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Original Article

Re-Evaluation of Local Community Participation in Waste Management in Malaysia: Primary Collection Scheme

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Abstract: Sustainable waste management in rapidly urbanizing regions requires effective integration of technical systems with community participation, yet many urban areas in Southeast Asia continue to rely on centralized and inefficient collection models that overlook the role of local communities at the source level. In Malaysia, waste management remains largely focused on downstream processes, while the collection stage receives limited attention, creating a critical gap in understanding how community participation influences system performance. This study addresses this gap by re-evaluating local community participation in waste management through Primary Collection Schemes (PCS) in Kota Bharu, Kelantan. A qualitative exploratory case study design was employed, involving in-depth interviews with 45 informants, participant observation over nine months, focus group discussions, and document analysis. The findings reveal that community-based PCS significantly improves collection frequency, service coverage, environmental cleanliness, and responsiveness to local needs. The model also reduces operational costs for local authorities and strengthens the institutional capacity of residents' associations. However, participation remains uneven, particularly in household-level waste sorting and recycling due to limited infrastructure and institutional support. The study concludes that community participation at the primary collection stage is a critical determinant of sustainable waste management. Effective implementation requires a hybrid governance model that combines community engagement with institutional support. This research contributes to the literature by highlighting the importance of upstream interventions. It provides policy-relevant insights for strengthening community-based waste management systems in Malaysia and similar urban contexts.

Keywords: Re-evaluation, Local community participation; Primary Collection Scheme; Informal neighborhood associations; Decentralization.

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1. Introduction

Sustainable waste management requires more than technical efficiency. It depends on active community participation, collective responsibility, and behavioral change at the household level. Empirical and theoretical studies consistently show that environmental outcomes improve when citizens engage directly in governance processes and resource management (Newig et al., 2018; Ostrom, 2010). In this context, participation is not a complementary element but a core determinant of system effectiveness. Without community involvement, waste management systems often fail to achieve long-term sustainability, particularly in rapidly urbanizing regions. Southeast Asia has experienced accelerated urbanization and industrial expansion over the past few decades. This transformation has reshaped consumption patterns, increased material throughput, and intensified pressure on municipal services. Urban population growth has emerged as a key driver of waste generation, with a strong empirical correlation between demographic expansion and waste volumes (Supangkat & Herdiansyah, 2020). At the regional level, urban environmental challenges have become increasingly prominent, reflecting rising expectations for environmental quality and public services (Webster, 1995). These structural changes have contributed to a substantial increase in municipal solid waste, both in quantity and complexity.

Globally, waste generation continues to rise at an unprecedented rate. Estimates indicate that total waste could increase significantly in the coming decades, with severe implications for environmental sustainability and public health (Kaza et al., 2018). A large proportion of this waste remains inadequately managed, particularly in developing regions. Inefficient systems lead to open dumping, uncontrolled burning, and environmental leakage, which contribute to pollution, greenhouse gas emissions, and ecosystem degradation. In Southeast Asia, persistent constraints, such as limited infrastructure, financial constraints, and weak institutional enforcement, further exacerbate these challenges (Ngoc & Schnitzer, 2009). Malaysia reflects many of these structural issues. Despite progress in policy development, waste management systems remain heavily reliant on landfills, with limited emphasis on source reduction. Existing studies highlight deficiencies in operational capacity, environmental monitoring, and public awareness (Samsudin & Dona, 2013). These limitations indicate that current approaches remain largely technocratic, focusing on collection, transportation, and disposal, while underestimating the role of social and behavioral dimensions. As a result, waste management systems often fail to address the root causes of waste generation.

The literature increasingly recognizes that effective waste management requires a holistic approach that integrates technical, institutional, and socio-cultural factors. Community participation plays a central role within this framework. Participation enhances environmental awareness, strengthens social norms, and improves compliance with waste management practices (Ihwughwavwe & Aniebonam, 2024). It also facilitates locally adapted solutions that align with community needs and capacities. Empirical evidence demonstrates that community engagement contributes positively to waste reduction, recycling, and composting, although participation remains uneven across the different stages of waste management (Hapuarachchi, 2024). From a governance perspective, participation operates through mechanisms of collective action and institutional coordination. Collective action theory explains how individuals cooperate to achieve shared environmental goals under conditions of trust, reciprocity, and local governance structures (Ostrom, 2010). Similarly, participatory governance frameworks highlight the importance of dialogue, representation, and stakeholder interaction in improving policy outcomes and implementation effectiveness (Newig et al., 2018). These perspectives suggest that waste management systems must move beyond centralized control and incorporate decentralized, community-driven approaches.

Community participation in waste management takes many forms, including recycling initiatives, composting programs, waste banks, and local environmental campaigns. Comparative studies show that community-based initiatives can enhance recycling performance and reduce waste volumes when supported by appropriate institutional arrangements (Oh & Hettiarachchi, 2020). However, participation is not uniform across all stages of waste management. Existing research tends to focus on downstream processes such as recycling and disposal, while upstream stages receive limited attention. This imbalance reveals a critical gap in the literature. The initial stage of waste management, particularly primary collection at the household level, remains underexplored. Primary Collection Schemes (PCS) represent the first point of interaction between households and formal waste systems. This stage determines the quality of waste segregation, the efficiency of collection processes, and the overall performance of the waste management system. Despite its importance, academic research rarely examines how community participation influences this stage. Most studies emphasize technical efficiency, logistics, and infrastructure, while neglecting social dynamics, local leadership, and behavioral factors.

The concept of community itself also requires careful consideration. Contemporary research defines community as a dynamic and relational construct shaped by social interactions, mobility, and institutional contexts (Botterill, 2018). Built environments and neighborhood structures influence social cohesion and participation patterns, which in turn affect environmental behavior (Farahani & Lozanovska, 2014). These insights indicate that participation cannot be treated as a uniform variable; rather, it must be analyzed within specific social and spatial contexts. In Malaysia, limited empirical attention has been given to community participation in Primary Collection Schemes, particularly in urban settings. While some studies document general participation in waste management (Djaelani, 2021), they rarely analyze institutional

relationships between local authorities and communities or assess participation at the initial collection stage. This gap restricts understanding of how governance structures, social norms, and local practices interact to shape waste management outcomes.

Kota Bharu, Kelantan, provides a relevant case for addressing this gap. The city has implemented community-based Primary Collection Schemes, supported by local authorities and community organizations. However, systematic evaluation of these initiatives remains limited in both national and international literature. There is insufficient evidence on how community participation influences operational efficiency, environmental outcomes, and program sustainability at the source level. This study responds to these limitations by re-evaluating the role of community participation in waste management, with a specific focus on Primary Collection Schemes. It examines how community engagement, institutional arrangements, and socio-cultural factors interact within the local context of Kota Bharu. The study also investigates how collective action, environmental awareness, and local leadership contribute to the effectiveness of community-based waste management systems. Accordingly, the objective of this research is to analyze and re-evaluate local community participation in waste management in Malaysia, focusing on Primary Collection Schemes in Kota Bharu to assess their effectiveness, identify key determinants of participation, and generate policy-relevant insights to strengthen sustainable, community-based urban waste management systems.

2. Literature Review

The concept of community remains central in social science, yet its analytical meaning often lacks precision. Early interpretations define community as a spatially bounded group characterized by shared residence, interaction, and social organization. However, contemporary scholarship challenges purely territorial definitions by emphasizing relational and dynamic dimensions. Community is better understood as a network of social relations shaped by interaction, mobility, and institutional context rather than a fixed geographic entity (Botterill, 2018). This perspective shifts attention from static locality to processes of engagement, identity formation, and collective practice. It also aligns with urban studies that highlight how built environments and neighborhood structures influence social cohesion and patterns of interaction (Farahani & Lozanovska, 2014). Despite these conceptual advances, much empirical research still relies on simplified notions of community based solely on proximity. Such reductionism limits the explanatory power of community-based approaches in environmental governance. A community does not emerge automatically from co-location. It requires sustained interaction, shared norms, and social capital. Trust, reciprocity, and institutional embeddedness form the basis of collective capacity. Without these elements, social groups remain fragmented and unable to coordinate collective action. This argument is consistent with institutional theories that emphasize the role of trust and rule systems in facilitating cooperation within complex social-ecological systems (Ostrom, 2010).

Community engagement extends this conceptual foundation by focusing on participation as an active process. Participation involves contributing time, labor, knowledge, and resources to collective decision-making and implementation. It operates across multiple levels, from informal grassroots initiatives to structured governance arrangements. However, not all forms of participation yield equivalent outcomes. Research distinguishes between passive participation, which involves compliance with externally imposed rules, and active participation, which reflects voluntary engagement and co-production of solutions. Evidence suggests that participatory governance enhances environmental outcomes when it incorporates meaningful dialogue, representation, and shared responsibility (Newig et al., 2018). Conversely, tokenistic participation often fails to produce measurable improvements. In the context of environmental management, community participation has gained prominence as a mechanism for improving sustainability outcomes. This shift reflects growing recognition that technical and centralized approaches alone are insufficient. Waste management, in particular, requires behavioral change at the household level, which cannot be achieved without community involvement. Educational interventions and community-based programs have been shown to enhance environmental awareness and promote sustainable practices across Southeast Asia (Ihwughwavwe & Aniebonam, 2024). These findings support the argument that social learning and local knowledge play critical roles in shaping environmental behavior.

Empirical studies further demonstrate that community participation contributes to improved waste management outcomes. For instance, active community engagement has been associated with increased waste reduction, recycling, and composting activities (Hapuarachchi, 2024). Similarly, comparative analyses of recycling initiatives indicate that collective action frameworks can enhance program effectiveness, particularly in contexts with limited technological capacity (Oh & Hettiarachchi, 2020). These studies highlight the potential of community-driven approaches to complement formal waste management systems. However, existing literature reveals important limitations. First, most studies focus on downstream stages of waste management, such as recycling and disposal, while neglecting upstream processes. This bias reflects a broader technocratic orientation that prioritizes infrastructure and logistics over social dynamics. Second, research often treats participation as a homogeneous variable, failing to examine variations in intensity, quality, and institutional context. Third, limited attention is given to the interaction between local authorities and communities, despite its importance in shaping governance outcomes.

The Southeast Asian context further illustrates these challenges. Rapid urbanization and changing consumption patterns have intensified waste generation, placing significant strain on municipal systems (Ngoc & Schnitzer, 2009; Webster, 1995). While global evidence highlights the scale of the problem and the need for integrated solutions (Kaza et al., 2018), regional studies indicate that institutional fragmentation and limited public engagement continue to hinder effective implementation. In Malaysia, waste management remains heavily dependent on landfills, with insufficient emphasis on source-level interventions and community participation (Samsudin & Dona, 2013). Although some studies document community involvement in waste-related activities (Djaelani, 2021), they often lack analytical depth and fail to link participation with governance structures and system performance. A critical gap arises at the primary waste collection level. Primary Collection Schemes represent the initial interface between households and the formal waste management system. This stage determines the quality of waste segregation, the efficiency of collection processes, and the effectiveness of downstream operations. Despite its importance, scholarly attention to this stage remains limited. Existing research tends to prioritize technical aspects such as transportation efficiency and disposal technologies, while overlooking the role of community participation in shaping source-level practices.

Moreover, the relationship between community engagement and institutional performance at the primary collection stage remains underexplored. The literature does not adequately explain how social capital, local leadership, and governance arrangements influence participation in Primary Collection Schemes. This gap is particularly evident in urban Southeast Asian contexts, where diverse social structures and institutional arrangements create complex governance challenges. Without addressing these dynamics, policy interventions risk overlooking key determinants of success. This study addresses these limitations by re-examining community participation within the specific context of Primary Collection Schemes. It builds on theoretical insights from participatory governance and collective action while integrating empirical evidence from waste management studies. By focusing on the interaction between local communities and urban authorities, the study aims to provide a more nuanced understanding of how participation operates at the source level. In line with this perspective, the research objective is to analyze and re-evaluate local community participation in waste management in Malaysia, with a focus on Primary Collection Schemes in Kota Bharu, to assess participation effectiveness, identify key socio-institutional determinants, and generate policy-relevant insights for strengthening sustainable, community-based waste management systems.

3. Materials and Methods

3.1. Research Design

This study adopts a qualitative, exploratory case study design to examine community participation in Primary Collection Schemes (PCS). A qualitative strategy is appropriate because the research seeks to understand social processes, behavioral patterns, and institutional interactions that cannot be adequately captured through quantitative measures. The exploratory design enables an in-depth investigation of underexamined phenomena, particularly the role of community engagement at the initial stage of waste management.

3.2. Study Area and Sampling

The research was conducted in two residential complexes located in Kota Bharu, Kelantan, Malaysia. These sites were selected through purposive quota sampling. The selection criteria focused on residential areas that have implemented relatively established community-based PCS initiatives. Despite their operational maturity, these initiatives remain insufficiently documented in academic literature, making them suitable for analytical exploration. The two sites also exhibit variation in community structure, leadership arrangements, and participation intensity. This variation allows comparative insights into how different social and institutional conditions influence the effectiveness of PCS implementation.

3.3. Data Collection

3.3.1. Primary Data

Primary data were collected through three complementary techniques to ensure depth and contextual richness. First, in-depth semi-structured interviews were conducted with 45 informants. The informants were selected based on their direct involvement in PCS activities and included community leaders, PCS coordinators, active residents, and representatives from local authorities. The interviews explored perceptions of participation, operational challenges, institutional support, and social dynamics within the community. Second, participant observation was conducted over a nine-month period. The researcher directly observed daily waste collection practices, household participation behavior, and coordination mechanisms within the community. This approach enabled the documentation of actual practices rather than relying solely on reported behavior. Field notes captured patterns of interaction, leadership roles, and informal norms that influence participation. Third, two focus group discussions were organized with resident groups. The discussions were conducted separately by gender to facilitate open communication and reduce social bias. These

sessions provided insights into collective perceptions, shared experiences, and group-level dynamics that may not emerge in individual interviews.

3.3.2. Secondary Data

Secondary data were obtained from multiple sources, including local government policy documents, technical reports, and relevant academic literature on community-based waste management. These materials were used to contextualize the empirical findings and to assess alignment between policy frameworks and actual practices at the community level.

3.4. Data Analysis

Data analysis followed a thematic approach using a systematic coding process. The analysis proceeded through three stages. First, open coding was applied to identify initial concepts and recurring patterns from interview transcripts, observation notes, and FGD recordings. Second, axial coding was conducted to organize these concepts into broader categories and to examine relationships between variables. Third, selective coding was used to integrate the categories into core themes that explain community participation in PCS. The analysis focused on key dimensions, including environmental awareness, cooperative culture, local leadership, trust, social solidarity, and social networks. These dimensions were examined in relation to participation intensity and program effectiveness.

3.5. Validity and Reliability

The study employed several strategies to ensure the credibility and robustness of the findings. Data triangulation was applied by integrating multiple sources, including interviews, observations, FGDs, and documentary analysis. This approach reduces bias and enhances the reliability of interpretations. In addition, member checking was conducted by sharing preliminary findings with selected informants. This process ensured that interpretations accurately reflected participants' perspectives and minimized misrepresentation. Prolonged field engagement over nine months also strengthened the study's validity by enabling the researcher to capture consistent behavioral patterns and reduce the influence of temporary or situational factors.

4. Results

4.1. Community Involvement in Malaysia: Primary Collection Schemes In Practice

4.1.1. Decentralization of Urban Waste Management

Since 2002, Kota Bharu, Kelantan has pioneered the implementation of the Primary Collection Scheme (PCS), a community-based waste management model that positions residents as key actors. This scheme emerged in response to the failure of private contractors, who sustained waste management services in the Kota Bharu Municipal Council (MPKB) area for only one year. Due to resource constraints, MPKB subsequently delegated part of its waste management responsibilities to local communities, while secondary collection remained under the jurisdiction of the Urban Services Department (JPB). The PCS emphasizes citizen involvement across all stages, including planning, implementation, and evaluation. In this model, the community functions not only as a service recipient but also as a provider of labor, an operational manager, and an environmental monitor. Through direct engagement, residents experience experiential learning in which knowledge and behavior evolve through daily practice and reflection. This process strengthens environmental awareness, reinforces a culture of cooperation, and fosters collective responsibility.

The pilot project was initiated in Taman Guru in 2002. This site was selected due to the presence of an active residents' association, the Persatuan Kesejahteraan Masyarakat Taman Guru (PKMTG), and a high level of compliance in municipal tax payments. The initiation process involved a series of structured meetings at the city council level, including sanitation committee discussions and plenary sessions. PKMTG was subsequently tasked with preparing a comprehensive proposal that detailed the number of households, infrastructure requirements, operational schedules, division of responsibilities, and cost estimates. Following approval, a formal contract was established with a monthly value of RM 1,433.88. MPKB supported the program by providing cleaning equipment and motorized three-wheel vehicles, and by facilitating large-scale communal work (gotong-royong) activities involving most residents. The success of the Taman Guru initiative led to its expansion to Taman Seri in 2004. Although this area did not fully meet municipal tax compliance criteria, strong resident participation and the presence of the BATAS association were considered sufficient for implementation. BATAS submitted a formal application, developed a working paper, and conducted consultations with PKMTG.

Upon approval, an annual contract valued at RM 14,869.92 was established, accompanied by logistical support from local authorities and community leaders. The operational structure followed the Taman Guru model, with residents serving as the primary agents in daily waste collection activities. The findings indicate that PCS implementation contributes to several outcomes: (i) increased participation in maintaining environmental cleanliness; (ii) strengthened capacity for self-managed local services; (iii) reduced operational burden on municipal authorities; (iv) enhanced

collective awareness and responsibility; (v) provision of informal environmental education; and (vi) streamlined operational processes through reduced bureaucratic layers. It demonstrates that community-based waste management can improve urban environmental performance, enhance program legitimacy, and build sustainable social capacity at the local level.

4.1.2. Primary Collection Scheme Model

Community participation represents a critical component in improving the efficiency and effectiveness of waste management systems. In the PCS framework, this participation is operationalized through activities such as communal work (*gotong-royong*), recycling, composting, and household-level waste handling. Under this scheme, residents are directly involved in sorting, storing, and initial transportation of waste. These activities occur at the source, where households play a decisive role in determining the quality and efficiency of subsequent waste management processes. In contrast, secondary collection is typically managed by local authorities or third-party contractors and involves transporting waste to processing facilities or landfill sites. This division of responsibilities reflects a hybrid governance model that integrates community-based action with formal institutional support. The PCS is also linked with 3R (reduce, reuse, recycle) initiatives and composting practices, which contribute to waste minimization at the household level. In Kota Bharu, the PCS operational model comprises several sequential stages: waste generation, source sorting, temporary storage at the household level, community-based collection and transportation, and transfer to designated temporary storage sites (see Figure 1). This structure illustrates how community participation at the initial stage can influence the performance and sustainability of urban waste management systems.

The management of the Primary Collection Scheme (PCS) in both residential areas is organized through formal community institutions. In Taman Guru, PCS operations are administered by the *Persatuan Kesejahteraan Masyarakat Taman Guru* (PKMTG) through its Bureau of Cleanliness and Health. In Taman Seri, management is conducted by BATAS through the Cleanliness and Beautification Committee. Both organizations maintain formal governance structures comprising a chairperson, a secretary, a treasurer, and elected members appointed at Annual General Meetings. Each organizational unit is responsible for supervising environmental cleanliness, coordinating waste management operations, and addressing resident complaints. In Taman Seri, operational authority is more centralized at the field level. The field supervisor is responsible for managing workers, monitoring service delivery, responding to complaints, and administering the monthly resident fee of RM 5.00 in coordination with block leaders. When operational disruptions occur, such as delays in secondary waste collection by the municipal authority (MPKB), the supervisor escalates the issue to the committee for collective resolution. This mechanism ensures continuity and responsiveness in service delivery.

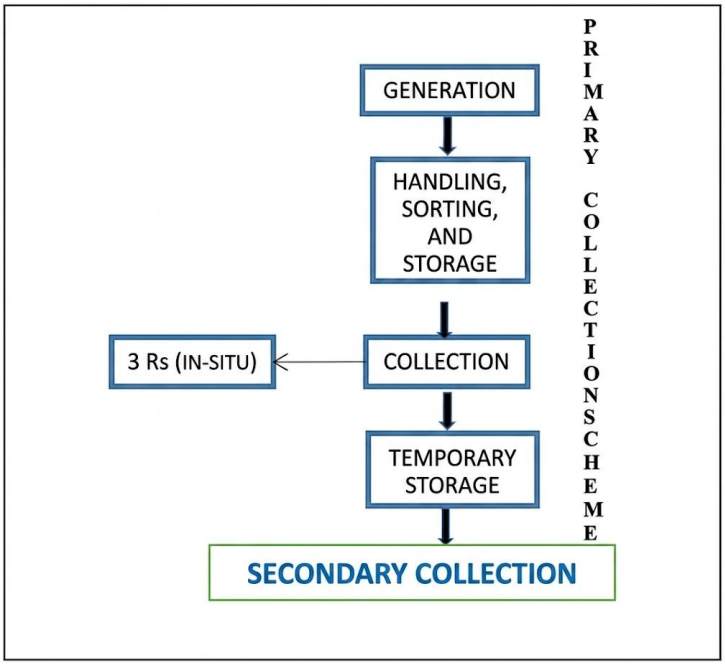

Figure 1. Overview of the Primary Collection Scheme in Taman Guru and Taman Seri

Planning and implementation processes in both locations are conducted through structured association meetings. Bureau and committee members participate actively in decision-making, and all operational issues, including program

improvements, are discussed collectively. This deliberative approach enables coordinated planning, strengthens institutional accountability, and ensures that follow-up actions are systematically implemented.

4.1.3. Workforce Organization

In both housing complexes, residents' associations employ two workers to carry out routine operational tasks, including waste collection and transportation, grass cutting, and drain cleaning. However, the labor organization differs between the two sites. In Taman Guru, drain cleaning is primarily conducted through communal work (*gotong-royong*), with workers providing support when required. The workforce consists of residents: Pak Rahman (57), a former gardener without formal education, and Pak Amin (44), a primary school graduate and former construction worker. Both individuals work five days per week (Sunday to Thursday) from 07:00 to 12:30 under informal employment arrangements. Although no formal contracts are issued, workers are required to provide one month's notice before resigning. Initial wages were set at RM 500 and later increased to RM 550. Additional benefits include holiday incentives and reimbursement of medical expenses upon submission of receipts. Outside formal working hours, workers are permitted to undertake supplementary employment. They frequently receive additional income from residents for personal services such as yard cleaning and grass cutting, typically ranging from RM20 to RM40 per task. Informal income is further supplemented through the sale of recyclable materials. For example, plastic bottles are sold at RM 0.80 per kilogram and aluminum cans at RM 4.00 per kilogram. Task allocation is clearly defined: Pak Rahman is responsible for waste collection and transportation, while Pak Amin focuses on grass cutting. Both workers also receive zakat contributions from residents in the form of money, food, and clothing.

In Taman Seri, operational tasks are performed collaboratively by two workers. Waste collection is conducted as a team, with one worker pushing the cart and the other collecting waste. Drain cleaning is carried out when blockages are identified during routine inspections. The workforce includes Hasnul (23), who completed primary education and has 2 years of experience, and Pak Hasan (50), a former crab catcher recruited through Hasnul's recommendation. Recruitment procedures in Taman Seri are less formalized than in Taman Guru. The field supervisor provides direct orientation regarding job responsibilities, work rules, and benefits. These benefits include medical assistance, contributions to the Employees Provident Fund (EPF) amounting to RM 166, and Social Security Organization (PERKESO) contributions of RM 17, all provided without salary deductions. These provisions were approved through committee-level decisions. Wages initially differed between workers: Hasnul received RM 450, and Pak Hasan, RM 400. Similar to Taman Guru, workers supplement their income through additional services to residents, such as yard cleaning for approximately RM 10 per task, and through the sale of recyclable materials, with proceeds shared equally. Cardboard and glass materials are distributed to local informal collectors. Working hours in Taman Seri are more structured and longer, consisting of six working days per week (excluding Friday), from 08:00 to 12:00 and 14:00 to 16:00. This contrasts with the more flexible schedule in Taman Guru.

4.1.4. Waste Generation

Accurate records of daily waste generation in Taman Guru and Taman Seri are not available. However, estimates can be derived using standard assumptions based on population size and per capita waste generation rates. Taman Guru has 210 housing units, while Taman Seri has 213. The average household size is estimated at four to five individuals, and the average waste generation rate is assumed to be 0.8 kilograms per person per day. Based on these parameters, estimated daily waste generation in Taman Guru ranges from 672 kilograms (210 × 4 × 0.8) to 840 kilograms (210 × 5 × 0.8). In Taman Seri, estimated generation ranges from 681.6 kilograms (213 × 4 × 0.8) to 852 kilograms (213 × 5 × 0.8). These estimates are consistent with empirical findings that identify population size as a primary determinant of waste generation, although factors such as income and demographic structure also contribute to variation. Waste generated in both areas can be classified into four categories: (i) domestic waste, including food scraps, paper, plastics, and metal containers; (ii) garden waste, such as grass clippings and branches; (iii) bulky waste, including discarded household items; and (iv) special waste, such as construction debris. Operational management in both areas focuses primarily on domestic and garden waste. Bulky and special waste are generally handled independently by residents, often in coordination with MPKB.

4.1.5. Waste Handling and Sorting

Waste handling practices in both Taman Guru and Taman Seri reveal limited household-level sorting. Residents typically store mixed waste in plastic bags and place them outside their homes for collection, or dispose of them directly into roll-on/roll-off (RoRo) bins. Sorting activities are conducted primarily by collection workers at temporary storage sites. Organic waste is separated and placed in communal storage areas, while recyclable materials such as plastic bottles, aluminum cans, and metals are partially recovered. These materials are either sold by workers as a source of supplementary income or transferred to waste collection crews and informal recyclers. The absence of sorting at the household level is not due to a lack of awareness. Instead, it reflects the absence of structured initiatives or incentives

from community organizations. The lack of formal recycling programs further limits household participation in sorting activities. At the municipal level, recycling infrastructure, including buy-back centers and designated drop-off points, has not been adequately developed. Financial constraints at the local government level contribute to this limitation.

Despite these structural barriers, residents demonstrate a basic understanding of recycling principles. Community members recognize that recycling can reduce landfill waste, conserve resources, generate economic value, and mitigate environmental impacts. Divergent views exist regarding implementation. Some residents believe that recycling initiatives can be independently managed by community associations, while others emphasize the need for institutional support from local authorities to ensure systematic implementation. A collaborative model that integrates community initiative with institutional support is likely to be more effective. Providing infrastructure, such as recycling bins and collection centers, in combination with organizational leadership, can strengthen trust and increase participation.

4.1.6. Storage Practices

Waste storage practices in both residential areas follow three primary methods. First, indoor storage involves collecting waste inside the household using bags or containers before transferring it outside for collection. This method helps maintain household cleanliness and reduces odor. Second, outdoor storage involves placing sealed waste outside the house, typically along the roadside, to facilitate collection. However, prolonged exposure may lead to environmental and sanitary disturbances. Third, direct storage involves temporarily storing waste indoors and then transporting it directly to communal bins without intermediate outdoor placement. This method is commonly used for organic waste that decomposes rapidly and may attract pests. These storage practices reflect residents' adaptive behavior in managing waste within existing infrastructural constraints. However, they also indicate the lack of standardized guidelines for household-level waste segregation and storage, which may affect system efficiency. In Taman Guru and Taman Seri, household waste storage follows three dominant patterns: the use of standard kitchen bins lined with small plastic bags (approximately 45 × 53 cm), the use of reused plastic bags such as grocery bags, and the use of larger individual bins (approximately 60 liters) lined with medium-sized plastic bags (approximately 71 × 91 cm). The first method is commonly applied to maintain hygiene, reduce odor, and prevent pest intrusion, particularly for organic waste. The second method reflects adaptive behavior among households with lower waste volumes or limited access to proper containers. The third method is typically used by households with higher waste generation, providing greater storage capacity in the kitchen.

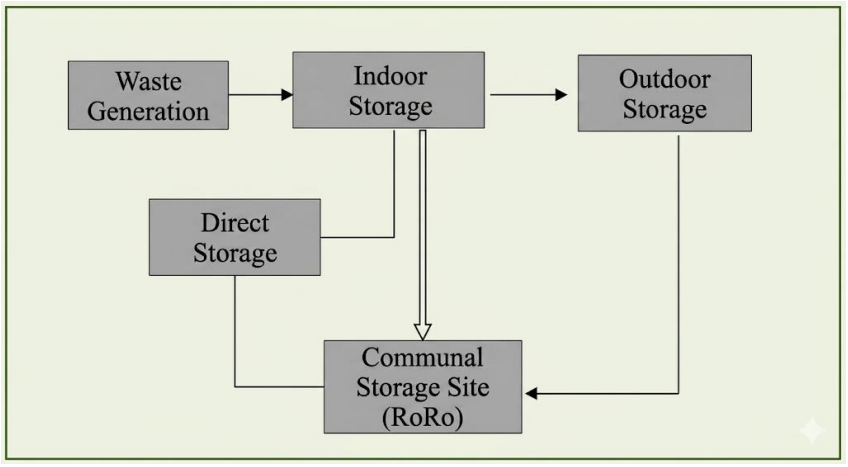

Figure 2. Indoor Storage, Outdoor Storage, and Direct Storage in Taman Guru and Taman Seri

For highly perishable waste, such as fish remains and poultry by-products, residents often adopt additional precautionary measures. These materials are separated into smaller plastic bags and stored temporarily indoors or in refrigeration units before being disposed of at communal collection points, usually in the evening. However, not all households' practice waste separation, and mixed waste storage remains prevalent. Waste is generally stored indoors before being transferred to outdoor collection points. Storage duration varies depending on household size, waste composition, and collection frequency. Three primary storage durations are observed: overnight, full-day, and two-day. Households with four to five members typically adopt overnight storage due to higher volumes of organic waste, which necessitate rapid disposal to prevent odor and decay. Smaller households tend to adopt full-day storage, as lower waste volumes reduce immediate environmental risks. Two-day storage is less common but occurs when waste accumulation remains manageable and collection schedules permit delayed disposal.

Outdoor storage practices are regulated through community norms. Residents place waste outside their homes in the morning prior to collection, generally before 8:00 AM. Early placement is discouraged to prevent disturbances

caused by stray animals, which may scatter waste and disrupt collection operations. Residents' associations actively reinforce compliance with these norms through regular meetings and communication. To ensure orderly storage, residents must use containers that meet municipal standards. Waste must be securely wrapped, typically in black plastic bags, to minimize odor and reduce pest exposure. Garden waste must be cut into smaller pieces to facilitate handling and transport. These practices reflect adherence to municipal guidelines aimed at maintaining environmental hygiene and operational efficiency.

In both residential areas, municipal guidelines are disseminated through circulars, meetings, and direct engagement with residents. Waste is initially stored indoors and later transferred to outdoor containers located at designated points, typically in front of houses in Taman Guru and at the rear in Taman Seri. When containers reach capacity, excess waste is placed nearby. Although garden waste is generally disposed of directly at communal storage points, some residents store it temporarily outside in separate bags. Unlike standard municipal practice, which excludes household-level collection of garden waste, local associations have arranged for its inclusion, demonstrating adaptive governance at the community level. The system also incorporates direct storage practices, in which waste is transported from households to communal disposal points without intermediate outdoor storage. This method is commonly used for highly perishable waste, garden waste, and by households located near communal storage facilities. It is also more frequent during periods of increased waste generation, such as holidays or festive seasons. Community associations consistently promote direct disposal to reduce environmental risks and improve cleanliness.

4.1.7. Waste Collection, Transportation, and Environmental Maintenance

Waste collection in both Taman Guru and Taman Seri follows a door-to-door system. Waste placed outside households is collected and transported to communal storage points before secondary collection by the municipal authority. Operational efficiency depends on scheduling, frequency, transport capacity, and worker coordination. In Taman Guru, collection activities are conducted by one worker between 8:00 AM and 11:30 AM, while a second worker focuses on grass cutting and general maintenance. The residential area is divided into two operational zones, which are served alternately every two days. This arrangement reflects the area's broader spatial coverage. In contrast, Taman Seri adopts a daily collection system due to its smaller size. Two workers conduct collection activities from 8:00 AM to 11:00 AM, excluding Fridays and Saturdays. Although formal micro-route systems are not implemented, workers rely on accumulated experience to optimize collection efficiency. Notably, the frequency of collection in both areas exceeds the contractual requirement of every two days. This reflects a high level of commitment among both workers and community organizations. However, the absence of formalized routing systems suggests an opportunity to improve efficiency, particularly in supporting new workers and standardizing operations.

Both areas use kerbside collection methods, though the placement differs. In Taman Guru, waste is placed at the front of the house, while in Taman Seri it is placed at the rear or along back lanes. Workers collect waste from these points and transport it to communal storage facilities. Garden waste, although encouraged to be disposed of directly at communal sites, is still collected by workers if properly stored. Bulk and special waste, such as construction debris and large household items, are managed through coordination between residents' associations and the municipal authority. Residents must inform the association, which then arranges collection schedules with the municipal authority. This coordinated approach ensures efficient handling of non-routine waste streams. Transportation systems differ between the two areas. In Taman Guru, waste is transported using a motorized three-wheeled vehicle, with approximately four trips per day and a capacity of about 150 kg per trip. This system enhances operational efficiency and enables coverage of a larger area. In Taman Seri, transportation relies on manual carts, requiring five to six trips per day with an average capacity of 200 kg per trip. Plans are underway to introduce motorized vehicles to improve efficiency.

Secondary collection is conducted by the municipal authority two to three times per week using a mobile container system. Communal containers are transported to disposal sites and returned after emptying. This system ensures continuity between primary and secondary collection stages. In addition to waste collection, environmental maintenance activities include street sweeping, grass cutting, and drain cleaning. In Taman Guru, sweeping is conducted after primary collection when necessary, while in Taman Seri it is performed routinely by both workers. Grass cutting is carried out daily in both areas, although responsibilities differ. The municipal landscape division manages open spaces in Taman Guru. Drain cleaning practices also vary. In Taman Guru, cleaning is conducted on an ad hoc basis, primarily through communal work or hired labor, with limited scheduled maintenance due to budget constraints. Routine inspections are conducted to identify blockages. In contrast, Taman Seri implements daily drain cleaning as part of routine operations. This reflects stronger integration of maintenance activities within the PCS framework.

4.1.8. Operational Supervision and Monitoring

Operational supervision in both areas is structured to ensure compliance with agreed standards and contractual obligations. Supervision involves collaboration between residents' associations and the Urban Services Department. Two primary supervision mechanisms are applied. First, direct supervision includes routine inspections of waste

collection, transportation, grass cutting, and drainage maintenance. These inspections are conducted almost daily by designated committees and field supervisors. Second, indirect supervision involves the collection of feedback through resident complaints and informal consultations. Workers are required to report operational issues, including non-compliance by residents, equipment failures, and disruptions in secondary collection. This reporting system enables rapid response and corrective action. Community associations play an active role in addressing issues through meetings, direct engagement with residents, and coordination with municipal authorities.

At the municipal level, supervision is conducted by environmental health officers through periodic inspections, typically three times per month. These inspections assess compliance with operational standards, including collection frequency and maintenance activities. A flexible, consultative approach is adopted, with an emphasis on problem-solving rather than enforcement. Resident complaints, which were more frequent during the early stages of implementation, have significantly declined. Feedback mechanisms have shifted toward direct communication with residents' associations, enabling faster resolution. Municipal authorities interpret the absence of complaints as an indicator of program effectiveness. The supervision system integrates community-level monitoring with institutional oversight. This dual structure enhances accountability, ensures operational continuity, and supports the sustainability of community-based waste management practices.

4.2. Impact of PCS Implementation

4.2.1. Impact on the Local Community

The implementation of the PCS in Taman Guru and Taman Seri has generated measurable improvements in service delivery, environmental quality, and daily living conditions. The previous system managed by MPKB-BRI was widely perceived as inefficient, particularly in narrow alleys and rear lanes that were often excluded from routine collection. The transition to a community-based model has addressed these limitations and improved service coverage. First, collection frequency has increased significantly. Waste is now collected daily, compared to the previous schedule of once every three to four days. This change reduces waste accumulation, minimizes odor, and limits disturbances caused by scavenging animals. Second, the scope of operational activities has expanded. Waste collection, grass cutting, and drain cleaning now cover the entire residential area, including areas previously underserved. This expansion improves environmental consistency and reduces localized sanitation issues.

Third, waste storage practices have become more standardized. Residents now use plastic bags and individual bins in accordance with association guidelines. Garden waste, such as tree branches, is cut into smaller pieces and bundled prior to disposal. These practices contribute to a cleaner and more organized environment. Previously, waste was often disposed of irregularly, including placement on fences, which created a disordered appearance. Fourth, worker performance has improved. Workers demonstrate greater responsibility, maintain consistent service quality, and respond promptly to resident needs. Tasks are carried out carefully, without generating excessive noise or complaints. In contrast, earlier practices were associated with inconsistent service and occasional operational negligence. Fifth, the use of appropriate equipment has enhanced operational efficiency. Handcarts and motorized three-wheeled vehicles allow access to all areas, including narrow routes, while reducing noise and odor compared to conventional collection trucks. Sixth, communication and supervision mechanisms have improved. Residents can now report issues directly to association management, enabling faster responses and resolutions. This contrasts with the previous system, where complaints were processed through a centralized structure and often experienced delays.

Seventh, environmental monitoring is supported through social mechanisms. Awareness campaigns are delivered through community channels, including mosques, local meetings, and direct engagement. Residents actively participate in maintaining cleanliness, including disposing of waste at communal points during non-collection periods. Regular communal activities, such as *gotong-royong* and cleanliness campaigns, reinforce shared responsibility. Finally, environmental and health conditions have improved. The residential areas are largely free from persistent odors, pests, and stagnant water. Drainage systems function more effectively, and localized flooding, previously observed in Taman Seri, has been mitigated. These improvements enhance comfort, safety, and quality of life. Thus, the PCS has strengthened community cohesion, increased environmental awareness, and shifted residents' roles from passive service recipients to active participants in maintaining environmental sustainability.

4.2.2. Impact on MPKB

The implementation of the PCS has also delivered significant benefits for the local authority, particularly in operational efficiency and cost management. By delegating primary waste collection responsibilities to community organizations, MPKB-BRI has restructured its operational model in line with participatory governance principles. First, operational workload has decreased. Activities such as waste collection, grass cutting, and drain maintenance are now managed at the community level. This allows MPKB-BRI to focus on strategic functions, including planning, monitoring, and service provision in areas not covered by community-based systems. Second, the model generates measurable cost savings. In Taman Guru, the annual operational cost managed by the residents' association is approximately RM

20,206.56, compared to an estimated RM 27,000 under direct municipal management. This results in annual savings of RM 6,793.44.

In Taman Seri, annual savings are estimated at RM 2,130.08. If implemented across a larger number of residential areas, the cumulative financial impact would be substantial. Third, decentralization supports environmental education and enforcement at the local level. Residents' associations operate more closely with the community and are more effective at promoting behavioral change through campaigns, monitoring, and direct engagement. Fourth, MPKB-BRI reduces its reliance on labor and equipment for routine operations in participating areas. This enables more efficient allocation of institutional resources and reduces pressure on municipal capacity. The PCS demonstrates that community-based waste management can improve efficiency, reduce costs, and enhance service quality while supporting participatory governance.

4.2.3. Impact on Residents' Associations

The implementation of the PCS has significantly strengthened the institutional capacity and social legitimacy of residents' associations. In both Taman Guru and Taman Seri, associations have evolved into key actors in environmental governance, assuming operational, administrative, and coordination roles.

1. Financial and Managerial Strengthening; Residents' associations receive regular funding from MPKB-BRI, amounting to RM 1,433.88 per month in Taman Guru and RM 1,239.16 in Taman Seri. These funds are allocated to worker wages, equipment procurement, and operational expenses. In Taman Guru, efficient financial management generated a monthly surplus of approximately RM 237.88, which later increasing to RM 500 following additional allocations. In Taman Seri, an initial deficit of RM 155.84 was addressed by introducing waste service fees, generating approximately RM 400 in additional income per month.

2. Social Investment and Community Cohesion; Financial surpluses and additional revenue have enabled social investments. In Taman Seri, the association developed a children's playground to support community interaction. Regular social, religious, and recreational activities further strengthen social cohesion. In Taman Guru, improved financial stability has reduced reliance on external donations. Increased resident trust is reflected in a rapid rise in membership, from 70 to 180 households within two months. A similar trend is observed in Taman Seri following improvements in service delivery.

3. Increased Legitimacy and Trust; Prior to PCS implementation, BATAS functioned primarily as a welfare organization with limited engagement from residents. Following its involvement in waste management, perceptions shifted significantly. Residents now recognize the association's capacity to manage services effectively and transparently and visible improvements in environmental conditions and consistent operational performance drive trust.

4. Institutional Transformation; The PCS has transformed residents' associations from social entities into multifunctional organizations with environmental management responsibilities. Their roles now include operational planning, enforcement of waste management rules, complaint handling, and coordination with local authorities. Associations also initiate community-based activities, such as *gotong-royong* and environmental campaigns, which reinforce participation and collective responsibility.

5. Discussion

5.1. Community Participation and Environmental Outcomes

The findings confirm that active community participation significantly improves waste management performance. Increased collection frequency, expanded service coverage, and improved cleanliness conditions in both Taman Guru and Taman Seri illustrate the practical benefits of localized engagement. These outcomes are consistent with evidence that participatory governance enhances environmental performance when citizens are directly involved in decision-making and implementation processes (Newig et al., 2018). The results also support the argument that collective action is a key mechanism in managing shared environmental resources. Residents in both study areas demonstrate coordinated behavior, such as adherence to collection schedules, participation in *gotong-royong*, and compliance with storage regulations. This reflects the role of trust, social norms, and local institutions in facilitating cooperation, as emphasized in collective action theory (Ostrom, 2010). The presence of strong community organizations, such as PKMTG and BATAS, further reinforces this dynamic by providing structure and coordination. Empirical findings also align with prior studies showing that community participation contributes to waste reduction and improved environmental practices (Hapuarachchi, 2024). However, this study extends existing literature by demonstrating that participation at the primary collection stage directly influences system efficiency, not only environmental behavior.

5.2. Institutional Decentralization and Governance Efficiency

The decentralization of waste management responsibilities to community organizations has generated measurable improvements in efficiency and cost savings. The reduction in operational burden and financial expenditure for the local authority reflects the effectiveness of shared governance models. These findings support arguments that decentralized systems can outperform centralized approaches when local actors are empowered and institutional arrangements are aligned with community capacity (Ostrom, 2010). The role of residents' associations as intermediaries between citizens and local authorities is particularly significant. These organizations facilitate communication, enforce local rules, and coordinate daily operations. This aligns with governance frameworks that emphasize the importance of stakeholder interaction, representation, and localized decision-making in improving policy outcomes (Newig et al., 2018). At the same time, the findings highlight the importance of institutional support. Although communities manage primary collection, secondary collection remains under municipal control. This hybrid governance model reflects a balanced distribution of responsibilities, where community-based action complements formal institutional functions. Similar patterns have been observed in comparative studies of recycling initiatives, where community engagement enhances effectiveness when supported by institutional frameworks (Oh & Hettiarachchi, 2020).

5.3. Social Capital and Community Dynamics

The transformation of residents' associations into operational entities demonstrates the role of social capital in sustaining community-based systems. Increased membership, improved trust, and expanded social activities indicate that participation strengthens both institutional legitimacy and community cohesion. These findings are consistent with research highlighting the importance of social networks, shared norms, and collective identity in shaping community behavior (Botterill, 2018). The study also supports the argument that built environments and local organizational structures influence participation patterns. Differences between Taman Guru and Taman Seri, particularly in operational organization and supervision, illustrate how local conditions shape implementation outcomes. This observation aligns with urban research suggesting that social interaction and spatial context shape community engagement (Farahani & Lozanovska, 2014). However, participation is not uniform across all aspects of waste management. While residents actively engage in collection and cleanliness activities, household-level waste sorting remains limited. This indicates that awareness alone is insufficient to drive behavioral change. Institutional incentives and infrastructure are required to translate knowledge into practice. This finding is consistent with studies showing that environmental awareness must be supported by enabling conditions to produce sustained behavioral change (Ihwughwavwe & Aniebonam, 2024).

5.4. Waste Management Systems and Structural Constraints

The study highlights the continued influence of structural constraints, including limited infrastructure and financial resources. The absence of formal recycling facilities and household-level sorting systems reflects broader challenges in Southeast Asian waste management systems (Ngoc & Schnitzer, 2009). These constraints limit the potential of community participation, particularly in advancing waste reduction and circular economy practices. The reliance on estimation methods for waste generation also indicates data limitations at the local level. While population-based estimates provide a reasonable approximation, more accurate data collection is necessary for effective planning and monitoring. This aligns with global evidence emphasizing the importance of reliable data in designing and managing waste systems (Kaza et al., 2018). In the Malaysian context, the findings reinforce previous research indicating that waste management systems remain heavily dependent on landfills and lack integration with source-level interventions (Samsudin & Dona, 2013). The PCS model partially addresses this gap by strengthening upstream processes, but further integration with recycling and resource recovery systems is required.

This study addresses a critical gap in the literature by focusing on the primary collection stage of waste management. Most existing studies emphasize downstream processes, such as transportation and disposal, while neglecting the role of community participation at the source. By examining PCS implementation, this research demonstrates that early-stage interventions are crucial for overall system performance. The study also contributes to the literature by analyzing the interaction between community organizations and local authorities. While previous research highlights the importance of participation, it often lacks a detailed examination of institutional relationships. This study shows that effective collaboration between communities and local governments is essential for sustaining community-based systems. Furthermore, the findings provide empirical evidence from a Southeast Asian urban context, where rapid urbanization and institutional constraints create unique challenges. This adds to the limited body of literature on community-based waste management in the region (Webster, 1995).

6. Conclusions

This study re-evaluates local community participation in waste management by examining the implementation of Primary Collection Schemes (PCS) in Kota Bharu, Malaysia. The findings demonstrate that community-based

approaches can significantly improve service efficiency, environmental quality, and institutional performance at the local level. The PCS model enables residents to participate directly in waste handling, collection, and environmental maintenance, leading to more responsive, context-specific service delivery. This study provides empirical evidence that community-based Primary Collection Schemes can enhance urban waste management when supported by appropriate institutional and policy frameworks. Strengthening the integration between community participation and formal governance systems is essential to achieving sustainable, resilient waste management in Malaysia.

The results show that decentralizing primary waste collection to community organizations enhances operational coverage, increases collection frequency, and improves cleanliness conditions. At the same time, it reduces the financial and administrative burden on local authorities. Residents' associations emerge as effective intermediaries, coordinating daily operations, enforcing local norms, and facilitating communication between citizens and municipal agencies. This hybrid governance model, combining community participation with institutional oversight, strengthens both efficiency and accountability. However, participation remains uneven across different stages of waste management. While engagement is strong in collection and environmental maintenance, household-level waste sorting and recycling practices remain limited. This indicates that participation alone is insufficient without supporting infrastructure, incentives, and institutional coordination. Therefore, sustainable waste management requires integration between community-driven initiatives and broader systemic interventions. Thus, the study confirms that community participation is a critical determinant of waste management effectiveness, particularly at the source level. By focusing on Primary Collection Schemes, this research highlights the importance of upstream interventions in shaping the overall performance of urban waste management systems.

6.1. Research Limitations

This study has several limitations that should be acknowledged. First, the research adopts a qualitative case study design focusing on two residential areas in Kota Bharu. While this approach provides in-depth insights, the findings may not be fully generalizable to other urban contexts with different socio-economic and institutional conditions. Second, the study relies on estimates of waste generation due to the absence of systematic measurement at the local level. Although population-based estimation provides a reasonable approximation, it limits the precision of quantitative analysis. Third, the research focuses primarily on primary collection processes and community dynamics. It does not examine downstream processes such as recycling systems, treatment technologies, and landfill management in detail. As a result, the analysis of the full waste management cycle remains partial. Fourth, behavioral analysis is based on observed practices and reported perceptions. The study does not employ quantitative behavioral models to measure participation intensity or causal relationships between variables.

6.2. Policy Implications

The findings provide several important implications for policy development. First, local governments should institutionalize community-based waste management models, particularly at the primary collection stage. Delegating operational responsibilities to community organizations can improve efficiency, reduce costs, and enhance service coverage. Second, policy frameworks should strengthen residents' associations' role as formal partners in environmental governance. This includes providing clear guidelines, financial support, and capacity-building programs to ensure accountability and sustainability. Third, infrastructure investment is essential to complement community participation. Facilities for sorting, recycling, and composting should be developed to enable households to engage in waste-reduction practices. Fourth, communication strategies should be localized and continuous. Community-based awareness campaigns, supported by local leaders and institutions, are more effective in shaping behavior than centralized approaches. Fifth, monitoring and evaluation systems should integrate community feedback mechanisms. Decentralized supervision can improve responsiveness and ensure that operational issues are addressed promptly.

6.3. Recommendations for Future Research

Future research should extend this study in several directions. First, quantitative studies are needed to measure the causal impact of community participation on waste management performance. Statistical models can provide stronger evidence on the relationship between participation, efficiency, and environmental outcomes. Second, comparative studies across different cities or regions should be conducted to assess the scalability of the PCS model. Such studies can identify contextual factors that influence success or failure. Third, future research should integrate analyses of upstream and downstream processes, including recycling systems, circular-economy practices, and waste-to-energy technologies. This will provide a more comprehensive understanding of waste management systems. Fourth, behavioral studies should explore the determinants of household-level waste sorting and recycling. Understanding barriers to participation can inform the design of targeted interventions. Fifth, longitudinal research is recommended to

examine the sustainability of community-based systems over time. It includes assessing how institutional arrangements, leadership, and social dynamics evolve.

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