



Waste Management Crisis and Collaborative Governance in Indonesia: Enhancing Public Participation for Effective Urban Waste Solutions

Tengku Rika Valentina, Roni Ekha Putera, Lubna Salsabila, and Andre Gunawan
Universitas Andalas
Padang, Indonesia
tengkurika@soc.unand.ac.id

Abstract. Waste management is a pressing global issue, with Indonesia being the second-largest contributor to oceanic waste. This paper explores the intersection of Institutional Design Collaborative Governance and public engagement in urban waste management, addressing gaps in understanding effective participation mechanisms. Adopting a qualitative approach, the study analyzes waste management practices across Indonesian cities through case studies, interviews, and surveys with government agencies, NGOs, and community-based organizations. A comparative analysis identifies best practices and successful community engagement models. The findings highlight two key innovations: (1) the critical role of Institutional Design Collaborative Governance in mobilizing local communities for active involvement in environmental policies, and (2) the effectiveness of specific participation models, such as voluntary environmental initiatives and local community partnerships, in enhancing waste management strategies. Despite challenges like community resistance and lack of incentives, the study identifies frameworks to bridge these gaps and improve collaborative governance in waste management.

Keywords: Collaborative Governance, Public Participation, Waste Management, Urban Waste

1 Introduction

The waste management dilemma in Indonesia poses a serious obstacle to sustainable development, notably in quickly urbanizing locales where waste output surpasses the current systems' capacity to deal with it effectively. Sustainable waste management is imperative not solely for mitigating pollution and conserving natural resources but also for fostering a balanced urban ecosystem that enhances public health and ensures environmental stability [1]. Robust environmental management, particularly concerning waste, incorporates strategic oversight and resource protection, pollution regulation, and practices for waste disposal, all of which are integral to reducing the human ecological footprint and addressing the harmful effects of human actions on the natural environment [2], [3]. This crisis necessitates comprehensive strategies, including optimal resource utilization, incorporating environmentally friendly technologies, and establishing effective waste management systems to bolster the resilience of urban areas against environmental adversities [4].

From a governmental standpoint, environmental management embodies a methodical,

strategic framework necessitated to supervise and enhance waste management at a national tier, mainly through the development of policies, enforcement of regulations, and collaboration on environmental initiatives [5]. In Indonesia, the governmental apparatus is pivotal in establishing ecological benchmarks, formulating emission and waste reduction objectives, and enforcing sustainable methodologies to ensure adherence and avert environmental deterioration [6], [7]. The initial phase in governmental waste management encompasses the development of environmental policies, including those delineating standards for waste disposal, recycling, and resource conservation. Furthermore, the government is responsible for monitoring and enforcing adherence to environmental regulations to avert violations and address waste-induced damages [8]. In addition to policy formulation, governments are also charged with the stewardship of natural resources, fostering public consciousness regarding waste-related challenges, and partaking in international collaborations that can promote sustainable practices locally [9]. Through these cooperative endeavors, the government aspires to cultivate a balanced ecosystem and advocate for all constituents' enhanced quality of life.

Waste management challenges within urban areas of Indonesia are profoundly significant. Major metropolitan regions generate substantial waste, encompassing biodegradable and electronic refuse, frequently lacking appropriate disposal mechanisms. Inadequate infrastructure, characterized by insufficient final disposal sites (TPA) and constrained processing facilities, exacerbates the waste dilemma and culminates in improper disposal practices, contributing to land, air, and water pollution [10]. Furthermore, insufficient public awareness concerning waste segregation and recycling undermines establishing a sustainable waste management ethos in urban locales. When inhabitants lack adequate information regarding effective waste management practices, efforts to implement waste segregation and management become futile, resulting in environmental degradation [11]. This deficiency in disseminating knowledge restricts public comprehension of the ramifications of inadequate waste management practices and obstructs initiatives to foster a culture of environmental stewardship.

Addressing the exigent waste management crisis necessitates a collaborative approach to urban governance encompassing many stakeholders [12], [13]. In the context of Indonesia, Batam City exemplifies a case study wherein synergistic partnerships among governmental bodies, commercial enterprises, and local communities have been demonstrated to augment waste management practices within the industrial domain. The incorporation of local democratic engagement permits communities to assert an active role in decision-making processes, thereby cultivating a profound sense of accountability and collective responsibility. The dynamics of regional politics in Batam City further shape the efficacy of these waste management strategies by galvanizing political backing for sustainable policies and allocating essential resources for environmental initiatives. It is imperative to engage local legislators and policymakers to establish regulatory frameworks and incentives that motivate industrial sectors to embrace sustainable waste management methodologies. More than just implementing technological strategies, effectively handling the complexities of waste management calls for an evolution in public mindset and actions about environmental conservation. Through the facilitation of public engagement, the city of

Batam can operationalize community-based initiatives that enhance awareness regarding waste segregation, recycling, and sustainable waste management practices [14]. By actively empowering citizens to participate in environmental governance, Batam City can cultivate a more resilient and sustainable urban ecosystem.

This scholarly inquiry endeavors to explore the extent to which collaborative urban governance and local political participation can effectively mitigate waste management issues in Indonesia, with a particular focus on the industrial sector of Batam City. In advocating for a unified approach, the research endeavors to coordinate the strategies of all essential stakeholders—including governmental organizations, corporate entities, civic groups, and academic establishments—toward sustainable development. The investigation aims to provide actionable insights into waste management strategies that bolster urban resilience, facilitate community involvement, and enhance the overall quality of life for both present and future generations in Indonesia's swiftly urbanizing areas.

2 Methodology

This investigation utilizes a qualitative research methodology to scrutinize the intricacies of collaborative urban governance and public engagement in tackling waste management issues within the industrial sector of Batam City. Qualitative research is adept at capturing profound insights into the meanings, viewpoints, and interactions among various stakeholders and the contextual elements that shape collaborative governance [15], [16]. This analytical strategy enables a holistic understanding of the convictions, experiences, and perspectives of various participants, including officials from local government, representatives from multiple industries, community individuals, and relevant groups, regarding waste management practices and environmental oversight.

The research employs a diverse array of qualitative data collection methodologies to elucidate the complex interactions inherent in collaborative urban governance and its significance in addressing waste management challenges.

1. Semi-Structured Interviews

The primary data collection methodology will consist of in-depth, semi-structured interviews with pivotal stakeholders, which will yield extensive insights into participants' perspectives regarding collaborative governance, local political engagement, and waste management practices. These interviews are designed to uncover the specific factors that either support or inhibit effective collaborative governance in environmental management, particularly in the industrial sector. Questions will focus on stakeholders' experiences with inter-organizational collaboration, perceptions of public participation, and challenges or facilitators to policy implementation in waste management.

2. Participant Observation

To gain firsthand insights into the interactions and dynamics between stakeholders, the researcher will engage in participant observation. By attending stakeholder meetings, community events, and other relevant activities, this approach will enable the study to capture real-time data on relationship-building, communication strategies, and collaborative decision-making processes among

stakeholders. Observations will focus on informal interactions, power dynamics, and communication patterns, providing a deeper understanding of how collaboration operates in practice and how decisions related to waste management are shaped by collective efforts.

3. Document Analysis

A comprehensive analysis of policy documents, reports, regulatory guidelines, and other authoritative literature will enhance the data from interviews and observations. Examining documents will elucidate the frameworks and policies that regulate waste management and collaborative governance within Batam City. It will also embed the study's conclusions within a more expansive social, cultural, political, and economic setting. The scrutiny of documents will furnish critical context for comprehending the official directives, regulatory structures, and historical precedents that inform stakeholder behaviors and affect collaborative governance.

This inquiry intends to use diverse qualitative methodologies to present a holistic viewpoint on the social, cultural, political, and economic elements that affect collaborative urban governance in Batam City. The methodological framework is meticulously crafted to elucidate the interactions among diverse stakeholders within governance frameworks, examine how their collective endeavors may proficiently confront the challenges posed by waste proliferation, and advocate for more sustainable waste management practices within the industrial domain. Ultimately, this qualitative paradigm is anticipated to produce an intricate and layered comprehension of how collaborative governance can bolster environmental outcomes in urban contexts, thereby harmonizing stakeholder initiatives to realize more resilient and efficacious waste management solutions.

3 Results and Discussion

Batam City, situated within the Singapore Strait in the Riau Islands Province, attained autonomous status in 1999, concurrently with seven other nearby districts and municipalities, under Law Number 53. The administrative jurisdiction of the city encompasses an area of 1,575 square kilometers, including Batam Island, Rempang Island, Galang Island, and numerous smaller islands. As delineated in the 2021-2024 Regional Spatial Planning Plan, as articulated in Regional Regulation Number 3 of 2021, the land area of Batam City is comprised of 103,374 hectares, complemented by an additional 6,901 hectares of reclaimed aquatic environments and 1,941 hectares of various other water bodies. The administrative reorganization established in Regional Regulation Number 2 of 2005 has increased the number of sub-districts from 8 to 12, which has been further divided into 64 smaller administrative entities.

The cumulative expanse of the subdistricts within Batam City is quantified at 458,024 hectares, which includes 103,480 hectares designated as terrestrial land and 354,544 hectares classified as marine territory. This space allocation accentuates the imperative for integrated environmental management frameworks and collaborative urban governance mechanisms to facilitate sustainable development. Subdistricts such as Batam Kota, Batu Ampar, and Lubuk Baja—predominantly urban and industrial centers—exhibit reduced land areas to their population density and economic

activities, thereby necessitating the implementation of efficacious waste management systems and pollution mitigation strategies to alleviate environmental deterioration. These densely populated and industrially active regions demand appropriate waste disposal sites, processing facilities, and initiatives to enhance public consciousness regarding waste segregation, thus ensuring adequate waste management practices.

Table 1. Batam City Area Based on District

No	Subdistrict	Number of Subdistricts	Area (Ha)		
			Land	Sea	Total
1	Batam Kota	6	3.854	789	4.643
2	Batu Ampar	4	1.096	8.276	9.372
3	Batu Aji	4	4.182	2.037	6.219
4	Bengkong	4	1.371	589	1.960
5	Belakang Padang	6	6.855	66.490	73.345
6	Bulang	6	15.893	26.550	42.443
7	Lubuk Baja	5	1.116	3.714	4.830
8	Galang	8	35.331	211.816	247.147
9	Sei Beduk	4	10.597	1.484	12.081
10	Nongsa	4	10.837	28.011	38.848
11	Sekupang	7	6.853	3.863	10.716
12	Sagulung	7	5.495	925	6.420
Total		64	103.480	354.544	458.024

Source: Batam City RPJMD 2021-2026

In contrast, subdistricts exhibiting larger geographical extents and significant industrial operations, exemplified by Bulang and Galang, necessitate a strategic emphasis on developing infrastructure that advances economic progress and environmental sustainability. Distinguished by their vast terrestrial and aquatic domains, these regions underscore the imperative for sustainable development initiatives that reconcile economic advancement with ecological conservation. To promote sustainable waste management throughout Batam City, it is crucial to implement targeted strategies tailored to each subdistrict's unique geographical and industrial characteristics, thereby highlighting the importance of enhancing public awareness and fostering community participation in the cultivation of an environmentally resilient urban area.

Waste Management as a Local Government Challenge

The conceptual framework governing national spatial planning in Indonesia originated with the promulgation of Law Number 24 of 1992, subsequently revised by Law Number 26 of 2007, to facilitate spatial development congruent with safety, comfort, productivity, and sustainability principles. The advancement of spatial planning is fundamentally dependent on data analysis conducted through the Strategic Environmental Assessment (SEA), which is referred to in the local context as KLHS. This analytical instrument enhances spatial planning by evaluating environmental capacities and ensuring that developmental plans adequately consider ecological conservation in tandem with urban development objectives.

In the context of Batam City, industrial undertakings are primarily classified into two principal categories: heavy and light industries. The heavy industry sector in Batam encompasses activities such as shipbuilding, fabrication, steel manufacturing, and

metalworking, whereas the light industry sector comprises electronics, textiles, plastics, and analogous manufacturing domains. Batam City is a pivotal center for shipbuilding within Indonesia, featuring significant industrial zones, including Wiraraja Industrial Park, Batamindo Industrial Park, and Kabil Integrated Industrial Park.

Under Law Number 32 of 2009 on Environmental Protection and Management, local governments are required to conduct SEAs to incorporate sustainable development principles into regional planning. Batam, as part of the Batam, Bintan, and Karimun (BBK) National Strategic Area, is a crucial hub for Indonesia's trade, industry, and tourism sectors. The spatial planning policy of the city, designated for the period spanning 2018 to 2038, identifies Batam as a principal urban zone structured into a central urban core, subsidiary urban centers, and community-focused centers to harmonize developmental initiatives alongside environmental conservation efforts.

In collaboration with the Environmental Service, the Batam City Government is undertaking a "Strategic Environmental Study for the Detailed Spatial Plan (RDTR) for 5 Districts on Batam Island" to integrate principles of sustainable development into the city's strategic planning framework. This initiative is particularly vital in light of Batam's accelerated industrial expansion and urbanization. Collaborative governance and community engagement are fundamental in addressing these challenges, necessitating partnerships among governmental entities, the private sector, and local communities to attain effective waste management solutions. The waste management predicament in Batam is predominantly influenced by rapid population increase, high-density urbanization, and elevated poverty levels, which collectively impose significant strain on the city's waste management systems. The escalating population is directly associated with an upsurge in waste generation (Fig 1), intensifying the demands on waste management infrastructure and available resources.

Consumer habits in Batam City also exacerbate the waste problem. Known for its consumer culture and expanding gastronomy sector, Batam has seen a rise in waste generation, particularly plastics, styrofoam, and cardboard due to the growth of delivery and takeout services. This shift in consumption patterns is visible across all sub-districts, where waste production rose notably from 2021 to 2022. For instance, Sei Beduk's waste production increased from 14,680,240 kg in 2021 to 17,895,770 kg in 2022, while Nongsa saw an increase from 10,888,870 kg to 12,478,650 kg (Fig 1).

Public participation in Batam's waste management efforts remains limited. The Batam City Government operates a Waste Bank program that encourages community involvement in waste sorting and recycling, but the program primarily targets recyclables like metals, plastic, and paper, leaving organic waste largely unmanaged. According to the Head of Environmental Management at the Batam Environmental Department, addressing community behavior poses a major challenge. He explains, "There is a dilemma in waste management, particularly concerning community behavior. For instance, people often dump waste along the roadside. If we clean it up, they might think, 'Oh, someone will clean it later,' which perpetuates the habit. However, if we don't clean it, we will be reprimanded by the Mayor, and our performance will be scrutinized. It's a tricky situation in dealing with community behavior."

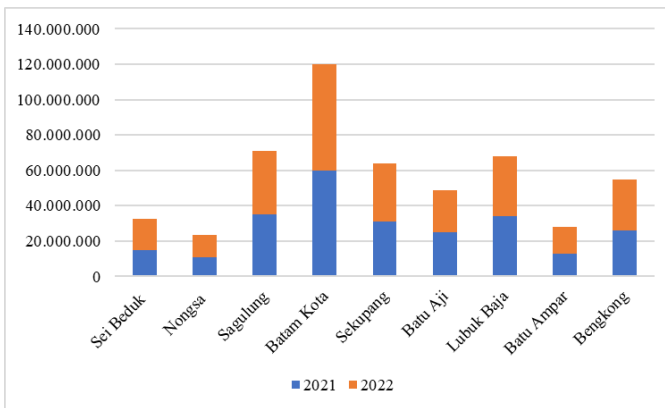


Figure 1. Data on Household Waste Entering Punggur Landfill (kg)

The Waste Bank program, while an important initiative, has not yet managed to address the organic waste problem—a key component of sustainable waste management. Effective waste management in Batam requires more than facilities and services; it also calls for a cultural shift in public attitudes and behaviors toward waste. Addressing Batam’s waste management challenges requires coordinated efforts between government, businesses, and communities. Local political engagement and leadership are crucial in shaping and enforcing policies that encourage sustainable practices. The ongoing Strategic Environmental Study for detailed spatial planning illustrates Batam City Government’s dedication to integrating sustainable development into its regional framework.

Collaborative Urban Governance and Local Democratic Engagement in Addressing Waste Growth Challenges

Effective waste management in Batam City is a complex issue that requires active collaboration between government agencies, the local community, and the corporate sector. This collaborative methodology is integral to achieving sustainable waste management strategies. The Waste Bank Program in Batam is a crucial framework for facilitating stakeholder engagement, promoting collective accountability, and consolidating initiatives to diminish waste production and advance environmental sustainability.

According to the Minister of Environment and Forestry Regulation No. 75 of 2019, producers should engage in partnerships with officially registered waste banks, thereby facilitating the establishment of infrastructures dedicated to waste collection, recycling, and reuse. This regulatory framework underpins a circular economy paradigm, which holds particular significance for Batam City. A circular economy prioritizes minimizing, reutilizing, and transforming materials to convert waste into valuable resources, thereby diminishing dependence on virgin raw materials. In Batam, governmental entities can lead these initiatives by implementing conducive policies, offering incentives to enterprises that embrace sustainable methodologies, and

allocating resources toward developing infrastructure for waste sorting and recycling.

The function of enterprises is crucial within the paradigm of the circular economy. They possess the capacity to foster innovation via sustainable approaches to product design, packaging, and manufacturing methodologies that diminish waste and enhance closed-loop systems. This methodology mitigates waste and fosters collaborations with startups and local businesses specializing in recycling and waste management, thereby establishing a local ecosystem committed to sustainability. To efficiently manage solid waste in Batam, it is imperative to ensure close collaboration among governmental entities, the community, and the business sector. The Waste Bank Program fortifies these inter-stakeholder relationships, consolidating their efforts to minimize waste and advocate for sustainability. The Batam City Environmental Service is responsible for overseeing and executing policies that promote sustainable waste practices, including operational guidelines for waste banks, incentives for community participation, and standards for waste management.

The government's role in waste management is inherently complex, emphasizing essential infrastructure, encompassing waste processing facilities, recycling centers, and adequately maintained landfills. Initiatives such as the SILH are instrumental in monitoring and documenting the efficacy of various waste management practices. Furthermore, educational initiatives and community awareness campaigns are paramount, empowering residents to participate actively in waste reduction strategies. Workshops, communal gatherings, and outreach programs educate citizens regarding efficient waste management practices, cultivating a culture of environmental stewardship. The local community assumes a similarly critical role, particularly at the household level, where practices such as waste segregation are vital to the success of programs like the Waste Bank. Community members, notably homemakers, play a significant role by meticulously separating organic from inorganic waste at the point of origin. Local entities, including neighborhood associations (RT/RW), further bolster these efforts by orchestrating waste collection and overseeing local waste banks. The active involvement of the community in these initiatives not only facilitates the effective functioning of waste management systems but also ensures the durability and sustainability of such endeavors.

Through these synergistic endeavors, Batam City has the potential to advance a waste management framework that effectively responds to its distinctive challenges, promotes sustainable development, and encourages civic democratic involvement. The congruence of governmental policies, entrepreneurial innovation, and community engagement will be imperative in revolutionizing Batam's waste management paradigm, thereby establishing a prototype for ecological stewardship and sustainability.

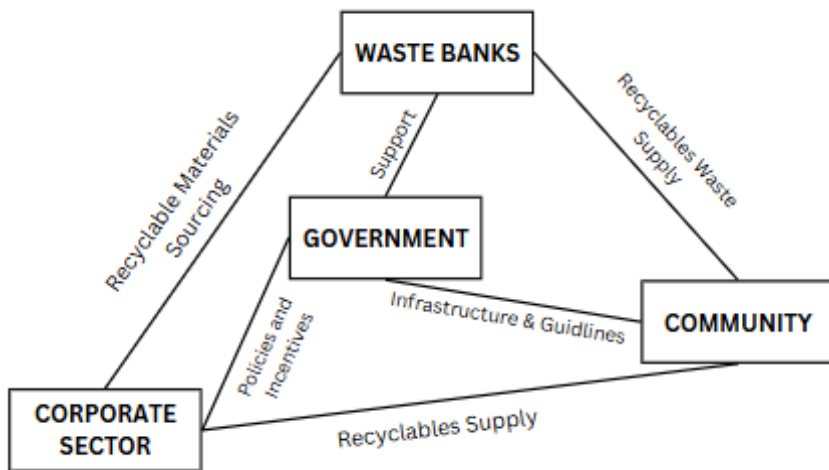


Figure 2. Collaborative Waste Management in Batam City

Although public involvement is essential in waste management, the business sector's role in managing industrial waste is a significant yet inadequately examined facet. Industries significantly contribute to garbage generation, especially in metropolitan regions. Data from Indonesia's Ministry of Environment and Forestry indicates that industrial waste constitutes roughly 30% of overall trash generation, with a mere 9% being effectively recycled. Numerous firms participate in extended producer responsibility (EPR) programmes; nonetheless, obstacles such as inadequate infrastructure, elevated recycling expenses, and variable policies impede their efficacy.

In collaborative waste management, firms are essential players in procuring recyclable materials and facilitating their reintegration into production cycles. Figure 2 illustrates that the business sector depends on waste banks as intermediaries for procuring recyclable materials from communities. Nonetheless, in the absence of robust legal frameworks and economic incentives, corporate engagement in sustainable waste management is constrained. Fortifying policies on industrial waste recycling, refining trash tracking systems, and augmenting corporate-community collaborations could markedly improve the efficacy of urban garbage management.

Figure 2 depicts the "Recyclables Supply," which illustrates the transfer of recyclable materials from communities to garbage banks and then to corporate recycling facilities. This approach encounters multiple obstacles, such as inadequate home participation, ineffective waste segregation, and insufficient incentives for community involvement.

1. **Community Participation:** Households and informal waste collectors are essential in providing recyclable items to waste banks. Nevertheless, fewer than 50% of urban families in Indonesia engage in source trash sorting, hence diminishing the efficacy of waste banks.
2. **Waste Bank Operations:** Waste banks function as collection centres for the aggregation, processing, and sale of recyclable materials to the recycling sector. Despite the operation of over 13,000 trash banks in Indonesia, many face challenges

related to insufficient funding, limited recycling demand, and inadequate logistical support.

3. **Corporate Utilization:** The corporate sector incorporates recyclables into production, especially in plastic manufacturing, paper processing, and metal refining industries. Nonetheless, merely 12% of the total garbage collected by waste banks is effectively reintegrated into industrial production, underscoring a substantial deficiency in recycling efficiency.

To enhance the recyclables supply chain and improve industrial waste management, stronger collaboration between governments, corporate entities, and local communities is essential. This interconnected structure showcases the mutual dependencies among stakeholders. Community behavior, government regulations, corporate innovation, and waste bank operations are all crucial to achieving an efficient and resilient waste management system in Batam City. As a result, the city can address its waste growth challenges by maintaining a collaborative governance approach that aligns with local democratic engagement and shared environmental objectives.

4 Conclusion

Effective solid waste management in Batam City, mainly through establishing waste banks, necessitates robust and enduring collaboration among governmental entities, industrial sectors, and the community. Although initial collaborative initiatives are currently in progress, considerable challenges hinder the comprehensive execution of these efforts. At present, cooperation tends to be restricted to particular projects, with individual corporations supplying waste receptacles or endorsing a limited number of disconnected programs. To attain a more extensive impact, it is imperative to adopt an integrated methodology encompassing a diverse array of stakeholders, each playing a pivotal role in formulating a unified waste management strategy.

The insufficient involvement of the community in waste management techniques poses a primary challenge, influenced by habitual patterns and a shortfall in environmental mindfulness. Mitigating this concern necessitates a more substantial commitment to educational schemes, awareness programs, and the introduction of incentives to foster community participation in waste sorting and management. Moreover, Batam City confronts challenges associated with constrained financial resources, deficient infrastructure, and irregular enforcement of regulations. Stakeholders within the industry must accord priority to sustainability by embracing environmentally responsible practices, endorsing green initiatives, and embedding these endeavors into their corporate strategies rather than merely concentrating on profit maximization.

Overcoming these impediments necessitates a collective dedication and an elevated collaboration among all relevant stakeholders. The government can fortify regulatory frameworks, provide more substantial incentives, and enhance interagency coordination to facilitate the achievement of waste management objectives. Concurrently, industry collaborators can play a pivotal role by disseminating technical expertise, allocating financial resources, and actively participating in sustainable corporate social responsibility initiatives. With thoughtfully organized collaborative initiatives, Batam City can form a more effective and long-lasting waste management framework that serves to make the urban area cleaner and healthier while supporting

sustainable economic advancement and improving the life quality for its inhabitants.

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