

## Integrating Circular Economy and Community-Based Governance for Sustainable Coastal Waste Management in Batam Coastal Community

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### ABSTRAK

Wilayah pesisir dan pulau-pulau kecil seperti Provinsi Kepulauan Riau menghadapi tantangan berkelanjutan dalam pengelolaan sampah. Kota Batam mengalami peningkatan sampah rumah tangga dan polusi plastik yang tinggi, mengancam ekosistem lokal serta ketahanan sosial ekonomi. Faktor penyebabnya meliputi keterisolasian geografis, keterbatasan infrastruktur, dan lemahnya sistem pemantauan. Penelitian ini menggunakan kerangka kerja integratif yang menghubungkan prinsip ekonomi sirkular dengan tata kelola berbasis komunitas dalam konteks pengelolaan sampah pesisir di wilayah kepulauan. Kebaruan penelitian terletak pada pengembangan model jejaring tata kelola adaptif yang mengintegrasikan tiga dimensi pemberdayaan, yaitu psikologis, organisasional, dan komunal dengan mekanisme ekonomi sirkular untuk mengubah sampah menjadi aset ekonomi. Melalui studi kasus kualitatif dengan observasi, wawancara, dan analisis dokumen, hasil menunjukkan bahwa ekosistem aktor yang terfragmentasi dimana program CSR, bank sampah, fasilitas pemerintah, dan intervensi LSM berjalan tanpa koordinasi sistematis. Meskipun kapasitas individu memadai, ketiadaan kolaborasi antarlembaga menyebabkan rendahnya tingkat pemilahan sampah yang baru mencapai 18%. Penelitian ini merekomendasikan pembentukan platform kelembagaan untuk kolaborasi multi-pihak yang mengintegrasikan prinsip ekonomi sirkular dengan pemberdayaan masyarakat guna mendukung pengelolaan sampah pesisir berkelanjutan dan restorasi ekosistem di Kota Batam.

### ABSTRACT

Coastal areas and small islands, such as the Riau Islands Province, face persistent challenges in waste management. Batam City experiences high household waste generation and severe plastic pollution, threatening local ecosystems and socio-economic resilience. Contributing factors include geographic isolation, limited infrastructure, and weak monitoring systems. This study uses an integrative framework that links circular economy principles with community-based governance in the context of coastal waste management in island regions. The novelty of this study is the development of an adaptive governance network model that integrates three dimensions of empowerment, namely psychological, organizational, and communal, with circular economy mechanisms to transform waste into economic assets. Using a qualitative case study through observation, interviews, and document analysis, findings reveal a fragmented, multi-actor landscape where corporate social responsibility programs, grassroots waste banks, government facilities, and interventions by non-governmental organizations operate independently with limited coordination. Despite existing capacities, the absence of inter-organizational collaboration has led to low waste sorting rates, reaching only 18%. The study proposes establishing an institutional platform for multi-stakeholder collaboration that integrates circular economy principles with community empowerment. Such a coordinated governance network can support sustainable coastal waste management and contribute to ecosystem restoration in Batam City.

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## INTRODUCTION

Coastal areas around the world face complex challenges from waste accumulation, environmental degradation, and declining ecosystem health. Batam, the largest city in the Riau Islands, faces increasingly complex challenges driven by rapid urbanization, industrialization, and tourism growth that are not matched by an adequate waste management system. Data from the National Waste Management Information System (SIPSN) show a significant increase in waste volume in Batam City over the past two years, with total waste production increasing from 1,132.77 tons per day in 2022 to 1,159.05 tons per day in 2023 (SIPSN, 2025). Based on data from the Batam City Environmental Agency (DLH), Batam City currently generates approximately 1,200 tons of waste per day, equivalent to 423,000 tons per year, with household waste accounting for the majority.

The geographical characteristics of Batam City, as an archipelagic area, exacerbate the complexity of this problem, as the rate of waste sorting in Batam City remains low, with only 18% of households sorting waste at the source. This results in mixed organic and inorganic waste, making it more difficult to process and increasing the likelihood of disposal in landfills. Waste that is not transported and does not undergo recycling, combined with improper waste disposal practices by the community, has led to the accumulation of waste in coastal areas. This situation also increases the risk of waste leakage into waterways and coastal zones that receive waste flows from densely populated settlements.

This situation is particularly concerning, given that Indonesia ranks second globally in terms of marine plastic waste, with an estimated 0.48 to 1.29 million tons of plastic entering the marine ecosystem each year (Jambeck et al., 2015). Measurable ecological impacts include coral reef degradation, declining fish stocks, and threats to the livelihoods of traditional fishermen in Batam City (Suhardono et al., 2024). Furthermore, waste pollution in Batam City's waters has generated diplomatic repercussions, as Indonesian waste has been detected on Singapore's beaches, indicating that this problem is not only a local issue but also has implications for bilateral relations.

The gap between institutional potential and field-level implementation is an indicator of systemic failure that requires serious attention in coastal waste management. Although field findings show that the Batam City Government, through the Environment Agency, has developed 212 waste banks by 2022, built recycling infrastructure in the form of one Recycling Center (PDU), one Integrated Waste Processing Site (TPST), two 3R TPS units, and manages 145 transportation fleets and 1,038 contract workers, the level of household waste sorting has only reached 18%, which is far below the target mandated by Batam City Regulation Number 11 of 2013 concerning Waste Management and Batam Mayor Regulation (Perwali) Number 5 of 2023, concerning Amendments to Batam Mayor Regulation Number 10 of 2019 concerning Regional Policies and Strategies for the Management of Household Waste and Household-like Waste.

This phenomenon suggests that Batam's waste problem is driven less by the absence of infrastructure or regulation than by weak integration across policy, technical implementation, community participation, and economic incentive mechanisms. Although multiple initiatives have been implemented, such as the Tanjung Uma Empowerment CSR program, which conducted 26 beach clean-ups in 2024 with an average of 3 tons collected per activity; the Seven Clean Seas program, which collected an average of 163 tons of waste per month while employing 66 local workers at minimum-wage levels; and the Harapan Jaya Waste Bank, operating since 2014 and providing microeconomic incentives these efforts remain fragmented and have not

generated significant collective impact on coastal waste reduction. The absence of a formal coordination platform to enable knowledge sharing and collective learning further constrains the development of a coherent coastal waste management system aligned with the comparative strengths of each actor.

The complexity of coastal waste management in island regions has generated diverse academic and practical approaches, yet the literature remains fragmented and lacks holistic integration of technical, social, economic, and governance dimensions. Many studies on coastal environmental degradation in Indonesia are largely descriptive, offering limited guidance on governance transformation that links technical solutions with community empowerment and economic incentives. For example, Safitri et al., (2023) identified structural constraints in small-island waste management in Batam, including limited landfill space, inadequate recycling infrastructure, and irregular transportation systems, while Suhardono et al., (2024) highlighted persistent threats from uncontrolled waste disposal and weak law enforcement in Tanjung Uma despite growing environmental awareness. However, these studies do not propose integrative intervention models capable of translating environmental awareness into sustainable, community-based waste management practices.

Legal and policy perspectives have identified a significant gap between formal norms and on-the-ground implementation, but have not yet explored alternative governance mechanisms capable of bridging this gap through multi-actor collaboration. Chomariyah & Rafiqi (2024) analyzed Indonesia's legal framework for marine plastic waste mitigation and concluded that although Indonesia has comprehensive regulations ranging from Law No. 18 of 2008 on Waste Management to Presidential Regulation No. 83 of 2018 on Marine Waste Management and various regional regulations, implementation at the local level remains weak due to limited institutional capacity, budget constraints, and the absence of effective monitoring mechanisms. While this study highlights the discrepancy between regulatory strength and enforcement weakness, it does not explore how a community-based circular economy could serve as a more adaptive solution tailored to local contexts.

Research on community behavior and participation has revealed various factors influencing individual and collective decisions in waste management; however, it continues to focus on individual-level correlational analyses without integrating institutional dynamics and economic incentive mechanisms capable of sustaining long-term behavioral change. Bahar et al., (2025) through a literature review of behavioral dynamics in coastal waste disposal, found that social norms, perceived environmental risks, and infrastructure accessibility significantly influence compliance with waste sorting practices. Voronkova et al., (2025) reinforced these findings through an empirical study in Indonesian coastal communities, demonstrating that community attachment and environmental concern are strong predictors of responsible waste management behavior.

The literature on circular economy in developing countries has expanded rapidly, primarily emphasizing economic value creation from waste, yet its application in island coastal communities remains limited due to structural, cultural, and institutional constraints and weak integration with context-specific governance dimensions. Mandpe et al., (2023) highlighted resource efficiency and value creation while identifying persistent challenges such as technological gaps, investment constraints, and limited institutional capacity. Similarly, Tamyiz et al., (2024) demonstrated that waste-to-value initiatives can improve community income and reduce pollution, but did not examine governance network structures linking community actors to circular economy principles in coastal settings. These gaps indicate that coastal cities like Batam require integrated approaches that connect waste management systems with economic

and social incentives through effective governance arrangements (Kirchherr et al., 2017).

The collaborative governance literature emphasizes multi-stakeholder participation and policy adaptability, yet its application to coastal waste management remains limited and weakly integrated with circular economy principles. Existing studies show that governance arrangements often lack institutionalization and fail to support ecologically effective, economically viable, and socially sustainable systems. In Batam, coordination among waste management actors remains ad hoc and insufficiently structured, preventing the development of coherent governance networks with mechanisms for communication and collective learning (Salsabila et al., 2024). Similar patterns are observed in the Riau Islands, where waste banks are not embedded within sustainable economic incentive systems or multi-level governance frameworks, and empowerment initiatives remain predominantly top-down (Hani & Safitri, 2019). Further evidence from Galang Island indicates that despite strong community awareness of marine plastic issues, limited access to recycling infrastructure, markets, and institutional support continues to constrain adaptive waste management practices (Widiastutie et al., 2025).

The most fundamental gap in the literature lies in the absence of an integrative framework that links circular economy principles with community-based governance in the specific context of coastal waste management in island regions. Previous literature has not developed an adaptive governance network model that systematically integrates the three dimensions of empowerment, namely the psychological dimension (community confidence and self-efficacy in waste management), the organizational dimension (local institutional capacity to independently operate recycling systems), and the communal dimension (collective ability to influence policy and advocate for community interests) with circular economy mechanisms to turn waste into economic assets (Hani & Safitri, 2019; Safitri et al., 2023; Syamsari & Muditomo, 2023; Widiastutie et al., 2025; Zakianis & Koesoemawardani, 2018). Based on a literature gap analysis and empirical findings, this study presents a circular economy framework and community-based governance that can be integrated and provides practical recommendations for sustainable waste management in the coastal areas of Batam City.

The circular economy concept offers a sustainable pathway by promoting resource efficiency and minimizing waste generation. Beyond environmental benefits, circular economy practices also contribute to local economic development. Recognizing the importance of individual and informal participation, this framework acknowledges the roles of diverse stakeholders, including local government agencies, community members, informal waste collectors such as waste banks, and non-governmental organizations at both local and international levels. Accordingly, this study formulates three interrelated research questions to examine the integration of circular economy principles and community-based governance:

1. How are circular economy principles applied in waste management in the coastal areas of Batam City?
2. What forms of community-based governance networks have been established in waste management in the coastal areas of Batam City?
3. How can an integrative framework that links circular economy principles with community-based governance be developed to improve the effectiveness and sustainability of waste management in the coastal areas of Batam City?

## Literature Review

### **Circular Economy**

The circular economy (CE) concept emphasizes maintaining the value of materials and resources for as long as possible through the principles of reduction, reuse, and recycling. It offers a shift from the conventional linear "take-make-dispose" model to a regenerative and restorative system that promotes sustainability and resource efficiency. According to the Ellen MacArthur Foundation (2013), this framework aims to minimize waste generation while encouraging innovation in product design, production, and consumption, positioning waste as a resource that can re-enter the economic cycle.

In the context of waste management, the circular economy approach enables the transformation of waste into valuable products, creating both environmental and socio-economic benefits. It has been particularly relevant in coastal and small-island communities where geographic isolation and limited infrastructure hinder effective waste management. Mandpe et al. (2023) highlighted that CE practices not only contribute to environmental protection but also enhance local economic resilience by supporting recycling industries, creative innovation, and community-based entrepreneurship that utilize waste as raw material.

However, the successful implementation of circular economy principles requires not only technological innovation but also strong collaboration among stakeholders and community participation. Morasae et al. (2024) emphasized that active public engagement and institutional support are essential for establishing effective and sustainable waste governance systems. This indicates that the transition toward a circular economy must integrate governance, policy, and behavioral aspects to ensure long-term effectiveness in waste management, particularly in coastal regions like Batam.

### **Governance Network**

The concept of governance networks highlights the importance of collaboration among diverse actors in formulating and implementing complex public policies. In the context of coastal waste management, such networks consist of interactions between local governments, private sectors, community groups, and non-governmental organizations working interdependently within a collaborative framework. This approach marks a shift from a hierarchical government model toward a more horizontal form of governance, where policy success depends on coordination, trust, and resource exchange among actors. As Marsh and Rhodes (1992) observed, policy networks emerged from patterns of interdependence and negotiation that allow policies to adapt to changing social and institutional contexts.

In practice, the waste management system in Batam City reflects an evolving governance network. The local Environmental Agency serves as the central coordinating node, while CSR institutions, coastal communities, and waste banks contribute through participatory programs and local innovations. Although the interactions among these stakeholders remain partly top-down, the system shows a gradual transition toward collaborative governance. Rhodes (2007) underlined that a mature governance network is achieved when relationships among actors are no longer dominated by hierarchy, but are built upon trust, shared values, and collective goals that strengthen cooperation and promote sustainable environmental management.

### **Community-Based Development**

The Community-Based Development (CBD) approach emphasizes the empowerment of local communities as the central actors in the development process. It enables residents to take ownership of their environment by identifying problems, utilizing local resources, and formulating context-specific solutions. As noted by Sambodo et al. (2023), the effectiveness of this approach lies in its ability to transform communities from passive beneficiaries into active co-creators of change, fostering both social and economic resilience. Within the context of waste management, the CBD framework promotes initiatives such as community waste banks, microcredit systems based on waste exchange, and participatory environmental education programs. These initiatives not only generate alternative livelihoods but also strengthen environmental stewardship at the grassroots level. By embedding community-based development within local governance structures, the approach reinforces social capital, accountability, and long-term sustainability through participatory planning, implementation, and evaluation.

This study offered a novel contribution by integrating the principles of the circular economy, governance networks, and community-based development within the specific context of coastal waste management in small-island environments like Batam. Unlike previous studies that discussed these frameworks separately, this research developed an adaptive governance model that links circular economy practices with community empowerment through multi-actor collaboration. The novelty of this study lies in its effort to conceptualize an institutional platform that unites government, private, and community actors into a cohesive network aimed at transforming waste into economic assets while restoring coastal ecosystems.

## RESEARCH METHODS

This research adopts a qualitative method to explore community-based waste management in Batam's coastal region (Creswell & Creswell, 2018). Data were collected through participatory observation, in which the researcher engaged directly in daily activities using structured observation guides; interviews, both semi-structured and unstructured, to capture in-depth perspectives; and document analysis of policy texts, reports, and media sources to triangulate empirical findings (Miles et al., 2014). Informants were selected based on their direct participation and active contribution to coastal waste management, as well as their capacity to provide comprehensive insights into Batam City's waste management network. The study's informants included five key stakeholders: Tanjung Uma Empowerment Batam (PT BatamOn Global Group) as a CSR representative, UBS Harapan Jaya representing community-based waste management units, UBS Harapan Jaya customers representing active coastal community members, Seven Clean Seas (SCS) representing international organizations, and Free the Sea as a private sector partner.

Data validity was assessed using triangulation techniques implemented through the NVivo 15 application. Information was entered into the NVivo analysis unit, and coding results were presented as a coding matrix, with additional visualization provided by a project map. Data analysis incorporated Social Network Analysis (SNA) and Discourse Network Analysis (DNA) to map actors, relationships, and interpretations within the coastal community-based waste management governance network. The analysis process included reading and preparing raw data, coding data using NVivo, connecting themes and descriptions, constructing findings, interpreting the meaning of themes, and concurrently validating information accuracy to generate substantive insights into the dynamics of the waste management governance network in the coastal area of Batam City.

## RESULTS AND DISCUSSIONS

## Circular Economy Principles in Coastal Waste Management

The implementation of circular economy principles within community-based governance in Batam's coastal waste management reflects a multi-actor system with complementary yet fragmented initiatives. Field observations indicate that despite the theoretical emphasis on synergy between economic incentives, environmental objectives, and participatory governance, coordination gaps remain and limit collective impact. The circular economy promotes resource efficiency by shifting linear "take-make-dispose" patterns toward waste reduction, reuse, and recycling. In coastal waste management, the application of the 3R approach: reducing waste at the source, extending material lifecycles through reuse, and recycling valuable materials supports environmental sustainability and encourages more responsible community behavior.

The Environment Agency (EA) of Batam acts as the institutional anchor in the waste management ecosystem, performing regulatory, operational, and facilitative roles while managing approximately 1,200 tons of waste daily (423,000 tons annually). As a regulator, EA enforces Batam City Regional Regulation No. 11 of 2013 and Mayor Regulation No. 5 of 2023 mandating waste segregation. Environmentally, EA manages the 49-hectare Telaga Punggur final disposal site, which includes a 20-hectare controlled landfill and a 2.4-hectare sanitary landfill equipped with a geomembrane, leachate treatment facilities, and methane capture systems. Circular economy infrastructure has been expanded through the development of a Recycling Center at Telaga Punggur (2022), an Integrated Waste Processing Facility in Belakang Padang (2021), two 3R TPS facilities in Sekupang and Sagulung, and the promotion of 212 waste bank units by 2022.

From a governance perspective, EA operates a fleet of 145 vehicles and employs 1,038 contract workers to support waste collection and processing. However, persistent structural constraints remain, including limited budgets largely allocated to routine operations, aging and inefficient vehicles, and declining landfill capacity without alternative treatment options such as waste-to-energy facilities. These challenges reflect broader national issues in Indonesia's waste management system, where infrastructure limitations and weak enforcement continue to impede the transition toward a circular economy.

The transition to a circular economy in Batam remains partial due to interconnected structural barriers that create a persistent gap between policy intentions and on-the-ground implementation. Despite comprehensive legal frameworks mandating waste sorting, household-level compliance has reached only 18%, reflecting a policy implementation gap driven by weak enforcement capacity and limited community engagement. In addition, although more than 50 potential investors have expressed interest through Public-Private Partnership (PPP) schemes, infrastructure development has stagnated due to regulatory uncertainty surrounding cost-sharing and tipping fee mechanisms. These challenges confirm Kirchherr et al., (2017) argument that circular economy transitions require not only formal regulations but also strong institutional capacity and incentive structures to translate policy into practice, as similarly observed in Indonesia's broader waste governance context (Chomariyah & Rafiqi, 2024).

Beyond institutional and investment constraints, Batam also faces a behavioral transformation deficit characterized by low public awareness, inadequate environmental education, and entrenched waste disposal habits. While empirical studies highlight environmental concern and community attachment as key drivers of responsible waste behavior (Voronkova et al., 2025), these social dimensions remain underutilized in Batam's policy design, which prioritizes infrastructure provision over behavioral change. Collectively, weak enforcement, stalled investment, and limited behavioral transformation form a reinforcing cycle that undermines the viability of circular economy infrastructure and reduces demand for 3R-based solutions. This

systemic interaction illustrates the multidimensional nature of circular economy transitions, where regulatory, economic, and social progress must advance simultaneously to enable effective coastal waste management and unlock the environmental and economic potential of recycling-based local development (Kirchherr et al., 2017; Morasae et al., 2024).

**Table 1.**  
**Waste Management of Batam Regulatory Framework**

Aspect	Value/Status	Notes	Data Sources/Year
<b>Regional Regulation</b>	Batam City Regional Regulation No. 11/2013 on Waste Management	Mandates household waste segregation.	Official regulation (2013)
<b>Technical Regulation</b>	Mayor Regulation No. 5/2023 on Waste Segregation and Operations	Reinforces segregation requirement; governs implementation details.	Official regulation (2023)
<b>Segregation Implementation</b>	18% household segregation rate	Far below policy expectations, it reflects enforcement and behavior challenges.	Attached interview transcript and observation

Source: Processed by Researchers (2025)

The implementation of the 3R (Reduce, Reuse, Recycle) solution in coastal areas such as Batam not only plays a role in reducing waste leakage into the sea, but also encourages local economic growth through the creation of jobs in the recycling and remanufacturing sectors. By adopting a circular economy model, coastal communities can improve resource efficiency, derive economic value from recycled materials, and strengthen resilience to environmental pressures. Improved environmental quality will drive sustainable economic growth, which in turn can fund environmental management initiatives, making the circular economy a catalyst for socio-economic transformation in the coastal region of Batam.

**Community-Based Governance and Stakeholder Participation**

The transition to a circular economy depends on active community participation and effective governance mechanisms. Community-based governance (CBG) promotes inclusive and participatory decision-making aligned with local needs, yet its implementation in Batam remains suboptimal due to weak integration between waste banks and other actors. Although 212 waste banks initiated by the Environmental Agency (DLH) contribute to waste management, circular economy principles have not been consistently applied across all units. This fragmentation aligns with Ansell and Gash’s (2008) argument that participatory governance requires not only multi-stakeholder involvement but also structured coordination mechanisms and collective learning platforms to share best practices.

This study focuses on the Harapan Jaya Waste Bank, an active unit established in 2014 under the Environmental Agency (EA) of Batam, which collaborates with multiple actors to process waste into economically valuable materials. The program aims to reduce landfill waste while providing economic incentives, particularly for low-income households and housewives. Managed by three core administrators and supported by three sorting and weighing staff, the waste bank operates a simple monthly deposit system with recorded savings. Although the economic benefits remain modest, ranging from IDR 300,000 to IDR 1,000,000 annually per customer, they provide meaningful psychological and financial support for urgent household needs. Environmentally,

the waste bank has contributed to a visible reduction of waste in communal bins, though its overall impact on municipal waste reduction remains limited.

**Table 2.**  
**Community-Based Governance-Harapan Jaya Waste Bank**

Indicator	Value	Unit/Notes
Year established	2014	
Core management	3	Chair, secretary, treasurer
Sorting & weighing workers	3	Operational staff
Members at start	60	Household customers
Active members (current)	30	Approximate
Regular monthly depositors	10	Consistently depositing each month
Annual savings per member	IDR 300,000–1,000,000	Per year, per member (range)
DLH training sessions	3	Across 11 years
Partnership with FTS	1	Year of partnership (recent)

Source: Processed by Researchers (2025)

This waste bank operates through partnerships with EA Batam for waste transportation and pricing, and with the private sector through Free The Sea's CSR program, which facilitates access to specific waste streams and institutional partners such as Haris Hotel and Batam Polytechnic. However, several constraints persist, including limited storage space that relies on the chairman's house terrace, a decline in active customers from 60 to around 30 with only about 10 regular monthly contributors, difficulties in marketing recycled products due to social stigma, and minimal capacity-building support, with only three training sessions provided by EA over 11 years. These challenges align with previous studies indicating that community-based waste management initiatives often face structural barriers related to low public awareness, weak household waste segregation practices, and insufficient institutional support, which collectively limit their effectiveness (Kerti et al., 2025).

Waste banks have the potential to function as pilot models for community-based waste governance if supported by stronger governance mechanisms that connect diverse actors in coastal waste management. Studies show that participatory governance involving both formal institutions and community groups can improve environmental outcomes, particularly when power delegation is effectively implemented (Newig et al., 2023). In Batam's coastal areas, such as Tanjung Uma, unmanaged household waste is still commonly disposed of along shorelines and tidal zones, creating persistent environmental problems, as illustrated in **Figure 1**. In response, community-led initiatives like the Tanjung Uma Empowerment Program (TUE) have adopted participatory approaches through informal waste sorting, small-scale recycling, and neighborhood collection points, while engaging women and youth as local mobilizers to encourage shared responsibility and gradual behavioral change.

**Figure 1.**  
**Coastal Waste Buildup in Tanjung Uma Prior to Community-Based Interventions**



Source: Processed by Researchers (2025)

These locally driven efforts align with broader ideas of the circular economy and co-managed waste governance in coastal settings. Although progress is still emerging, such initiatives help to reduce unmanaged waste and strengthen everyday participation in environmental stewardship. The experience in Batam shows how grassroots action can serve as an adaptive response to marine plastic leakage while offering context-specific pathways that complement formal policies and institutional strategies.

**Table 3.**  
**The Inter-Actor Dynamics within Batam's Coastal Waste Management Ecosystem**

<b>Actor Code</b>	<b>Full Name</b>	<b>Role</b>	<b>Type/Category</b>
<b>CC</b>	Coastal Community	Local beneficiaries and participants	Beneficiaries
<b>EA</b>	Environment Agency	Regulator and facilitator of waste management	Government
<b>FTS</b>	Free The Sea	Private-sector recycling partner linked to waste bank	NGO
<b>RT/RW</b>	Neighbourhood Units	Local gatekeepers connecting programs to residents	Societal Institution
<b>SCS</b>	Seven Clean Seas	Private-sector operator for coastal plastic collection & recycling	NGO
<b>TUE</b>	Tanjung Uma Empowerment	Community-based empowerment and environmental NGO	NGO
<b>WB</b>	Waste Bank Harapan Jaya	Community-based waste collection and savings	Local Community

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Actor Code	Full Name	Role	Type/Category
MC	Mcdermott	Corporate Social Responsibility: Sewing machines, shredders, and bio pore drill	Private Sector

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Source: Processed by Researchers (2025)

Based on Table 3, the coastal waste management ecosystem in Batam exhibits complex yet fragmented actor dynamics, with limited integration across institutional roles. The Batam City DLH serves as the core institution by providing regulatory legitimacy and infrastructure support; however, budget constraints and weak monitoring capacity have contributed to persistently low household waste separation rates (18%). This institutional gap is partially addressed by the Tanjung Uma Empowerment Program (TUE), which adopts a long-term community empowerment approach through multi-year social investment. Nevertheless, TUE continues to face structural limitations, including low engagement from neighborhood associations (RT/RW), the absence of permanent facilities, and difficulties in establishing independent, neighborhood-based waste management systems.

At the community level, Bank Sampah Harapan Jaya demonstrates resilience in sustaining participation for over 11 years, largely driven by social and religious motivations. However, its contribution remains constrained by stagnation in innovation, digitalization, and impact scaling due to limited and inconsistent support from government and private-sector actors. In contrast, SCS represents a more professional and technology-driven model supported by digital systems and international certification, yet its operations remain dependent on external funding and have not achieved local institutional independence. Together, these patterns indicate that while diverse actors contribute complementary strengths, the absence of an integrated governance framework prevents the formation of a coherent and sustainable coastal waste management system in Batam, reflecting an evolving but still immature governance network in which coordination remains largely hierarchical rather than trust-based and collaborative, as emphasized in governance network theory (Marsh & Rhodes, 1992; Rhodes, 2007).

The main weakness of this ecosystem lies in the weak cross-sector coordination mechanism, characterized by the absence of a regular forum for program synchronization, resource sharing, and mutual learning, resulting in various initiatives running in parallel without optimal synergy. This finding is in line with previous studies showing that cross-sector collaboration is often ineffective due to weak coordination, low commitment from the public sector, and power imbalances (Wicaksana et al., 2025). Various studies also confirm that delegating authority to local communities correlates positively with improved waste management performance, with participation levels influenced by psychological factors (attitudes toward waste sorting) and situational factors (availability of infrastructure) (Newig et al., 2023). Education programs and public awareness campaigns have proven effective in increasing community participation, strengthening circular economy practices, and supporting the development of community-based waste management governance in Batam (Syamsari & Muditomo, 2023; Voronkova et al., 2025).

### **Integrating Circular Economy with Community-Based Governance: A Conceptual Framework**

Effective governance systems require the representation of diverse stakeholders, including local residents, government agencies, private enterprises, and informal sectors. In contexts such as Batam, with coastal constraints and rapid urbanization posing unique challenges, inclusivity in decision-making is essential to ensure that the interests of marginalized groups such as informal waste collectors and small-scale entrepreneurs are taken into account, while building trust and social cohesion within the community. The integration of circular economy principles with community-based governance results in a holistic approach to coastal waste management that combines economic, environmental, and social objectives into a single coherent strategy.

Based on the experience in Batam City, which focuses on how the waste bank works with other stakeholders, the proposed framework consists of two major components that interact dynamically:

- a. **Circular Economy Component:** Focused on the application of the 3R strategies (reduce, reuse, recycle) to minimize waste, recover resources, and stimulate economic activity.
- b. **Governance Component:** Emphasizes participatory decision-making processes, power delegation, and stakeholder representation to ensure that waste management strategies are tailored to local needs.

This framework offers a scientific contribution in the form of a new synthesis that integrates circular economy theory (Ellen MacArthur Foundation, 2013; Kirchherr et al., 2017) with network governance theory (Rhodes, 2007; Ansell & Gash, 2008) in the specific context of coastal waste management in archipelagic regions, resulting in a hybrid model that bridges the gap between technical-economic and social-institutional perspectives. To operationalize this framework, several enabling factors must be addressed:

- a. **Education and Awareness:** Enhancing community understanding of the benefits of the circular economy and its environmental challenges is critical. Educational interventions can improve both the importance rating and implementation of waste management practices, as seen in studies from Galang Island.
- b. **Infrastructure Development:** Investment in robust waste collection systems and recycling facilities is essential. The development of such infrastructure has been rated as one of the most effective measures in reducing marine plastic litter.
- c. **Economic Incentives:** Aligning economic incentives with environmental goals is crucial. For example, factors such as per capita expenditure influence individual participation in waste management, thereby making economic support a key driver for successful policy implementation.
- d. **Legislative and Policy Support:** Effective regulation and law enforcement create an enabling environment for both circular economy practices and participatory governance. Strengthening legal frameworks ensures that environmental standards are adhered to and that the delegation of power within governance processes is clearly defined and understood.

Below is a flowchart that illustrates the dynamic interaction between circular economy principles and community-based governance within the proposed framework, with **Figure 2** serving as illustration.

**Figure 2.**  
**Cyclical Process of Integrating the Circular Economy Practices with Governance Structures**



Source: Processed by Researchers (2025)

The cycle begins with the identification of waste challenges, which triggers community education and subsequent adoption of the 3R principles, as shown in **Figure 2**. This leads to the development of appropriate infrastructure and economic incentives, which in turn feed into robust participatory governance. Continuous monitoring and adaptive management ensure that the system remains responsive to emerging challenges. To provide a clear understanding of the roles and responsibilities of various stakeholder groups within the proposed framework, the table below outlines key stakeholder groups, their primary responsibilities, and expected contributions, as presented in **Table 4**:

**Table 4.**  
**Stakeholders in Batam Coastal Waste Management and Their Contributions**

Stakeholder Group	Primary Responsibilities	Expected Contributions
<b>Local Government</b>	Policy formulation, legislation enforcement, and infrastructure development	Establish a regulatory framework and invest in infrastructure projects
<b>Community Residents</b>	Active participation in waste segregation, recycling, and monitoring	Increase waste sorting and recycling rates; provide local feedback
<b>Informal Waste Collectors</b>	Waste collection, sorting, and recycling support	Enhance the efficiency of waste collection and contribute to recycling initiatives.
<b>Non-Governmental Organizations (NGOs)</b>	Advocacy, education, and capacity building	Lead community awareness campaigns and training programs

Stakeholder Group	Primary Responsibilities	Expected Contributions
Private Enterprises	Waste management services, recycling operations, and innovation in waste processing	Invest in green technologies and develop circular business models
Academic and Research Institutions	Monitoring, evaluation, and best practice dissemination	Provide relevant research and technical support for policy improvement

Source: Processed by Researchers (2025)

Within this framework, effective coastal waste management in Batam depends on coordinated contributions from multiple stakeholder groups with distinct yet complementary roles, as summarized in **Table 4**. Local government institutions function as the regulatory backbone by formulating policies, enforcing legislation, and providing supporting infrastructure. Community residents act as frontline participants whose daily practices in waste segregation and recycling determine neighborhood-level effectiveness. Informal waste collectors contribute essential on-the-ground labor that strengthens material recovery. Non-governmental organizations support advocacy, education, and capacity building to reinforce behavioral change, while private enterprises provide technical expertise and innovation through waste management services and circular business models. Academic and research institutions complement these efforts by monitoring system performance, evaluating outcomes, and generating evidence-based recommendations for continuous policy improvement.

Experiences from other regions demonstrate the potential effectiveness of this conceptual framework, particularly in Jakarta and Takalar, where community participation has been shown to play a decisive role in solid waste management (Newig et al., 2023; Tamyiz et al., 2024). Empirical analyses indicate that individual participation is strongly influenced by involvement in social activities and key socio-economic factors such as education and household expenditure. In Takalar, sustained participation in government-led waste programs resulted in 44.2% of households adopting systematic waste sorting practices, confirming that active community engagement can significantly improve waste management outcomes when supported by enabling institutional arrangements.

Beyond participation intensity, governance quality particularly power delegation and communication emerges as a critical determinant of environmental performance. Meta-analytical evidence from more than 300 case studies shows that delegating decision-making authority to participants is the most consistent predictor of strong environmental governance outcomes (Zakianis & Koesoemawardani, 2018). Shared authority encourages communities to co-design innovative and socially equitable waste management solutions, while effective communication enhances program responsiveness and accountability (Sandra et al., 2025). Similar dynamics are evident in Bintan Island, where inclusive policy networks involving government agencies and community actors supported coastal governance under the blue economy framework (Safitri et al., 2024). These findings reinforce the need for Batam’s coastal waste management strategies to institutionalize community empowerment and stakeholder inclusivity as core governance mechanisms.

## CONCLUSION

This study finds that how well coastal waste is managed in Batam does not depend on whether programs or people exist, but on how well circular economy activities and community-run systems work together. Some efforts to reuse and recycle waste are already in place, such as waste banks, company-supported projects, and recycling by businesses. However, these efforts

are scattered and do not follow a clear structure. As a result, they have not done much to reduce the amount of waste reaching the coast, as shown by the low rate of households sorting their waste only 18%.

Although community capacity at the individual level is relatively adequate, this potential has not translated into systemic improvements due to weak coordination, insufficient institutional linkages, and the absence of shared platforms for collaboration and collective learning. These findings demonstrate that circular economy initiatives in Batam tend to function in isolation, while community-based governance exists but lacks institutional consolidation. Addressing this gap requires adaptive governance arrangements capable of aligning actors, incentives, and responsibilities within a coherent multi-actor framework. Without such integration, environmental benefits remain localized, economic gains marginal, and risks to coastal ecosystems persist, underscoring the need for a transition from fragmented interventions toward coordinated governance to achieve sustainable coastal waste management.

### Recommendations

To operationalize the integration of the circular economy and community-based governance, local governments should establish a formal multi-stakeholder coordination platform that connects government agencies, coastal communities, waste banks, private-sector actors, and non-governmental organizations. This platform should be supported by clear coordination mechanisms and measurable implementation indicators, such as household waste segregation rates, circular material flows, and levels of stakeholder participation, to ensure program alignment, reduce fragmentation, and support adaptive policy implementation. Linking circular economy initiatives with sustainable economic incentives, including market access for recycled products and targeted capacity building for community-based waste management units, is essential to reduce local risks while enhancing environmental benefits.

Future research should focus on comparative and longitudinal studies that examine how governance coordination mechanisms evolve over time and across different coastal contexts, as well as on quantitative assessments of environmental, economic, and social outcomes under integrated governance arrangements. Such studies would strengthen the evidence base for refining policy interventions and scaling sustainable models of coastal waste management. Overall, this study contributes by demonstrating that the effectiveness of circular economy implementation in coastal cities depends not merely on technical interventions, but on the institutional integration of community-based governance within adaptive, multi-actor coordination frameworks.

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