waste management—evident in the Bukit Sulap traditional market—continues to hinder the development of adaptive waste systems (Anggraini et al., 2023).

The concept of a resilient city refers to a city's capacity to respond to, adapt to, and recover from long-term pressures and sudden shocks across environmental, social, and economic dimensions (Meerow et al., 2016). In the context of waste governance, resilience depends on the effectiveness of technical infrastructure, institutional sustainability, adaptive local policies, and participatory community engagement (Jakarta Provincial Government, 2019; Muta'al & Widayanti, 2024). Waste management strategies must therefore be formulated within a holistic resilience framework that integrates spatial, institutional, and social dimensions. Technology-based innovations and grassroots empowerment have also proven effective

in enhancing system performance in various urban contexts (Lasaiba & Lasaiba, 2024).

The literature reviewed in this study reinforces the argument that waste management is inseparable from local social dynamics and policy frameworks. Several studies emphasize the role of community-based social capital—such as trust, local leadership, and a sense of ownership—in determining the success of waste programs (Theresia et al., 2015; Mukaromah & Kusumastuti, 2021). In Surakarta, the ProKlim initiative demonstrates how environmental education, urban greening, and household-level innovation can strengthen community-based resilience (Arum et al., 2024; Muta'al & Widayanti, 2024). In contrast, Lubuklinggau's Bukit Sulap Market illustrates how low community engagement can hinder source-based waste reduction programs (Anggraini et al., 2023).

Public participation in Lubuklinggau's waste governance remains limited. Stakeholder mapping indicates continued dominance by government actors, with insufficient collaboration from the private sector, businesses, and local communities (Sartika & Yogopriyatno, 2024). This pattern resembles conditions in Pangkalpinang and Samarinda, where weak cross-sectoral synergy and limited policy execution have led to suboptimal waste governance (Nagong, 2020; Arkum et al., 2023). A similar issue is noted in Batam, where collaborative governance remains rhetorical rather than operational (Sari et al., 2024). Nonetheless, governance efficiency is crucial for the sustainability of waste systems, as emphasized by Atmanti & Purwanti (2020). Therefore, future strategies must integrate both technical and non-technical approaches to achieve long-term resilience.

Addressing these multidimensional challenges requires adaptive and structured strategies that can guide systemic transformation toward urban resilience. Previous studies have employed planning tools such as SWOT (Rachmawati & Wilujeng, 2023), AHP (Ajrina et al., 2024; Lazim et al., 2014), and other quantitative approaches (Syed et al., 2013). However, few have explicitly applied these tools within a resilient city framework. The concept of urban resilience extends beyond physical infrastructure to include institutional robustness, social adaptability, and the capacity to absorb future shocks (Meerow et al., 2016; Jakarta Provincial Government, 2019).

Accordingly, this study hypothesizes that strategies involving regulatory integration, spatial alignment, and participatory approaches are more effective in enhancing urban waste resilience than infrastructure-based strategies alone. Strategies are developed through the integration of SWOT and AHP to address technical, ecological, institutional, and social challenges in a comprehensive manner. To examine this hypothesis, SWOT is used to identify internal and external strategic factors, while AHP provides structured prioritization based on logical consistency and expert judgment. This research aims to contribute both theoretically and practically to the development of environmentally adaptive, socially inclusive, and institutionally sustainable waste management policies. The findings are intended to inform other medium-sized cities facing similar governance and urbanization pressures.

Method

This study adopted an exploratory mixed-methods design that sequentially integrated qualitative and quantitative analyses to develop adaptive waste management strategies aimed at enhancing urban resilience. This methodological choice was motivated by the inherently multidimensional nature of waste management issues, which involve interconnected technical, social, and institutional dimensions (Creswell, 2014; Meerow et al., 2016). The qualitative phase employed SWOT analysis, while the quantitative phase applied the Analytical Hierarchy Process (AHP) to prioritize strategies through structured logical reasoning.

The SWOT analysis was used to identify strategic internal factors—strengths and weaknesses—and external factors—opportunities and threats—that influence waste governance in Lubuklinggau City. The analysis was based on official planning and environmental documents, direct field observations, and a review of relevant academic literature. As demonstrated by Rachmawati and Wilujeng (2023) in their application of SWOT to household waste strategies in Surabaya, this method was considered suitable for the local context. Context-specific strategic alternatives were developed from the SWOT findings to reflect the unique conditions of Lubuklinggau.

The AHP method, originally developed by Saaty (1980), was employed to rank the formulated strategies based on logical structure rather than survey responses. In this study, weights were derived from literature synthesis and the internal consistency of argumentation (Ajrina et al., 2024; Lazim et al., 2014). This approach is deemed appropriate for medium-sized cities facing constraints in resources and institutional capacity. The AHP process involved constructing a hierarchical framework based on the SWOT-derived strategies and conducting pairwise comparisons to assess urgency and potential impact on the waste management system.

This methodological model is supported by the work of Wijayanti (2013), which emphasizes the significance of urban governance in environmental mitigation, and by the findings of Muta'al and Widayanti (2024), who advocate for community-based resilience approaches in urban sustainability planning. The validity of the research method was reinforced through source triangulation and by ensuring conceptual and quantitative consistency between the SWOT results and the corresponding AHP weightings.

Since the study did not involve human participants, ethical approval was not required. All data were obtained from publicly available documents, observational records, and secondary sources. This structured and literature-informed approach is expected to produce contextually grounded, actionable, and policy-relevant waste management strategies to support Lubuklinggau City's transformation toward a resilient, inclusive, and sustainable urban system.

Results

General Description of the Study Area

Lubuklinggau City is situated in South Sumatra Province, located between 102°40'–103°00' E and 3°08'–3°22' S, covering an area of 401.50 km^2. Administratively, it is divided into eight districts and seventy-two sub-districts (BPS Lubuklinggau, 2025; Lubuklinggau City Government, 2012). The city's topography comprises both lowland and hilly areas, with elevations ranging from 130 to 250 meters above sea level. Strategically positioned along the central Sumatra corridor, Lubuklinggau functions as an economic hub for the border regions of South Sumatra, Bengkulu, and Jambi. The projected population for 2024 is 246,046, with the highest density in Lubuklinggau Barat I District, placing considerable pressure on basic urban infrastructure, including waste management systems (BPS Lubuklinggau, 2025).

Daily waste generation is estimated at approximately 180 tons, while the existing collection system can accommodate only 77% of the total, leaving an estimated 40–50 tons unmanaged. This unmanaged waste poses a significant risk of pollution, particularly along riverbanks and in traditional market areas (Ajrina et al., 2024; Anggraini et al., 2023). The Lubuk Binjai landfill currently serves as the final disposal site, operating under a controlled landfill system with a capacity of 4,250 m^3, which is expected to reach full capacity by 2025 (Pamungkas et al., 2021). Technical assessments indicate that the facility has not yet met sanitary landfill standards and poses a high risk of leachate production and soil contamination (Arini et al., 2022).

The primary challenge facing Lubuklinggau City lies in the disparity between increasing public service demands and limited local financial capacity. Regional Regulation No. 1 of 2019 concerning waste service retribution provides a foundational policy framework; however, it remains unsupported by technical regulations governing integrated and comprehensive waste management practices (Sartika & Yogopriyatno, 2024). The absence of such a regulatory framework has led to policy implementation gaps, particularly in relation to inter-agency coordination and community involvement (Nagong, 2020). Lubuklinggau City thus presents a relevant context for examining waste management strategies through the lens of urban resilience, by integrating spatial, social, and institutional dimensions. In this study, a SWOT analysis was used as the initial diagnostic tool to identify key strategic factors, followed by prioritization using the Analytical Hierarchy Process (AHP) method.

Participant Flow and Recruitment

This study did not involve the participation of human subjects nor the application of sampling procedures. Accordingly, there were no participant flow charts, recruitment phases, or follow-up assessments applicable to the research design. Instead, all data were

obtained through the analysis of official documents, direct field observations, and literature-informed strategic modeling using the SWOT framework and the Analytical Hierarchy Process (AHP). This approach aligns with the study's objective of evaluating institutional and spatial factors in waste governance, rather than individual behavioral responses.

SWOT Analysis

The results of the SWOT analysis (Table 1) show that Lubuklinggau City possesses several foundational advantages, including a preliminary regulatory framework, opportunities to enhance community engagement through waste bank initiatives, and a spatial basis embedded in its regional spatial plan. Structural weaknesses—such as a limited fleet of waste transport vehicles, the absence of specific technical regulations, and low human resource and technological capacity—hinder the effectiveness of an adaptive waste management system (Arini et al., 2022; Sartika & Yogopriyatno, 2024). Strategic opportunities, including national policy support and innovative funding potential, could be optimized through institutional reform and capacity strengthening. Systemic threats—such as environmental pollution, social instability, and the lack of emissions mitigation measures—require immediate, structured, and participatory responses. These four categories of strategic factors were formulated into core strategic alternatives (Table 2) and subsequently prioritized using the Analytical Hierarchy Process (AHP) method to generate implementation-oriented strategic weightings.

Table 1. SWOT Analysis – Strategic Factors of Waste Management in Lubuklinggau City

Strengths	Weaknesses
1. Existence of a regional regulation (Perda) on waste service retribution, serving as a fiscal foundation to strengthen incentives and sanctions. 2. Availability of land and initial operations at the Lubuk Binjai landfill, with potential for development into an integrated, controlled landfill facility. 3. Emergence of waste bank initiatives in several sub-districts, providing a foundation for community-based waste management systems. 4. Presence of a spatial plan document that provides zoning guidelines for waste facilities and supports environmental integration.	1. Lack of specific technical regulations addressing operational, institutional, and service-related aspects of waste management. 2. Insufficient number of waste transport fleets relative to the geographic coverage area and volume of waste generated. 3. Limited technical and managerial capacity among personnel in implementing the 3R system and technology-based services. 4. Absence of a digital system for logistics management, vehicle tracking, and daily waste volume monitoring.
Opportunities	**Threats**
1. National policy direction supporting the circular economy, including incentives for waste reduction and reuse. 2. Potential for infrastructure financing through Public-Private Partnership (PPP) schemes and CSR contributions from the private sector. 3. Availability of appropriate technologies such as household composters and mobile-based waste reporting systems. 4. Opportunity for Lubuklinggau to become a regional model of resilient, inclusive, and adaptive waste governance.	1. Increasing volume of waste driven by population growth and economic activity surpassing the capacity of municipal services. 2. Continued open dumping practices at landfill sites causing environmental hazards and social resistance from surrounding communities. 3. Absence of methane mitigation systems and environmental safeguards in the waste management sector. 4. Public resistance to the development of new waste facilities due to minimal community involvement in the planning process.

SWOT Strategy

The four main strategies—SO, WO, ST, and WT—were derived from the SWOT matrix (Table 2) and tailored to the contextual realities of Lubuklinggau City. The SO strategy focuses on leveraging internal strengths to capitalize on existing opportunities, such as expediting the formulation of technical regional regulations integrated with spatial planning documents and regional fiscal frameworks to promote cross-sectoral synchronization (Lubuklinggau City Government, 2012; 2019). The transformation of the Lubuk Binjai landfill into a zone-based controlled facility can be supported through innovative financing mechanisms such as Public-Private Partnerships (PPP) and Corporate Social Responsibility (CSR) programs (Ajrina et al., 2024). In addition, strengthening community-based waste banks is considered a participatory approach to socially driven waste management, supported by promising incentive mechanisms (Sartika & Yogopriyatno, 2024). The WO strategy aims to address internal weaknesses by capitalizing on external opportunities. This includes optimizing fleet distribution based on zoning and digital tracking, developing a collaborative investment roadmap (Lasaiba & Lasaiba, 2024), and enhancing staff capacity through partnerships with academic institutions (Wijayanti, 2013).

Table 2. SWOT Analysis – Strategic Factors of Waste Management in Lubuklinggau City

SWOT Strategy	Strategic Formulation	Code
SO (Leveraging Strengths to Seize Opportunities)	1. Accelerate the formulation of regional regulation on waste management and integrate it with the spatial plan and budget policy to strengthen legal certainty and cross-sectoral synergy.	**SO1**
	2. Develop the Lubuk Binjai landfill into an integrated controlled landfill facility with PPP and CSR schemes and sustainable spatial planning.	**SO2**
	3. Encourage the expansion of community-based waste banks by strengthening regulations, continuous mentoring, and providing economic and social incentives.	**SO3**
WO (Overcoming Weaknesses by Leveraging Opportunities)	1. Optimize the distribution of waste transport fleets in high-generation and high-risk zones using digital tracking technologies.	**WO1**
	2. Formulate a waste management investment roadmap by involving the private sector, community, and government through PPP or other collaborative financing innovations.	**WO2**
	3. Establish technical training partnerships with local universities and vocational institutions to enhance the capacity of waste management personnel and officers	**WO3**
ST (Using Strengths to Counter Threats)	1. Deploy real-time, data-driven monitoring systems to track waste generation, fleet activity, and open dumping risks.	**ST1**
	2. Involve communities surrounding the landfill in social monitoring systems and develop organic waste reduction programs as a methane emission control effort.	**ST2**
	3. Establish flood absorption zones aligned with spatial plans and develop waste-free drainage systems in densely populated neighborhoods	**ST3**
WT (Mitigating Weaknesses to Prevent Threats)	1. Set technical standards for temporary waste sites, sorting systems, and zonal services, with periodic audits to assess performance.	**WT1**
	2. Design new temporary waste collection site locations through	**WT2**

SWOT Strategy	Strategic Formulation	Code
	participatory processes to prevent community resistance.	
	3. Introduce early warning systems to detect waste accumulation and blockages in markets and residential areas.	**WT3**

The ST strategy targets the mitigation of external threats using internal strengths, including the implementation of real-time, data-driven monitoring systems for waste flows and fleet operations, as well as engaging local communities in surveillance and organic waste reduction programs to minimize methane emissions (Theresia et al., 2015; Muta'al & Widayanti, 2024). Meanwhile, the WT strategy serves as a preventative response to structural vulnerabilities and long-term risks through the development of technical standards for temporary collection points (TPS), participatory site planning, and the establishment of early warning systems in densely populated areas (Pamungkas et al., 2021; Anggraini et al., 2023). All strategic formulations were quantitatively assessed using the Analytical Hierarchy Process (AHP) method to derive implementation priorities and formulate systematic, context-responsive, and actionable policy recommendations for Lubuklinggau City.

Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) was employed to determine the priority order of strategic alternatives for resilient city-based waste management in Lubuklinggau City. This was done by constructing a hierarchical structure composed of a main objective, SWOT strategy groups (SO, WO, ST, WT), and sub-strategies formulated based on local data and empirical studies (Ajrina et al., 2024; Sartika & Yogopriyatno, 2024). Unlike standard AHP models that rely on explicit weighting criteria, this study adopted a logical-argumentative approach. The weightings were derived by evaluating the urgency and contextual relevance of each SWOT-derived strategy in light of local policy challenges.

The analysis proceeded through several stages: identifying alternative strategies, constructing a pairwise comparison matrix, normalizing weight values, calculating the Consistency Index (CI) and Consistency Ratio (CR), and determining final strategic priorities. Logical coherence and internal consistency were critical in ensuring the validity of the ranking outcomes. The resulting weight scores formed the basis for generating measurable, actionable, and contextually grounded policy recommendations tailored to the realities of medium-sized urban settings like Lubuklinggau.

Developing the Pairwise Comparison Matrix

The pairwise comparison matrix was constructed to assess the relative importance of twelve strategies derived from the SWOT analysis (Table 2). Using Saaty's AHP scale (1–9), each strategy was compared with every other to determine its contribution toward the overarching objective: building a resilient urban waste management system. This assessment followed a qualitative-argumentative approach, taking into account variables such as urgency, scale of impact, feasibility, and potential for policy and sectoral integration. The comparison matrix (Table 3) was structured using AHP's reciprocal principle: if Strategy A is rated X times more important than Strategy B, then Strategy B is rated 1/X against A. Empirical considerations—such as local regulation documents, landfill capacity studies, waste transportation performance, and community participation potential—were used to assign comparison values.

Table 3. **Pairwise Comparison Matrix of Waste Management Strategies in Lubuklinggau City**

Code	SO1	SO2	SO3	WO1	WO2	WO3	ST1	ST2	ST3	WT1	WT2	WT3
SO1	1	4	5	6	3	5	4	3	4	3	2	4
SO2	1/4	1	3	4	2	4	3	3	5	3	2	5
SO3	1/5	1/3	1	2	1/3	3	1/2	2	3	2	1/2	4
WO1	1/6	1/4	1/2	1	1/5	1/2	1/2	1/2	2	1/3	1/4	3
WO2	1/3	1/2	3	5	1	4	2	3	4	3	2	5
WO3	1/5	1/4	1/3	2	1/4	1	1/3	1/2	3	1/3	1/4	3
ST1	1/5	1/4	1/3	2	1/2	3	1	3	4	2	1/2	5
ST2	1/3	1/3	1/2	2	1/3	2	1/3	1	3	1/2	1/3	4
ST3	1/4	1/5	1/3	1/2	1/4	1/3	1/4	1/3	1	1/3	1/4	3
WT1	1/3	1/3	1/2	3	1/3	3	1/2	2	3	1	1/3	4
WT2	1/2	1/2	2	4	1/2	4	2	3	4	3	1	5
WT3	1/4	1/5	1/4	1/3	1/5	1/3	1/5	1/4	1/3	1/4	1/5	1

Table 4. **Normalized Weights of Waste Management Strategies in Lubuklinggau City**

Code	SO1	SO2	SO3	WO1	WO2	WO3	ST1	ST2	ST3	WT1	WT2	WT3
SO1	0,25	0,49	0,30	0,19	0,34	0,17	0,27	0,14	0,11	0,16	0,21	0,09
SO2	0,06	0,12	0,18	0,13	0,22	0,13	0,21	0,14	0,14	0,16	0,21	0,11
SO3	0,05	0,04	0,06	0,06	0,04	0,10	0,03	0,09	0,08	0,11	0,05	0,09
WO1	0,04	0,03	0,03	0,03	0,02	0,02	0,03	0,02	0,06	0,02	0,03	0,07
WO2	0,08	0,06	0,18	0,16	0,11	0,13	0,14	0,14	0,11	0,16	0,21	0,11
WO3	0,05	0,03	0,02	0,06	0,03	0,03	0,02	0,02	0,08	0,02	0,03	0,07
ST1	0,05	0,03	0,02	0,06	0,06	0,10	0,07	0,14	0,11	0,11	0,05	0,11
ST2	0,08	0,04	0,03	0,06	0,04	0,07	0,02	0,05	0,08	0,03	0,03	0,09
ST3	0,06	0,02	0,02	0,02	0,03	0,01	0,02	0,02	0,03	0,02	0,03	0,07
WT1	0,08	0,04	0,03	0,09	0,04	0,10	0,03	0,09	0,08	0,05	0,03	0,09
WT2	0,12	0,06	0,12	0,13	0,06	0,13	0,14	0,14	0,11	0,16	0,10	0,11
WT3	0,06	0,02	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,02

Once the pairwise matrix was completed, the values were normalized by dividing each cell value by the total of its corresponding column. The resulting normalized matrix (Table 4) was used to compute priority scores for each strategy. These scores reflect the relative weight of each strategy in contributing to a resilient urban waste system and served as input for consistency testing.

Calculating Priority Values

After normalizing the comparison matrix, the subsequent step in the Analytical Hierarchy Process (AHP) involves calculating the priority weights (priority vectors) for each strategy. These values represent the relative contribution of each strategy toward achieving the overarching objective of establishing a resilient waste

management system. The results of the calculation indicate that Strategy SO1—accelerating the formulation of a regional regulation integrated with the spatial plan and budget policy—receives the highest weight, at 22.88%. This is followed by Strategy SO2, which pertains to the development of the Lubuk Binjai landfill. In contrast, Strategies ST3 (designating flood absorption zones) and WT3 (establishing early detection systems) receive the lowest rankings, highlighting the need for strengthened regulatory and institutional frameworks to support their effective implementation.

Table 5. **Priority Weights of Waste Management Strategies in Lubuklinggau City**

No.	Proposed Program	Code	Priority Score	% Score	Program Rank
1	Accelerate the formulation of a regional regulation on waste management and integrate it with the spatial plan and budget policy to strengthen legal certainty and cross-sectoral synergy.	SO1	0.229	22,88%	**I**
2	Develop the Lubuk Binjai landfill into an integrated controlled landfill facility with PPP and CSR schemes, and sustainable spatial planning.	SO2	0.155	15,53%	**II**
3	Formulate a waste management investment roadmap by involving the private sector, community, and government through PPP or other collaborative financing innovations.	WO2	0.136	13,58%	**III**
4	Design new temporary waste collection site locations through participatory processes to prevent community resistance.	WT2	0.116	11,62%	**IV**
5	Deploy real-time, data-driven monitoring systems to track waste generation, fleet activity, and open dumping risks.	ST1	0.076	7,56%	**V**
6	Encourage the expansion of community-based waste banks by strengthening regulations, continuous mentoring, and providing economic and social incentives.	SO3	0.068	6,79%	**VI**
7	Set technical standards for temporary waste sites, sorting systems, and zonal services, with periodic audits to assess performance.	WT1	0.063	6,27%	**VII**
8	Involve communities surrounding the landfill in social monitoring systems and develop organic waste reduction programs as a methane emission control effort.	ST2	0.049	4,86%	**VIII**
9	Establish technical training partnerships with local universities and vocational institutions to enhance the capacity of waste management personnel and officers.	WO3	0.036	3,60%	**IX**
10	Optimize the distribution of waste transport fleets in high-generation and high-risk zones using digital tracking technologies.	WO1	0.031	3,06%	**X**
11	Establish flood absorption zones aligned with spatial plans and develop waste-free drainage systems in densely populated neighborhoods.	ST3	0.024	2,45%	**XI**
12	Introduce early warning systems to detect waste accumulation and blockages in markets and residential areas.	WT3	0.018	1,79%	**XII**
	Total		**1**	**100%**	

The variation in priority weights across strategies, as presented in Table 5, reflects differing levels of urgency and feasibility of implementation in practical contexts. However, to ensure these weightings serve as a reliable basis for strategic decision-making, a consistency test must be conducted. The next stage in the AHP analysis involves calculating the Consistency Ratio (CR), which serves as a validation tool to confirm that the comparison matrix has been logically constructed and is free from contradictory assessments. This ratio is essential for ensuring that the resulting priorities are methodologically sound and justifiable. To validate the reliability of the calculated priority weights, the final step in the AHP involves conducting a consistency test to verify that the pairwise judgments in the matrix are logically coherent and internally consistent.

Consistency Test (Consistency Ratio – CR)

The final step in the Analytical Hierarchy Process (AHP) involves testing the consistency of the pairwise comparison matrix after the priority weights for each strategy have been determined. This test ensures that the judgments made during the comparison process are logically sound and free from contradictions. In this study, the maximum eigenvalue (λmax) was calculated at 12.880, which was then used to derive a Consistency Index (CI) of 0.080. The CI measures the extent to which the judgment matrix deviates from perfect consistency, where a CI of 0 indicates absolute consistency.

To evaluate the acceptability of the CI value, the Consistency Ratio (CR) was computed by comparing it with the standard Random Index (RI) for a matrix size of n = 12, which is 1.49. The resulting CR of 0.054, or 5.4%, falls below the commonly accepted threshold of 0.10 as proposed by Saaty (1980). Therefore, the pairwise comparison matrix used in this study is considered consistent and methodologically valid as a foundation for strategic decision-making in waste management planning in Lubuklinggau City. This validation reinforces the credibility of the prioritization outcomes obtained through the AHP model. The consistency test thus provides a solid basis for interpreting the findings more deeply in the subsequent discussion section.

Disscussion

The results of the analysis demonstrate that Strategy SO1—accelerating the establishment of regional waste management regulations—has the highest priority weight (22.88%). This finding suggests that regulatory alignment and cross-sectoral integration serve as foundational elements for building a resilient waste governance system. Strategy SO2, which promotes the development of the Lubuk Binjai landfill into a zone-based controlled facility, ranks second (15.53%) and highlights the urgency of addressing open dumping practices that pose environmental risks. Conversely,

Strategy WT3—focusing on early detection of waste accumulation—receives the lowest priority weight, indicating that structurally demanding interventions continue to face institutional and technical implementation challenges. These findings are consistent with Ajrina et al. (2024), who underscore the significance of regulatory coherence, innovative financing, and institutional reinforcement in shaping effective waste governance in medium-sized cities. This study contributes to the literature by explicitly embedding resilience-oriented strategies within the SWOT–AHP framework, thereby advancing empirical models beyond earlier works that lacked such integration.

Aligned with the theoretical perspectives of Meerow et al. (2016) and Wijayanti (2013), the results affirm that urban resilience is shaped by the synergy between systemic robustness and the adaptive capacity of local stakeholders. The prominence of SO and WO strategies in the AHP results further validates the urgency of institutional strengthening and collaborative financing, as also highlighted by Lasaiba & Lasaiba (2024) and Lazim et al. (2014). The analysis supports earlier observations that fragmentation in regulation and minimal engagement of multi-sector actors represent core barriers to effective waste governance (Sartika & Yogopriyatno, 2024; Nagong, 2020). The study also reaffirms that technical constraints—such as inadequate fleet capacity, lack of operational regulatory standards, and persistence of open dumping—remain critical challenges to system performance. From a methodological standpoint, employing a logic-based AHP model without direct respondent input proves effective, particularly in contexts like Lubuklinggau where limited resources and stakeholder participation hinder empirical surveying (Syed et al., 2013; Wijayanti, 2013).

The prioritization of SO1 (0.2288) further reinforces its role as a legal instrument that enables regulatory enforcement, institutional harmonization, and spatial integration within the spatial planning document framework. WO2 (collaborative investment roadmap) and WO3 (capacity-building initiatives) are recognized as complementary strategies that address medium-term institutional and technical constraints. These outcomes suggest that cities like Lubuklinggau are undergoing transitional governance phases, where institutional consolidation and financing mechanisms must be optimized. Meanwhile, the lower weight of WT3—which emphasizes early detection of waste buildup in dense urban areas—reflects the ongoing limitations in technological readiness and cross-sector collaboration, consistent with the analysis of Rahmawati et al. (2021).

These results provide meaningful implications for local governments in identifying adaptive, measurable, and context-specific priorities for improving urban waste systems. Recommendations such as expediting technical regulation development, enhancing controlled landfill implementation, and pursuing collaborative financing frameworks can be feasibly adopted by municipal authorities. Integrating waste management plans with spatial zoning frameworks can foster the development of environmentally sustainable and spatially coherent waste service areas (Rahayu et al., 2017). From a theoretical perspective, the study contributes to advancing resilient waste governance models through a document-based mixed-methods approach. Future research should consider incorporating participatory mapping or spatial modeling tools to better reflect community needs and geographic variations in waste service provision.

Limitation of the Study

While this study offers a structured framework for formulating waste management strategies based on a resilience-oriented SWOT–AHP integration, it is constrained by the absence of direct stakeholder input through surveys or participatory assessments. The prioritization process relied heavily on secondary data, document reviews, and logical inference, which, while methodologically sound, may not fully capture local perceptions or behavioral factors influencing waste management practices. Furthermore, the study's limited integration of spatial simulation and geospatial analysis restricts its ability to assess spatial disparities and environmental risks across different zones in Lubuklinggau. These limitations suggest the need for future research to incorporate participatory mapping, spatial modeling, and community engagement mechanisms to enhance the contextual accuracy and policy relevance of resilience-based waste management planning.

Conclusions and Recommendations

This study developed adaptive and context-specific waste management strategies for Lubuklinggau City by integrating the SWOT framework with the Analytical Hierarchy Process (AHP) under the concept of urban resilience. The highest priority was assigned to Strategy SO1, which advocates for the acceleration of a technical regional regulation (Perda) aligned with the city's spatial plan (RTRW) and fiscal policy. This strategy received a significant priority weight of 22.88%, indicating its fundamental role in reinforcing institutional synergy and regulatory coherence in waste governance. These findings highlight that structural inefficiencies and fragmented policy implementation remain major constraints in the transition toward socially and environmentally resilient urban systems. The use of AHP without explicit criteria—based solely on document analysis and logical argumentation—proved effective for medium-sized cities with limited participatory data sources.

Through a structured process—from strategic formulation to the calculation of the Consistency Ratio (CR = 0.054)—the study validated the internal logic and methodological consistency of its prioritization outcomes. It directly responds to the research gap concerning locally grounded waste governance strategies that address multidimensional urban challenges. As such, the case of Lubuklinggau contributes to the broader discourse on urban resilience, as previously conceptualized by Meerow et al. (2016), Wijayanti (2013), and Muta'al & Widayanti (2024).

Theoretically, this study contributes to the growing body of literature on resilient urban systems, particularly in emerging cities facing institutional and environmental pressures. Practically, the results offer a replicable model for designing integrated and cross-sectoral waste policies. The AHP framework has demonstrated its utility in simplifying complex, multi-dimensional policy challenges into actionable strategic priorities. Furthermore, this study addresses a notable research gap related to the limited spatial integration in regional waste management planning (Ajrina et al., 2024; Sartika & Yogopriyatno, 2024; Meerow et al., 2016).

To further refine these findings, future research is advised to incorporate participatory weighting mechanisms and scenario-based assessments involving local stakeholders. Key policy recommendations include: (1) accelerating the enactment of technical waste regulations; (2) developing a funding roadmap using PPP and CSR schemes; (3) integrating waste service zones with digital fleet tracking systems; (4) scaling up incentive-driven community-based waste banks; and (5) enhancing community engagement in environmental education. These strategies are expected to support Lubuklinggau City in building a waste management system that is sustainable, inclusive, and resilient to long-term socio-environmental risks.

References

Ajrina, F. I., Agustine, V., & Fuady, S. N. (2024). Multi-criteria analysis of selection waste management development strategy for Lubuk Binjai landfill in Lubuk Linggau City. Pena Teknik, 9(1).

Alfansyah, M. A., Fitriani, H., & Hadinata, F. (2024). Evaluasi pengelolaan sampah menggunakan CRIC waste assessment tool Kota Palembang. JURMATEKS, 7(1), 56–68.

Anggraini, S., Safriyani, E., & Harnawansyah, M. F. (2023). Pengelolaan sampah pasar tradisional (Studi kasus Pasar Bukit Sulap Kota Lubuklinggau). INNOVATIVE: Journal of Social Science Research, 3(3), 10768–10778.

Arini, N. W. A., Pratama, I. G. Y., & Surata, S. P. K. (2022). Evaluasi kebutuhan TPS berdasarkan aspek daya tampung, kesesuaian lokasi dan infrastruktur. Jurnal Pembangunan Wilayah dan Kota, 18(4), 318–355.

Arkum, D., Handini, W., & Kurniawan, R. (2023). Optimalisasi implementasi kebijakan pengelolaan sampah di Kota Pangkalpinang. Jurnal Administrasi Negara, 5(2), 121–132.

Arum, M. S., Putro, R. H., Putra, A. R., & Asmiatun, S. (2024). Perancangan sistem pengolahan limbah organik pada sampah rumah tangga menggunakan metode spiral. In Proceedings of the National Seminar on Innovation and Technology Trends, Universitas Semarang.

Atmanti, H. D., & Purwanti, E. Y. (2020). Analisis efisiensi pengelolaan sampah perkotaan di Indonesia. In Dinamika Pembangunan Berkelanjutan (pp. 187–194).

Badan Pusat Statistik Kota Lubuklinggau. (2025). Kota Lubuklinggau dalam angka 2024. Lubuklinggau: BPS.

Badan Standardisasi Nasional. (2002). SNI 19-2454-2002: Tata cara teknik operasional pengelolaan sampah perkotaan. Jakarta: BSN.

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). SAGE Publications.

Lasaiba, M. A., & Lasaiba, I. (2024). Strategi inovatif untuk pengelolaan sampah perkotaan: Integrasi teknologi dan partisipasi masyarakat. GEOFORUM, 3(1), 1–18.

Lazim, M. A., Mohd, H., & Awang, Z. (2014). AHP application in evaluating public solid waste management system: A case study. Journal of Environmental Management, 145, 48–58.

Mukaromah, H., & Kusumastuti, D. (2021). Modal sosial dalam upaya pengelolaan sampah berkelanjutan di Kampung Iklim Joyotakan Surakarta. Region: Jurnal Pembangunan Wilayah dan Perencanaan Partisipatif, 16(1), 83–91.

Muta'al, M. R., & Widayanti, P. W. (2024). Community-based city resilience in facing climate change through the Program Kampung Iklim (ProKlim) in Surakarta. E-Proceeding: Indonesia Social Responsibility Award, 2(4), 26–41.

Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. Landscape and Urban Planning.

Mula'al, M. R., & Widayanti, P. W. (2024). Community-based city resilience in facing climate change. E-Proceeding: ISRA, 2(4).

Nagong, A. (2020). Studi tentang pengelolaan sampah oleh Dinas Lingkungan Hidup Kota Samarinda berdasarkan Peraturan Daerah Nomor 02 Tahun 2011. Jurnal Administrative Reform, 8(2), 105–108.

Pamungkas, R. C. P., Endah, N., & Satrya, T. R. (2021). Perencanaan sel tempat pembuangan akhir dengan sistem controlled landfill pada TPA Lubuk Binjai-Lubuklinggau. Jurnal Teknik ITS, 10(2).

Pemerintah Kota Lubuklinggau. (2012). Peraturan Daerah Kota Lubuklinggau Nomor 1 Tahun 2012 tentang Rencana Tata Ruang Wilayah Kota Lubuklinggau Tahun 2012–2032.

Pemerintah Kota Lubuklinggau. (2019). Peraturan Daerah Kota Lubuklinggau Nomor 1 Tahun 2019 tentang Retribusi Pelayanan Persampahan/Kebersihan.

Pemerintah Provinsi DKI Jakarta. (2019). Strategi Ketahanan Kota Jakarta. Jakarta: Jakarta Berketahanan & 100RC.

Rahayu, T. P., Yuliani, S., & Daryanto, T. J. (2017). Pendekatan arsitektur ekologis pada pusat pengelolaan sampah di Surakarta. Arsitektura, 15(2), 483–490.

Rachmawati, F., & Wilujeng, S. A. (2023). SWOT analysis to determine waste management strategy in Tenggilis Mejoyo District, Surabaya City. IOP Conference Series: Earth and Environmental Science, 1263, 012064.

Rahmawati, A. F., Amin, R., Rasminto, & Syamsu, F. D. (2021). Analisis pengelolaan sampah berkelanjutan pada wilayah perkotaan. Bina Gogik, 8(1), 1–12.

Saaty, T. L. (1980). The analytic hierarchy process. McGraw-Hill.

Sari, C. F., et al. (2024). Tantangan pertumbuhan sampah melalui tata kelola kota yang kolaboratif di Kota Batam. Dialogue: Jurnal Ilmu Administrasi Publik, 6(2), 761–764.

Sartika, S., & Yogopriyatno, J. (2024). Stakeholder mapping dalam formulasi kebijakan pengelolaan persampahan di Kota Lubuklinggau. Prosiding IAPA, Universitas Sriwijaya, 375–378.

Syed, R. H., et al. (2013). Integrating AHP, SWOT, and QSPM in strategic planning. International Journal of Academic Research, 5(3), 123–131.

Theresia, D. T., Kusumastuti, I., & Andini, I. (2015). Dampak perubahan modal sosial terhadap perubahan sistem pengolahan sampah di Yogyakarta. Arsitektura, 13(2).

Wijayanti, W. P. (2013). Peluang pengelolaan sampah sebagai strategi mitigasi dalam mewujudkan ketahanan iklim Kota Semarang. Jurnal Pembangunan Wilayah dan Kota, 9(2), 152–162.