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A Community-Driven Approach to Urban Waste Management: Insights from the Kenanga Waste Bank, Bogor, Indonesia

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ABSTRACT

Urban waste management remains a pressing challenge in Indonesia, with Bogor City being among the highest waste-producing areas. Community-based waste banks offer a promising solution by promoting waste reduction, recycling, and economic incentives. This study examines the effectiveness of the Kenanga Waste Bank, a leading community initiative in RW 1 (Rukun Warga, or neighborhood unit), Babakan Subdistrict, Bogor City. Using a mixed-methods approach, the research combines surveys of 35 waste bank members, in-depth interviews, and observations to assess managerial performance, community participation, and socio-environmental benefits. Data analysis employed Spearman rank correlation and chi-square tests to explore key relationships between participation levels, governance structures, and financial sustainability. The findings reveal strong operational and institutional management but highlight gaps in waste-sorting enforcement and participation in decision-making. While economic and environmental benefits are recognized, financial sustainability remains a concern due to fluctuations in the recyclable market. Strengthening participatory governance, diversifying revenue sources, and enforcing waste-sorting practices are critical for long-term success. This study offers practical recommendations for policymakers, waste bank operators, and community leaders to enhance participation, improve governance, and integrate waste banks into formal waste management systems. By addressing these key challenges, waste banks can serve as scalable models for sustainable urban waste management in Indonesia.

Keywords: *Community-Based Waste Management; Financial Sustainability; Participatory Governance; Urban Environmental Planning; Waste Bank*

1. Introduction

The rapid increase in urban waste poses a critical environmental and governance challenge for cities worldwide, particularly in developing countries such as Indonesia. The rise in waste generation is driven by multiple factors, including population growth, lifestyle changes, increased consumption patterns, and rising purchasing power, especially in urban areas (Astanti & Santoso, 2017; Wiyanti, 2017). Waste generation in Indonesia has reached alarming levels, with 68.5 million tons produced in 2021, up from 67.8 million tons in 2020 (Ministry of Environment and Forestry of Indonesia., 2021). Bogor City, the second-largest waste contributor in West Java, generates approximately 245,922 tons annually, with households accounting for 60% of the total waste (Setiawan & Fithrah, 2019). If not properly managed, this growing waste burden exacerbates environmental pollution, health risks, and urban sustainability challenges (Ariawan et al., 2020; Wardi & Nyoman, 2011).

Despite the enactment of Law No. 18 of 2008 on Waste Management, which mandates a shift toward the Reduce, Reuse, and Recycle (3R) principles, implementation gaps persist. The country remains heavily reliant on landfill-based disposal systems, which have proven inadequate in addressing the scale of urban waste production (Damanhuri & Padmi, 2010). These conditions highlight the urgent need for alternative waste management models complementing formal municipal waste systems.

One innovative approach that has gained prominence in Indonesia is the waste bank model. This community-based waste management system operates as an intermediary, enabling communities to deposit sorted waste and convert it into economic value. This model reduces the waste volume sent to final disposal sites and economically and socially empowers local communities. Participants gain financial benefits by "saving" sorted recyclable waste, which can be monetized or exchanged for goods (Prasetyo et al., 2018). In addition to its economic benefits, the model fosters environmental awareness, social engagement, and grassroots participation in waste governance (Asteria & Heruman, 2016; Burhanuddin et al., 2021).

As of 2021, more than 11,500 waste banks were operating across 363 municipalities in Indonesia, reflecting their increasing adoption as a scalable waste management solution (The Jakarta Post, 2022). However, despite their potential, many waste banks struggle to achieve long-term sustainability due to limited community participation, managerial inefficiencies, and financial instability (Mulyanti & Fachrurozi, 2016; Setiawan & Fithrah, 2019). Studies have shown that although economic incentives initially attract participants, long-term engagement depends on institutional effectiveness, governance mechanisms, and the perceived benefits of participation (Berampu & Agusta, 2015; Dhokhikah et al., 2015). Research also indicates that the operational effectiveness of waste banks varies, with some successfully integrating waste management education and community mobilization, while others falter due to poor financial planning and weak enforcement of waste-sorting regulations (Ariefahnoor et al., 2020). These findings underscore the need for a more nuanced understanding of the relationship between managerial effectiveness, community participation, and waste bank sustainability.

Existing studies emphasize the economic and environmental benefits of waste banks, including waste reduction, income generation, and community empowerment (Fikriyyah & Adiwibowo, 2018; Ramadani, 2021). However, much of the literature has overlooked operational challenges, managerial performance, and the dynamics of participation—factors that are crucial for ensuring long-term sustainability (Dhokhikah et al., 2015; Mulyanti & Fachrurozi, 2016). While community engagement is widely recognized as key to success, few studies differentiate participation across planning, decision-making, implementation, and evaluation stages (Berampu & Agusta, 2015). Moreover, empirical evidence on how governance

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and financial management influence participation and performance remains limited. Addressing these research gaps is essential for strengthening community-based waste management models and informing policies that support sustainable waste bank governance.

This study contributes to the existing literature by offering a comprehensive assessment of managerial effectiveness and community participation in waste banks, using the Kenanga Waste Bank in RW 01 (Rukun Warga, or neighborhood unit), Babakan Subdistrict, Bogor City, as a case study. Established in 2015, the Kenanga Waste Bank has been recognized for its innovative waste collection strategies, partnerships with private firms, and effective community mobilization. It has received multiple awards, including first place in the 2021 "Bogorku Bersih" competition, highlighting its perceived success as a community-based waste management initiative. Nevertheless, despite these achievements, critical questions remain regarding its long-term sustainability, governance structure, and participation dynamics.

To address these gaps, this study focuses on three interrelated objectives. First, it assesses the managerial effectiveness of the Kenanga Waste Bank, with particular attention to its operational, institutional, financial, and organizational dimensions. Second, it analyzes the level of community participation across various stages of waste bank management, including planning, decision-making, implementation, and evaluation. Third, it examines the relationship between managerial effectiveness, community participation, and the environmental, economic, and social benefits of waste bank activities. Through these objectives, the study aims to advance the academic discourse on community-based waste management by offering empirical evidence on sustainability, governance, and financial viability. It further contributes to policy-oriented discussions on participatory waste governance and the circular economy by providing actionable insights for policymakers, waste bank operators, and community stakeholders. In doing so, it supports broader efforts to integrate waste banks into formal municipal systems, contributing to Indonesia's transition toward a more inclusive, circular, and sustainable model of urban waste management.

2. Literature Review

2.1. Regulatory Framework and Its Effectiveness

Indonesia's traditional approach to waste management has predominantly followed a linear model focused on waste collection, transportation, and disposal at designated final sites (Ariawan et al., 2020). While this method remains functional in the short term, it has proven insufficient to address the country's escalating waste generation, which is driven by urbanization, consumption patterns, and inadequate waste-processing infrastructure (Damanhuri & Padmi, 2010).

Recognizing these challenges, the enactment of Law No. 18 of 2008 on Waste Management marked a paradigm shift toward a dual framework of waste reduction and handling, emphasizing the principles of Reduce, Reuse, and Recycle (3R) to minimize waste at its source and reduce dependence on landfill disposal (TPA). Additionally, Regulation No. 13 of 2012, issued by the Ministry of Environment and Forestry, introduced waste banks as a community-based initiative to promote waste reduction and resource recovery. This transition necessitates active collaboration among the private sector, government institutions, and local communities (Damanhuri & Padmi, 2010).

However, despite these progressive aspirations, implementation has revealed persistent gaps, particularly in translating policy into effective practice—raising concerns about its efficacy in addressing the waste crisis. Studies highlight that local governments often lack the technical capacity and funding needed to enforce household-level waste separation, resulting in low

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compliance rates and continued reliance on landfills. While the waste bank model offers a promising solution, its success remains largely dependent on voluntary community participation and fluctuating market conditions, which vary significantly across regions (Mulyanti & Fachrurozi, 2016; Setiawan & Fithrah, 2019).

A critical limitation of these policies lies in their inconsistent enforcement and limited integration with formal municipal waste management systems. Waste banks often operate independently of official waste collection services, leading to operational inefficiencies and financial constraints, especially when recyclable demand declines. Furthermore, the absence of standardized operational guidelines has resulted in performance disparities among waste banks, with many struggling to sustain long-term participation and financial viability (Ariefahnoor et al., 2020; Dhokhikah et al., 2015).

2.2. Waste Banks as a Community-Based Solution

The waste bank model has gained prominence as a community-driven approach to reducing household waste while generating economic and social benefits. It operates as a community-based initiative to minimize waste at its source while fostering environmental awareness. Waste banks allow residents to deposit sorted waste in exchange for savings, which can be redeemed for cash or goods, thereby creating economic incentives for recycling.

Prasetyo et al. highlight the economic potential of waste banks, noting that households can monetize recyclable materials, thereby transforming waste management into an income-generating activity (Prasetyo et al., 2018). Posmaningsih also emphasizes the importance of financial incentives in engaging communities in waste management initiatives (Posmaningsih, 2017). Nonetheless, market dependency on recyclables introduces economic instability, necessitating diversified revenue streams and strengthened institutional support to ensure the resilience of waste banks.

Beyond their economic benefits, waste banks contribute to social and ecological improvements. As emphasized by Ariawan et al., this model not only facilitates waste management but also empowers communities economically, socially, and educationally (Ariawan et al., 2020). Suryani underscores the role of this model in fostering cleaner communities and promoting environmental stewardship (Suryani, 2014). Previous studies (Asteria & Heruman, 2016; Ramadani, 2021) further highlight the multifaceted advantages of waste banks, including environmental enhancement, social cohesion, and job creation.

Previous studies (Fikriyyah & Adiwibowo, 2018; Mulyanti & Fachrurozi, 2016) underscore the transformative role of waste banks in reshaping public perceptions of waste, redefining it as a valuable resource rather than a burden. Burhanuddin et al. argue that the economic incentives tied to recycling efforts within this model significantly encourage public participation (Burhanuddin et al., 2021). Furthermore, the operational structure of waste banks—which requires users to sort waste by type and deposit it as savings—demonstrates the model's capacity to drive behavioural change (Fikriyyah & Adiwibowo, 2018; Indrianti, 2016).

Empirical studies suggest that waste banks contribute significantly to waste reduction at the community level. In cities where waste banks operate effectively, household waste separation rates are higher, and dependency on landfills is reduced. Moreover, waste banks function as platforms for environmental education, engaging schools, households, and local businesses in sustainable waste practices (Burhanuddin et al., 2021; Indrianti, 2016). Despite these advantages, waste banks' scalability and long-term sustainability remain subject to debate due to their dependence on community participation and the volatility of recyclable material markets.

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2.3. Challenges in Community Participation

Sustaining the benefits of waste banks requires overcoming a range of social, structural, and operational challenges, such as fluctuating community engagement, inadequate funding, and limited technical expertise. Community engagement is a critical determinant of the success of waste banks. Mulyanti and Fachrurozi emphasize that public awareness and behavioural habits significantly influence participation (Mulyanti & Fachrurozi, 2016). Research also shows that economic incentives are pivotal in sustaining community involvement. Direct financial benefits, such as savings from waste deposits, encourage participation, particularly among low-income households (Burhanuddin et al., 2021). However, non-monetary factors—such as social cohesion and environmental consciousness—also serve as important drivers of engagement (Suryani, 2014).

Despite these motivations, several barriers to participation remain. A key challenge is the limited capacity of households to sort waste effectively, often resulting in contamination of recyclables and reduced operational efficiency. Many households lack the necessary knowledge or resources to properly separate waste, undermining the waste bank's objective of improving recycling rates. In addition, inconsistent enforcement of sorting rules further complicates implementation. While regulations are in place, administrators often prioritize operational flexibility over strict adherence to guidelines, leading to varying levels of compliance (Ariefahnoor et al., 2020). This can discourage members from developing consistent sorting habits, ultimately affecting collected recyclables' quality and market value.

Another notable issue is the lack of inclusivity in decision-making processes. Many waste banks are primarily managed by a small group of administrators, offering limited opportunities for community members to participate in planning or rule-setting. As a result, involvement is often confined to waste deposit activities, while strategic decisions regarding program development and governance remain centralized (Dhokhikah et al., 2015).

Structural limitations further exacerbate these challenges, including insufficient government funding and limited market access for recycled products (Habib, 2019). These constraints illustrate the difficulty of shifting from entrenched linear disposal practices to a circular economy framework. Operational inefficiencies persist, particularly in waste bank management's technical and institutional aspects. Kodoatie emphasizes that addressing these interrelated factors is essential to ensure the effectiveness of waste banks (Kodoatie, 2003).

These findings highlight the need for waste banks to strengthen public education on waste sorting, establish and enforce clear operational guidelines, and promote inclusive decision-making to enhance community ownership. Diversifying income sources—such as partnerships with businesses and local governments—can also contribute to financial stability. Moreover, integrating waste banks into formal municipal waste management systems can provide much-needed technical and institutional support. Without these measures, waste banks may face participation gaps and financial uncertainty, limiting their potential as a sustainable community-based waste management solution in Indonesia.

2.4. Financial Viability

The economic sustainability of waste banks remains a critical challenge, as their revenue primarily depends on the fluctuating market value of recyclables (Apriliyanti et al., 2015). Financial instability has led to the closure of many waste banks. Setiawan and Fithrah report that as of 2016, only 51% of waste banks in Bogor remained active, with many closures attributed to managerial shortcomings, inadequate operational space, and unstable income streams (Setiawan & Fithrah, 2019). The reliance on volatile demand for recyclables makes it

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difficult for waste banks to maintain consistent revenue, particularly when the prices of materials such as plastic and paper decline. These findings underscore the urgent need for comprehensive support mechanisms—including policy reforms, technical training, and financial assistance—to ensure the sustainability of waste bank initiatives (Nursamsiyah & Qodir, 2024).

Beyond market dependency, waste banks also struggle with limited funding and investment. They receive minimal government support and depend primarily on community contributions and sporadic corporate partnerships. In addition, high operational costs—including expenses for collection, sorting, storage, and transportation—often outweigh the income generated from recyclable sales. Without stable financial backing, many waste banks face persistent challenges in maintaining their operations, rendering long-term viability uncertain (Habib, 2019; Kodoatie, 2003). Overcoming these obstacles requires diversifying income streams through strategies such as expanding partnerships with businesses for paid waste collection services, developing waste-based micro-enterprises that produce value-added products like eco-bricks and compost, and securing government subsidies to support integration into formal municipal waste systems. Implementing these measures is essential to ensure that waste banks remain viable and scalable solutions for sustainable waste management in Indonesia (Ariawan et al., 2020).

In summary, while waste banks represent a promising model for community-based waste management, their full potential remains underutilized due to persistent structural and operational limitations. Addressing these issues calls for a comprehensive assessment of waste bank implementation to identify systemic gaps and constraints and formulate targeted recommendations to strengthen management practices and enhance long-term sustainability.

3. Research Methodology

This study was conducted in RW 01 (Rukun Warga, or neighborhood unit), Babakan Subdistrict, Bogor Tengah District, Bogor City, where the Kenanga Waste Bank is located. A mixed-methods approach was employed, integrating quantitative and qualitative data collection techniques. Fieldwork was carried out between January and June 2023. A survey was administered to 35 respondents, selected from an initial population of 43 members of the Kenanga Waste Bank. Although the sample size is relatively small, it captures key variations in participation levels and perceptions within the community. While this limitation is acknowledged, potential bias was mitigated by ensuring representation across diverse demographic characteristics, including gender, age, and occupational backgrounds. However, the findings may not be fully generalizable beyond the studied community, and future research should consider expanding the sample to include multiple waste banks across different urban contexts.

The respondents comprised 20 men and 15 women. Most were within the productive age group (33–64 years), while four were in the non-productive category (65–72 years). Older respondents were more actively involved in waste management activities, likely because they had more free time than their younger counterparts. The primary occupations of respondents included small-scale trading for men and homemaking for women. In terms of education, most participants had completed high school or its equivalent. The majority came from low-to-middle-income groups. However, in-depth interviews revealed that household incomes were inconsistent and largely dependent on daily sales from informal trading activities.

The study applied Spearman rank correlation and chi-square tests to analyze relationships between variables. Spearman's rank correlation was chosen because it is a non-parametric test

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suitable for ordinal and non-normally distributed data. It is appropriate for examining associations between participation levels, managerial effectiveness, and perceived benefits—measured using Likert-scale responses. Unlike Pearson's correlation, Spearman's method does not assume linearity, making it more suitable for assessing subjective survey data (Field, 2013). In addition, the chi-square test was used to examine associations between categorical variables (e.g., gender, education, occupation) and levels of community participation, providing insights into potential disparities (Bryman, 2016).

Qualitative data were gathered through in-depth interviews and observations to explore community dynamics, managerial practices, and institutional challenges. Key informants included waste bank administrators; members of Dasawisma PKK (Pemberdayaan dan Kesejahteraan Keluarga, or Family Welfare and Empowerment Program), a grassroots women-led organization focused on family well-being and environmental education; representatives from BASIBA (the city government-affiliated main waste bank); and partner organizations such as Octopus Indonesia and WWF Indonesia. Observations focused on operational procedures, participation behaviours, and rule enforcement practices within the Kenanga Waste Bank. Thematic analysis was conducted following Braun and Clarke's framework, involving coding interview transcripts, identifying recurring themes, and categorizing findings under three key research dimensions: managerial effectiveness, stages of community participation, and socio-environmental impacts (Braun & Clarke, 2006).

The study adhered to ethical research principles, including informed consent, confidentiality, and voluntary participation. All respondents were fully informed about the study's objectives, rights, and data protection protocols. They were also given the option to withdraw at any stage without consequence. To ensure anonymity, personal identifiers were removed, and all data were securely stored following ethical guidelines for social research.

4. Results

4.1. Performance Levels of Kenanga Waste Bank Administrators

Kenanga Waste Bank's operations are characterized by three main programs: (1) a waste-free neighborhood initiative that engages community members, particularly women; (2) a maggot farming project; and (3) educational outreach programs targeting schools and other neighborhoods. Its clients are not limited to individual households but include companies and institutions such as restaurants and schools. The waste bank has partnered with several businesses, including coffee shops and restaurants such as Kopitagram, Kopi Nu Sae, and Klappertaart Huize. Kenanga Waste Bank manages waste collection, which may or may not be pre-sorted by its partner organizations. Operational fees are charged for transportation services provided to these businesses.

As stated earlier, this study aims to evaluate the waste bank's managerial effectiveness, community participation, and socio-environmental benefits. The performance of Kenanga Waste Bank administrators was assessed based on respondents' evaluations using key indicators adapted from Kodoatie. These indicators cover the implementation of operational waste management practices, the institutional framework, financial management, and organizational structure (Kodoatie, 2003).

4.1.1. Operational and Institutional Aspects

The performance of the operational aspect of waste management was assessed based on respondents' perceptions of waste containment, collection, transfer, transportation, processing, and final disposal. Meanwhile, institutional performance was evaluated through respondents'

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views on regulations and sanctions related to participation, members' rights and responsibilities, and the role of administrators in conducting outreach activities. **Table 1** presents respondents' evaluations of Kenanga Waste Bank's management regarding these two aspects.

Table 1. Respondents' Evaluation of Operational Techniques and Institutional Performance in Kenanga Waste Bank Management, 2023

Performance of Waste Bank Management	Frequency (n)	Percentage (%)
Level of the operational and technical implementation		
Low	0	0.0
Moderate	19	54.3
High	16	45.7
Total	35	100
Level of the institutional aspect implementation		
Low	0	0.0
Moderate	7	20.0
High	28	80.0
Total	35	100

The data indicate that 54.3% of respondents rated the implementation of the operational aspect as moderate, while 45.7% considered it high. None of the respondents rated operational performance low, suggesting that Kenanga Waste Bank has established a relatively effective waste management system. However, the majority's placement of operational performance in the moderate category indicates room for improvement.

Several factors may explain the mixed evaluations of operational effectiveness. While most respondents expressed satisfaction with the availability of organic waste bins—deemed adequate for household waste—issues emerged in the provision of containers for inorganic waste. Respondents noted that each household had only one bag, mainly suited for collecting plastic waste. This posed difficulties for those wishing to sort waste more meticulously, such as separating bottle caps, labels, or different types of plastic. As a result, members had to use additional containers, leading to inconsistent sorting practices among participants.

Furthermore, the fact that more than half of the respondents rated operational performance as moderate suggests inefficiencies in the collection, transfer, or processing of waste. Since only 45.7% rated operational implementation as high, this indicates that although the system functions adequately, there is room for optimizing collection schedules, transfer logistics, and final disposal procedures. Constraints such as infrequent pickups or logistical bottlenecks may influence these perceptions.

Regarding institutional performance, 80% of respondents rated it as high, while 20% rated it as moderate, and none rated it as low. These results suggest that Kenanga Waste Bank has established a governance structure that is generally accepted and trusted by its members, especially in terms of rule-setting and engagement.

Despite these positive perceptions, nuances remain in the application of institutional mechanisms. Although regulations on waste sorting and containment exist, enforcement among members is not strict. Instead, administrators adopt a flexible approach, relying primarily on financial incentives rather than punitive measures. Members who deposit properly sorted waste receive higher purchase prices, while those who do not follow sorting guidelines receive lower valuations.

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Strict enforcement of sorting rules is applied only at the resale stage to partner organizations, as properly sorted waste yields higher market value. While this strategy maximizes financial returns for the waste bank, it creates a gap between institutional rules and their enforcement at the community level. Since members are not consistently required to follow strict sorting practices, some may fail to develop lasting waste management habits, undermining the initiative's long-term sustainability.

The disparity between operational and institutional assessments suggests that governance structures and incentive systems effectively sustain participation, and operational challenges—such as inconsistent sorting and limited waste separation infrastructure—may hinder overall efficiency. Moreover, the reliance on market-based incentives implies that community compliance is driven more by financial considerations than environmental awareness or regulatory adherence.

4.1.2. Financial and Organizational Aspects

The financial performance of Kenanga Waste Bank is primarily assessed based on revenue generated from the sale of recyclable materials to partner organizations. The bank's administrators have strategically allocated financial resources, including funding for maintaining partnerships during waste collection visits, while ensuring that revenues consistently exceed expenditures. This approach has enabled the waste bank to maintain short-term financial stability. However, a deeper analysis reveals a fundamental vulnerability in this model due to its heavy reliance on the fluctuating market prices of recyclables. As highlighted by Setiawan and Fithrah, such dependency on unstable market conditions poses significant economic risks that could undermine the long-term sustainability of the waste bank (Setiawan & Fithrah, 2019).

Kenanga Waste Bank would benefit from diversifying its income sources to mitigate this financial uncertainty. Expanding revenue streams could involve establishing waste-based micro-enterprises, such as producing eco-bricks, composting, or recycled-material crafts. These ventures would generate additional income and provide economic opportunities for community members engaged in the bank's operations. Another promising strategy is to broaden partnerships with local businesses by offering specialized waste management services, such as paid waste collection for commercial establishments. This approach would reduce reliance on volatile recyclable market prices while enhancing the bank's financial resilience.

From an organizational standpoint, Kenanga Waste Bank's administrative team has demonstrated strong managerial capabilities, particularly in institutional governance and operational efficiency. Clearly defined roles among administrators and members have facilitated effective internal coordination, ensuring smooth operations. Furthermore, the presence of a well-structured governance framework has significantly contributed to organizational stability, consistent with previous studies indicating that a solid institutional foundation is key to sustaining community-based waste management initiatives (Ariefahnoor et al., 2020; Dhokhikah et al., 2015; Mulyanti & Fachrurozi, 2016).

Despite these strengths, flexibility in enforcing waste-sorting regulations remains an area for improvement. While lenient sorting guidelines may have been introduced to encourage participation, Berampu and Agusta caution that excessive flexibility can compromise recyclables' quality and market value, ultimately affecting the waste bank's economic performance (Berampu & Agusta, 2015). A more structured enforcement approach and enhanced education on sorting practices could help improve material quality and financial outcomes.

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Kenanga Waste Bank has shown competence in managing its financial and organizational structure—an important factor in ensuring day-to-day operational stability. Even so, several strategic improvements are needed to secure its long-term sustainability. These include broadening income sources to reduce reliance on fluctuating recycling markets, enforcing better waste-sorting practices to preserve the quality of collected materials, and ensuring that communities have sufficient tools and support for proper waste separation. With these improvements, Kenanga Waste Bank can further solidify its position as a strong sustainable, community-based waste management example.

4.2. Community Participation in Waste Management

Community participation is a critical factor in evaluating waste banks' performance (Kodoatie, 2003). This study assesses community involvement across four key management stages: planning, decision-making, implementation, and evaluation. **Table 2** presents respondents' participation levels, highlighting engagement variations across different waste bank operations stages.

Table 2. Respondents' Participation Levels in Kenanga Waste Bank, 2023

Level of Participation in Kenanga Waste Bank	Frequency (n)	Percentage (%)
Participation level in the planning stage		
Low	5	14.3
Moderate	17	48.6
High	13	37.1
Total	35	100
Participation level in the decision-making stage		
Low	12	34.3
Moderate	17	48.6
High	6	17.1
Total	35	100
Participation level in the implementation stage		
Low	0	0.0
Moderate	17	48.6
High	18	51.4
Total	35	100
Participation level in the evaluation stage		
Low	0	0.0
Moderate	17	48.6
High	18	51.4
Total	35	100

The data from **Table 2** and qualitative observations reveal distinct patterns of community participation across the four management stages. Engagement is highest in direct, hands-on activities such as implementation and evaluation, while participation in governance-oriented planning and decision-making processes is relatively limited.

During the planning phase, participation was moderate (48.6%), with 37.1% reporting high involvement and 14.3% reporting low. Most respondents contributed by attending meetings, offering ideas, and assisting with program design. While administrators welcomed community input, proactive engagement from members remained limited. Some moderately engaged

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participants noted that administrators still drove most initiatives, indicating a semi-participatory approach in which decision-making authority largely rests with the leadership, potentially limiting community ownership of strategic planning.

The decision-making stage recorded the lowest level of participation, with only 17.1% highly involved, 48.6% moderately engaged, and 34.3% reporting low participation. This sharp decline suggests a centralized governance structure where administrators retain primary control over rule-setting and strategic direction. Limited involvement at this stage may diminish members' sense of ownership and inclusivity, as key operational and financial decisions are made with minimal community input. Interviews with administrators confirmed that decision-making was largely internal, with community feedback acknowledged but not actively integrated into policy-making. This top-down dynamic aligns with findings by Berampu and Agusta, who argue that restricted community agency can hinder long-term engagement and program sustainability (Berampu & Agusta, 2015).

By contrast, the implementation stage demonstrated the highest level of engagement, with 51.4% of respondents reporting high participation and 48.6% moderate. Notably, no participants reported low involvement, indicating a strong community presence in waste collection and recycling activities. This pattern suggests that members are more inclined to participate in visible, action-oriented tasks than abstract governance processes. Observations further indicated that several participants actively sought additional recyclable materials beyond their households, underscoring their commitment to the program's operational success. These findings support previous research suggesting that community-driven waste initiatives thrive when members experience tangible benefits from their involvement.

Participation in the evaluation stage mirrored that of implementation, with 51.4% highly involved and 48.6% moderately engaged. Despite these high levels, interactions between administrators and members remained largely informal. Most communication occurred through online group chats and casual discussions, which allowed convenient information sharing but lacked structured feedback mechanisms. While this method was generally accepted, the absence of regular formal meetings limited deeper engagement in reviewing and improving the program. Researchers noted that many members relied solely on updates provided by administrators, indicating a passive role in evaluating program performance rather than active participation in shaping improvements.

The participation pattern observed in Kenanga Waste Bank aligns with broader findings on community-based waste management, showing higher engagement in direct implementation than governance activities. This trend echoes the work of Mulyanti and Fachrurozi, who found that communities are more responsive to practical involvement than abstract decision-making roles (Mulyanti & Fachrurozi, 2016). However, limited participation in governance and relying on informal communication may challenge long-term sustainability. As Dhokhikah et al. noted, informal approaches may lack accountability and consistency, which are essential for maintaining participation over time (Dhokhikah et al., 2015).

In summary, although Kenanga Waste Bank has succeeded in encouraging community involvement in day-to-day operations, participation in planning and decision-making still needs to be improved. Strengthening this aspect through clearer and more inclusive governance mechanisms is key to fostering long-term ownership. Closing the gap between operational roles and strategic involvement will not only support the sustainability of the program but also reinforce Kenanga Waste Bank's position as a reference for community-based waste management initiatives.

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4.3. The Benefits of Community-Based Waste Management

Implementing community-based waste management through the Kenanga Waste Bank has generated significant benefits for its members and the broader community of RW 01 (Rukun Warga, or neighborhood unit). These benefits span environmental, economic, and social dimensions, aligning with findings by Asteria and Heruman, who emphasize that waste banks function as effective, community-driven solutions for sustainable waste management (Asteria & Heruman, 2016). The data in **Table 3** confirm these advantages, with high levels of perceived economic and social benefits and a somewhat more moderate perception of environmental gains.

Table 3. Respondents' Assessment of Benefits from Kenanga Waste Bank, 2023

Perceived Benefits of Kenanga Waste Bank	Frequency (n)	Percentage (%)
Level of environmental benefits		
Low	0	0.0
Moderate	21	60.0
High	14	40.0
Total	35	100
Level of economic benefits		
Low	0	0.0
Moderate	16	45.7
High	19	54.3
Total	35	100
Level of social benefits		
Low	0	0.0
Moderate	0	0.0
High	35	100
Total	35	100

Kenanga Waste Bank is vital in managing household waste, contributing to cleaner surroundings, and encouraging better waste reduction practices. Sixty percent of respondents rated environmental benefits moderate, while 40% considered them high. The absence of any low ratings suggests a positive overall impact. However, the fact that a majority perceived the environmental benefits as only moderate indicates that improvements are visible but may not yet be fully transformative at the community scale.

This finding is consistent with Suryani, who argues that while waste banks help improve environmental quality, stronger mechanisms are needed to maximize their ecological impact (Suryani, 2014). Although the initiative promotes waste segregation and recycling, the community may perceive these changes as incremental rather than fundamental. Raising awareness of the environmental value of waste bank activities and integrating complementary programs—such as composting, reforestation, and plastic waste reduction campaigns—could further strengthen ecological outcomes.

Economic benefits were widely recognized, with 54.3% of respondents rating them as high and 45.7% as moderate. No respondents rated the economic benefits as low, underscoring the positive financial impact of the waste bank on household well-being. Most participants used their savings from waste deposits to meet essential needs such as purchasing LPG, paying utility bills, or covering emergency expenses. This finding aligns with Prasetyo et al., who

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found that waste banks enhance financial resilience by providing additional income through recycling incentives (Prasetyo et al., 2018).

However, the fact that nearly half of respondents rated the economic benefits as moderate suggests some uneven distribution of financial gains. Several factors may contribute to this variation, including fluctuations in recyclable material prices, differences in members' waste contributions, and levels of participation in collection and resale activities. To enhance financial outcomes, Kenanga Waste Bank could diversify its income streams through waste-based micro-enterprises—such as producing eco-bricks, compost, or crafts from recycled materials. Expanding paid waste collection services for businesses could also help stabilize income and reduce dependency on volatile market conditions.

Among all benefit categories, social benefits received the highest recognition, with 100% of respondents rating them as high. This unanimous response reflects the waste bank's central role in fostering community solidarity, strengthening social networks, and enhancing local knowledge and skills in waste management. Kenanga Waste Bank serves as an environmental and economic platform and a catalyst for community development.

The organization regularly allocates a portion of its revenue to support social programs, including Posyandu (maternal and child health services), Independence Day celebrations, communal clean-up initiatives, and religious events. These activities promote stronger community ties, increase participation in neighborhood improvement, and encourage shared responsibility for environmental stewardship.

The significant social impact observed at Kenanga Waste Bank aligns with Ramadani, who found that waste banks play a critical role in building social cohesion and community capacity (Ramadani, 2021). Although environmental and economic benefits are acknowledged, the social dimension is the most substantial. This suggests that the initiative has successfully established a strong foundation of community participation that can be leveraged to enhance other impact areas further.

Kenanga Waste Bank should consider expanding participation beyond its current member base to maximize its broader impact. Increasing outreach through education campaigns on sustainable waste management, offering incentives for early engagement, and integrating the waste bank into formal municipal waste policies could extend environmental and financial benefits to a wider audience. Formalizing a participatory governance structure that includes active member involvement in planning and decision-making could also support the initiative's long-term sustainability. Strengthening institutional capacity, securing government subsidies, building partnerships with private enterprises, and innovating new waste-based revenue models will further consolidate Kenanga Waste Bank's position as a leading example of sustainable, community-based waste management.

5. Discussion

5.1. Characteristics of Respondents and Their Correlation to Community Participation

This study examined five characteristics of Kenanga Waste Bank members—age, gender, education level, occupation, and income level—to assess their relationship with community participation across four stages of management: planning, decision-making, implementation, and evaluation. Age, education, and income were analyzed using Spearman's rank correlation, while gender and occupation were analyzed using the chi-square test.

Table 4 presents the results of the correlation analysis, highlighting the relationship between respondents' characteristics and their level of participation in each management stage. The results reveal varying degrees of influence, with education emerging as the most significant

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predictor of participation. Other characteristics—including age, income, gender, and occupation—did not show statistically significant correlations across the four stages.

Table 4. Correlation Analysis Between Respondents' Characteristics and Levels of Community Participation in Kenanga Waste Bank, 2023

Characteristics of Respondents	Level of Community Participation							
	Planning		Decision-Making		Implementation		Evaluation	
	Correlation Coefficient	Significance (Sig.)	Correlation Coefficient	Significance (Sig.)	Correlation Coefficient	Significance (Sig)	Correlation Coefficient	Significance (Sig)
Age	0.174	0.316	-0.085	0.626	-0.315	0.65	-0.033	0.851
Sex	3.316	0.190	5.496	0.064	2.440	0.118	0.238	0.625
Education	0.516**	0.002	0.296	0.085	0.110	0.528	0.066	0.705
Occupation	7.347	0.290	10.342	0.111	1.844	0.605	2.117	0.549
Income	0.096	0.583	0.147	0.400	0.256	0.138	0.036	0.837

Note: ** indicates significance at the 99% confidence level.

This analysis's only statistically significant correlation is between education level and participation in the planning stage, with a correlation coefficient of 0.516 and a significance level of 0.002 ($p < 0.05$). This indicates a moderate positive relationship, suggesting that individuals with higher levels of education are more likely to be involved in structured planning processes. The 99% confidence level further reinforces the reliability of this finding.

This result aligns with previous research (Mulyanti & Fachrurozi, 2016), highlighting that higher educational attainment enhances awareness of environmental issues, civic engagement, and strategic thinking in community initiatives. Educated members are also more likely to possess problem-solving skills and a stronger understanding of policymaking, enabling them to contribute meaningfully to planning processes.

However, the absence of significant correlations between education and the other three stages—decision-making, implementation, and evaluation—suggests that while education supports early-stage involvement, it does not necessarily lead to sustained participation throughout the full management cycle. This implies that other factors—such as institutional structure, peer influence, or financial incentives—may play a more influential role beyond the planning phase.

No significant correlations were found between age, gender, or income and participation in any of the four stages, indicating that these demographic variables do not strongly influence involvement. Although occupation showed higher correlation coefficients in decision-making (10.342) and implementation (1.844), the associated significance values (0.111 and 0.605) indicate that these results are not statistically meaningful. While it is possible that certain occupations—such as educators or environmental professionals—may be more engaged in decision-making and operational activities, these trends require further investigation.

Overall, the findings suggest that education is the strongest predictor of participation in waste bank planning, emphasizing the role of knowledge-based engagement in community-driven programs. The lack of significant relationships with other characteristics indicates the importance of external motivators—such as institutional support, community leadership, and reward systems—in sustaining participation. To promote engagement across all stages, Kenanga Waste Bank should consider expanding environmental education programs, fostering participatory decision-making structures, and offering long-term incentives. These strategies

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can strengthen member involvement in planning, governance, and evaluation, ensuring the continued sustainability of the initiative.

5.2. Managerial Performance and Its Relationship to Community Participation

Managerial performance was assessed using four indicators: the operational aspects of waste management, institutional aspects, financial aspects, and organizational aspects. Spearman's rank correlation analysis was applied to the first two indicators, while qualitative analysis was employed to evaluate the financial and organizational components.

The correlation analysis presented in **Table 5** offers valuable insights into the relationship between waste management performance and levels of community participation across various stages. Specifically, the findings highlight the differing impacts of operational and institutional practices on community engagement in planning, decision-making, implementation, and evaluation.

Table 5. Correlation Analysis Between Managerial Performance and Levels of Community Participation in Kenanga Waste Bank, 2023

Managerial Performance	Level of Community Participation							
	Planning		Decision-Making		Implementation		Evaluation	
	Correlation Coefficient	Significance (Sig.)	Correlation Coefficient	Significance (Sig.)	Correlation Coefficient	Significance (Sig)	Correlation Coefficient	Significance (Sig)
Operational aspect of waste management	0.308	0.072	0.310	0.070	0.295	0.086	0.208	0.231
Institutional aspect of waste management	0.343*	0.044	0.154	0.378	0.036	0.837	-0.096	0.582

Note: * indicates significance at the 95% confidence level.

The correlation results reveal critical insights into the relationship between managerial performance—both operational and institutional—and community participation in waste bank governance. While institutional factors significantly influence participation during the planning stage, operational performance does not demonstrate a statistically significant correlation with engagement at any phase. These findings suggest deeper structural barriers to sustained participation and offer implications for designing more inclusive, community-driven waste management models.

The operational aspect of waste management—encompassing technical execution such as waste collection, sorting, transportation, and processing—did not significantly correlate with participation at any stage. Even the strongest correlation in decision-making ($r = 0.310$, $p = 0.070$) falls short of statistical significance. This disconnect suggests that operational efficiency alone cannot encourage deeper community engagement.

Several factors may explain this gap. Community participation is not solely driven by the quality of services but also by the perception of empowerment. Members are more likely to engage actively when they perceive decision-making processes as inclusive rather than administrative. In many cases, waste banks function primarily as service providers rather than participatory governance platforms, leading to transactional participation (e.g., depositing waste) rather than transformational involvement (e.g., co-governance and innovation). Consequently, while community members may rely on administrators for operational execution, they may not feel a sense of ownership over these processes.

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If administrators make operational decisions—such as collection schedules, pricing models, or sorting protocols—unilaterally, members are likely to remain passive participants. To move beyond passive engagement, waste bank policy frameworks must be reoriented to treat waste banks as participatory governance institutions. Local authorities and waste bank managers should ensure community representation in operational decision-making, allowing members to co-design services, influence pricing structures, and contribute to innovation in waste handling.

Institutional performance emerges as the only variable significantly correlated with participation—specifically at the planning stage ($r = 0.343$, $p = 0.044$). However, this influence diminishes in subsequent stages, with weak or negative correlations observed in decision-making, implementation, and evaluation. This pattern raises concerns about the sustainability of participatory governance within waste banks.

The significant correlation in planning suggests that well-structured governance mechanisms—such as inclusive policymaking, clearly communicated regulations, and socialization efforts—encourage initial participation. However, the sharp decline in influence beyond the planning stage indicates that these mechanisms are not effectively embedded throughout the governance cycle. If planning is inclusive but subsequent stages remain administrator-driven, members may perceive that their early contributions have little long-term impact. Additionally, the absence of structured feedback loops may further weaken engagement, as community members are excluded from decision-making processes after initial consultations.

To maintain participation beyond the planning phase, governance models must move beyond consultation to incorporate co-decision-making. Policies should mandate the election of community representatives to waste bank governance boards, with shared authority over financial and operational decisions. Moreover, institutionalized community forums should be conducted regularly—not just during planning—to sustain participatory momentum. By embedding participation in all phases of governance, waste banks can build more resilient, inclusive models that reflect and respond to the needs of their communities.

5.3. Community Participation and Its Correlation to Waste Bank Benefits

The benefits derived from Kenanga Waste Bank activities were analyzed about community participation. These benefits were categorized into those received by members and those experienced by the broader RW (Rukun Warga, or neighborhood unit) 01 community. **Table 6** presents varying degrees of association between participation levels and perceived benefits across different stages of involvement. However, none of the correlations reached statistical significance at the conventional threshold ($p < 0.05$).

Table 6. Correlation Analysis Between Community Participation Levels and Benefits of Kenanga Waste Bank, 2023

Level of Community Participation	Benefits of Waste Bank	
	Correlation Coefficient	Significance (Sig.)
Planning stage	0.323	0.059
Decision-making stage	0.290	0.091
Implementation stage	0.145	0.407
Evaluation stage	0.018	0.918

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The analysis in **Table 6** reveals a fundamental contradiction in the participatory dynamics of Kenanga Waste Bank. While participation during the planning and decision-making stages shows some association with perceived benefits, engagement in the implementation and evaluation phases appears largely disconnected from tangible advantages. This pattern raises critical questions about participation's structural design and the barriers preventing it from translating into economic and social empowerment.

Participation in the planning stage shows the highest correlation with perceived benefits ($r = 0.323$, $p = 0.059$), approaching statistical significance. This suggests that individuals involved in early-stage discussions are more likely to recognize benefits from the waste bank's operations. However, lacking statistical robustness implies that consultative involvement alone may not lead to meaningful long-term outcomes. Members may contribute ideas during planning, but their ability to influence resource allocation and operational decisions remains limited.

A similar trend is seen in the decision-making stage ($r = 0.290$, $p = 0.091$), suggesting that participation in governance structures does not necessarily yield material or financial rewards. This may reflect that such forums function more as administrative formalities than platforms for equitable decision-making or benefit-sharing.

As participation shifts to implementation, the correlation weakens further ($r = 0.145$, $p = 0.407$). This indicates that involvement in waste collection, sorting, and recycling does not inherently result in greater perceived benefits. When financial incentives or structured rewards do not accompany operational contributions, participation may resemble unpaid labor rather than meaningful economic engagement. Without revenue-sharing or productivity-based compensation, community members will likely remain functionally involved but not economically empowered.

The evaluation stage reveals the most significant disconnect, with a near-zero correlation ($r = 0.018$, $p = 0.918$). This suggests that involvement in monitoring and feedback processes has virtually no relationship to perceived benefits. If evaluation mechanisms are informal, unstructured, or symbolic in nature—lacking the capacity to shape policy or resource allocation—community members may view their contributions as inconsequential. The absence of accountability structures only deepens this detachment, making evaluation a procedural requirement rather than a tool for shared learning and adaptive governance.

These findings point to structural limitations within the participatory model. The lack of statistically significant correlations suggests that key decisions around revenue allocation, resource management, and institutional priorities remain concentrated among administrators. Participation risks becoming symbolic rather than substantive without formal mechanisms for redistributing benefits or sharing governance authority. Community members may be engaged in name but excluded from meaningful influence.

Furthermore, the absence of financial incentives for sustained engagement undermines long-term participation. When involvement does not translate into economic returns, capacity-building opportunities, or upward mobility, members are unlikely to remain active beyond obligatory interactions. The failure to link participation with concrete outcomes ultimately limits the potential of community-based waste management to drive structural change.

A deeper issue lies in the operational philosophy of the waste bank, which appears to prioritize efficiency over empowerment. The model risks reproducing extractive dynamics if participation is confined to administrative consultation and manual labor, without pathways to leadership or shared ownership. Instead of fostering collective stewardship, the system

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reinforces a top-down approach where administrators make decisions and community members execute them.

To address this disconnect, participation must be redefined not as voluntary compliance but as a mechanism for economic and political inclusion. Waste banks should be restructured into community-owned cooperatives where members hold decision-making authority and equity stakes. This would ensure that engagement directly influences financial and governance outcomes. Without such reform, participation will remain performative and fail to empower those it intends to serve.

Implementing legally mandated participatory budgeting processes could further democratize governance. Rather than allowing administrators to determine financial allocations unilaterally, members should have formal voting power over budgetary decisions. Profit-sharing schemes based on participation intensity would directly link involvement and financial reward, incentivizing sustained engagement. Moreover, participation should extend beyond operational tasks, including structured training in environmental entrepreneurship, cooperative governance, and circular economy innovation. By linking participation to leadership, income generation, and skill development, waste banks can evolve from labor-dependent operations to engines of collective prosperity.

In conclusion, the results presented in **Table 6** underscore the urgent need to reconceptualize participation in community-based waste management. Unless engagement leads to economic security, social mobility, and governance influence, it will remain an obligation rather than an opportunity. The sustainability of waste banks ultimately hinges on their ability to transform passive compliance into active empowerment. Without this shift, they risk replicating the power imbalances they aim to dismantle—leaving community members engaged in name but excluded in practice.

6. Conclusion

The Kenanga Waste Bank has demonstrated success as a community-driven waste management initiative, yielding environmental, economic, and social benefits. Its institutional governance, operational effectiveness, and high levels of community participation during the implementation and evaluation stages contribute significantly to its sustainability. Members have benefited from economic incentives, while broader environmental improvements have supported local waste reduction efforts. However, lower levels of engagement in the planning and decision-making stages underscore the need for a more participatory governance structure to strengthen long-term community involvement.

Theoretically, this study contributes to environmental governance and participatory development discourse by reinforcing that community participation is driven more by institutional frameworks and perceived benefits than by technical efficiency alone. The findings support participatory development models, emphasizing that education is critical in fostering early-stage engagement. This study also aligns with theoretical perspectives on community-based environmental management, highlighting that the sustainability of waste banks depends on institutional robustness and structured incentives.

From a policy standpoint, the findings suggest that enhancing institutional support, promoting community-led decision-making processes, and incorporating financial incentives for early engagement are crucial for ensuring the long-term viability of waste banks. Policymakers should consider integrating waste banks into formal waste management systems by providing subsidies, offering incentives for early-stage participation, and expanding technical training programs to improve administrative capacity.

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The Kenanga Waste Bank model has strong potential for replication in urban and rural settings across Indonesia, provided that challenges related to financial sustainability, participatory governance, and operational efficiency are effectively addressed. Its success in Bogor City demonstrates that community-based waste management can be a viable response to urban waste accumulation. However, scaling this model requires adaptation to varying socioeconomic and institutional contexts, ensuring that local communities receive adequate structural support to maintain long-term engagement.

A crucial factor for scalability is the enhancement of participatory governance, particularly during the planning and decision-making stages. This study highlights that greater community involvement in early-stage decision-making correlates with more structured and effective waste management outcomes. Replicating the Kenanga model elsewhere necessitates the establishment of engagement mechanisms such as community consultations, participatory meetings, and formal feedback loops to foster a stronger sense of ownership among members. Without these frameworks, waste banks may struggle with low engagement and ineffective sorting practices.

Financial sustainability remains another critical challenge, as dependence on revenue from recyclable sales alone is insufficient amid market fluctuations. Expanding partnerships with local businesses, securing government subsidies, and supporting community-based enterprises can contribute to greater financial resilience. Developing waste-based micro-enterprises—such as upcycling workshops, composting initiatives, and community-run sorting services—could diversify income streams and further enhance economic benefits for participants.

Another key aspect of scaling up waste bank models is integrating them into municipal waste management systems to ensure institutional stability and long-term support. Local governments can play a pivotal role by offering regulatory incentives, providing technical assistance, and facilitating infrastructure development, such as waste-sorting stations or centralized collection hubs. These measures would support a more structured and efficient waste management ecosystem, reducing dependence on landfills and promoting a circular waste economy. Addressing these governance, financial, and institutional challenges is essential to positioning Kenanga Waste Bank as a scalable and adaptable model for sustainable, community-based waste management that empowers communities and promotes environmental stewardship.

Nevertheless, while this study offers valuable theoretical, policy, and practical insights, some limitations must be acknowledged. First, the relatively small sample size (35 respondents) limits the generalizability of the findings beyond the Kenanga Waste Bank context. Second, using self-reported data from surveys and interviews may introduce response biases, potentially affecting the accuracy of reported participation levels and perceived benefits. Future research should involve larger sample sizes across multiple waste bank models and incorporate longitudinal approaches to assess better the long-term effects of community participation and managerial strategies on waste bank sustainability.

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8. Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest regarding this article's research, authorship, and/or publication.

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