“Economic outcomes and community participation in rural waste bank initiatives: A study from Indonesia”

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ARTICLE INFO	Ernoiz Antriyandarti, Muhammad Hendri Nuryadi, Wahyu Noviansyah, Refa’ul Khairiyakh and Nimas Suci Kusuma Melati (2025). Economic outcomes and community participation in rural waste bank initiatives: A study from Indonesia. *Problems and Perspectives in Management*, *23*(4), 620-634. doi:10.21511/ppm.23(4).2025.42
DOI	http://dx.doi.org/10.21511/ppm.23(4).2025.42
RELEASED ON	Tuesday, 23 December 2025
RECEIVED ON	Friday, 29 August 2025
ACCEPTED ON	Thursday, 11 December 2025

JOURNAL	"Problems and Perspectives in Management"
ISSN PRINT	1727-7051
ISSN ONLINE	1810-5467
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
52	0	4

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Type of the article: Research Article

Received on: 29th of August, 2025
Accepted on: 11th of December, 2025
Published on: 23rd of December, 2025

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Conflict of interest statement:
Author(s) reported no conflict of interest

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ECONOMIC OUTCOMES AND COMMUNITY PARTICIPATION IN RURAL WASTE BANK INITIATIVES: A STUDY FROM INDONESIA

Abstract

Waste banks have emerged as a community-driven strategy that encourages households to sort and trade recyclable waste, generating economic value while reducing environmental burdens. This study examines the economic contribution of waste banks in rural areas and evaluates the level of community participation in their management. Data were collected through an online survey conducted from April to May 2024, involving 118 rural decision-makers, village heads, officials, village-owned enterprises' (BUMDes) directors, and members of the village consultative body across Indonesia. Respondents represented from Java (34%), Sumatra (33%), Sulawesi (13%), Bali and Nusa Tenggara (7%), Kalimantan (5%), and Papua (3%), providing broad geographic coverage. A logit model was used to identify determinants of economic impact. Results show that routine waste bank operations, combined with training or socialization programs, significantly enhance economic benefits at the 1% level. Community participation in waste collection also makes a positive contribution. Overall, 70.3% of respondents reported improved village economic conditions, and 66.1% observed increased BUMDes revenue from waste bank initiatives. Participation analysis using Arnstein's ladder reveals that most residents remain at the consultation stage, with limited decision-making power. Strengthening community empowerment and expanding capacity-building programs are, therefore, essential to maximize the social and economic potential of rural waste banks.

Keywords waste, recycling, economy, participation, empowerment

JEL Classification Q53, R11, O18

INTRODUCTION

Waste has increased globally in line with rapid urbanization, rising consumption levels, and changing lifestyles. The World Bank (2018) estimates that global waste production will increase from 2.01 billion tons in 2016 to 3.4 billion tons in 2050. Neglected waste does more than pile up – over time, it seeps into the soil, pollutes rivers and canals, and contributes to worsening air quality. Another issue often overlooked is methane, a potent greenhouse gas produced when organic waste decomposes without proper processing (Mor & Ravindra, 2023). This situation is more pronounced in developing countries, where waste-handling systems are still being established, and local initiatives often operate with limited resources and institutional support (Banerjee et al., 2023). As a result, global attention is increasingly focused on sustainable practices, such as the 3R (reduce, reuse, and recycle) approach and community-based waste management programs that offer low-cost, participatory solutions.

http://dx.doi.org/10.21511/ppm.23(4).2025.42

Waste management remains a pressing challenge in Indonesia. Data from the National Waste Management Information System (SIPSN, 2024) indicate that, in 2024, the country generated approximately 27.74 million tons of waste, yet only about 10.8 million tons were handled correctly. The rest continues to accumulate in landfills, creating persistent odor problems, increasing methane emissions, and posing risks to both environmental quality and public health (Zahrah et al., 2024).

Interestingly, much of what ends up in these sites, such as plastic, paper, metal, and other materials, still carries economic value when treated and sorted effectively (Sapri, 2023). Waste banks have emerged from this opportunity, functioning not only as a recycling mechanism but also as a grassroots economic model that encourages communities to view waste as a resource. By 2024, 25,540 waste banks were operating across the country, reflecting considerable momentum and policy support for community-driven waste initiatives (Indonesian Ministry of Environment and Forestry, 2025). However, the performance of waste banks in rural regions varies widely. In many cases, operational routines are inconsistent, leadership capacity is limited, and ongoing participation from residents is difficult to sustain. While previous studies tend to highlight the environmental side of waste bank activities, less attention has been given to their economic contributions and to the social factors shaping participation in rural settings. This gap raises an important question: to what extent do waste banks strengthen local economies, and what drives or hinders community engagement in these systems? Addressing this gap is crucial for developing effective community-based waste management strategies and promoting sustainable rural development.

1. LITERATURE REVIEW AND HYPOTHESES

Waste management remains one of the most pressing environmental issues in developing countries, particularly in rural areas. In Indonesian villages, this issue is especially challenging due to the lack of infrastructure, low public awareness, and the absence of organized systems. Waste is often burned or discarded carelessly, causing environmental pollution and posing significant health risks. Rapid population growth and increased consumption have led to a substantial rise in solid waste generation, which negatively impacts land use, public health, and ecological sustainability (Wikurendra et al., 2024). Improper waste disposal is directly linked to soil and water contamination, the spread of disease, and increased greenhouse gas emissions, especially in areas where burning and open dumping are standard practices (Kaza et al., 2018; Wilson et al., 2015). In rural areas of Indonesia, inadequate waste management persists, leading to significant environmental and public health issues. Many communities still rely on unsustainable disposal methods, such as open burning and indiscriminate dumping, which lead to air pollution, water contamination, and disease transmission (Akeju & Omotoso, 2023; Jakhar et al., 2023). By 2023, Indonesia's annual waste production had reached approximately 40 million tons, with food waste alone accounting for 39.62% (Indonesian Ministry of Environment and Forestry, 2023). Despite these concerning figures, awareness and education on the dangers of poor waste management remain limited in rural communities.

A promising solution to this growing problem is the implementation of waste banks, community-driven systems designed to reduce waste, promote recycling, and offer economic incentives through the collection, sorting, and sale of recyclables. As of 2024, approximately 17,000 waste banks had been established across Indonesia (Indonesian Ministry of Environment and Forestry, 2024). However, their effectiveness remains uncertain due to ongoing challenges related to community participation, limited government support, and weak institutional management (Coordinating Ministry for Maritime Affairs and Investment, 2021). Waste banks, as community-based models, have emerged as innovative approaches that align environmental goals with economic incentives. These systems operate by collecting sorted waste from households and providing either monetary or in-kind compensation, thereby promoting recycling behaviors and reducing the volume of waste di-

rected to landfills (Tomic & Schneider, 2020). Community-led initiatives, such as waste banks, can be cost-effective, adaptable, and socially empowering (Dushkova & Ivlieva, 2024). While these programs have gained popularity in urban and peri-urban areas in Indonesia (Dahlan et al., 2024), their effectiveness and implementation in rural contexts remain underexplored.

Waste banks that adopt a savings-based model encourage communities to sort and deposit inorganic waste, which can then be converted into financial savings. These systems not only help reduce household waste generation but also create local economic opportunities, increase environmental awareness, and support the sustainable independence of rural villages. The success of waste bank programs is closely linked to the quality and extent of community participation. Active engagement in sorting, collecting, and managing waste is essential not just for operational efficiency but also for the long-term sustainability of the program (Rachman et al., 2021). Arnstein's (1969) ladder of participation remains a relevant theoretical framework in this context, offering a spectrum of engagement from passive information-sharing to complete citizen control. In most rural waste bank programs, community members tend to occupy the lower rungs of this ladder, where they are consulted but not empowered, thereby limiting their ability to influence or shape program outcomes (Masruroh et al., 2022).

In addition to their environmental benefits, waste banks also present opportunities for local economic development. They provide households with additional income and contribute to the growth of village-owned enterprises such as BUMDes (village-owned enterprises). However, the extent of their economic impact depends on several key factors, including the frequency of operational activities, the degree of community engagement, institutional backing, and the presence of structured capacity-building programs (Budiyarto et al., 2024). Programs that incorporate regular training, educational campaigns, and financial incentives tend to deliver more robust economic outcomes (Kibria et al., 2023). Despite their potential, many waste banks face considerable challenges, including inconsistent funding, limited technical expertise, and insufficient government support.

Although previous research has addressed the environmental and social dimensions of waste banks (Harahap et al., 2024; Budiyarto et al., 2024), few studies have rigorously examined their economic contributions at the village level using empirical data at the national scale. Furthermore, the relationship between community participation, as analyzed through frameworks such as Arnstein's ladder, and economic outcomes remains under-theorized in the current literature. Most prior studies are descriptive or focused on specific case studies, lacking a systematic exploration of how institutional and participatory variables influence the success of these programs. This study aims to address this gap by examining the determinants of the economic impact of waste banks, utilizing data from a national sample of village policymakers. It also investigates how varying levels of community participation relate to broader sustainability strategies. By combining a logit model with participation theory, the analysis contributes a more nuanced understanding of how waste banks can operate as both environmental solutions and economic engines in rural Indonesia.

Several interrelated factors influence the ability of waste banks to generate economic benefits. One of the most important is operational consistency. Waste banks that regularly carry out collection, sorting, and selling activities are more likely to produce reliable income streams for both individuals and institutions, such as BUMDes (Fitria, 2024). Regular operations foster community motivation, as participants begin to perceive tangible and recurring benefits. Another critical factor is the level of community participation. When more community members are actively involved in sorting and collecting recyclable materials, the waste bank can process a larger and higher-quality volume of recyclables, which in turn increases potential revenue (Lawrence et al., 2020). However, participation alone does not equate to empowerment. In many rural settings, residents often contribute to operational tasks without being involved in decision-making processes (Litvaj et al., 2022), thereby limiting opportunities for innovation and shared ownership.

Training and education are equally vital. Access to knowledge – whether it pertains to proper

http://dx.doi.org/10.21511/ppm.23(4).2025.42

waste sorting, entrepreneurship in recycling, or financial management – enables individuals and communities to extract greater value from waste. Research indicates that capacity-building efforts lead to more efficient waste bank operations and higher income generation (Sukapti et al., 2024). Moreover, institutional support from local actors, such as village governments and BUMDes, plays a crucial role in determining the scale and sustainability of waste banks. Institutional support not only ensures access to funding but also enhances the legitimacy, infrastructure, and policy integration required for long-term success (Setiyaningrum et al., 2022). Finally, access to stable and profitable markets for recyclable materials is a crucial determinant of economic outcomes. Some communities have begun forming networks and partnerships to strengthen their market position, increase bargaining power, and establish more stable income streams.

In summary, previous studies demonstrate the growing importance of waste banks in improving environmental outcomes and community empowerment in rural settings. However, limited empirical research has examined their economic impacts and the role of community participation through a systematic analytical approach.

Therefore, this study aims to fill this gap by examining the determinants of the economic outcomes of rural waste banks and the impact of community participation levels. The paper offers the following hypotheses:

H1: Regular waste bank activities positively affect the economic contribution of waste banks to the village economy.

H2: Socialization and training programs have a positive influence on the economic performance of waste banks.

H3: Regular waste bank activities increase community participation in waste bank operations.

H4: Higher environmental awareness increases the likelihood of active community participation in waste bank management.

2. METHODS

Primary data were collected through a structured questionnaire survey conducted between April and May 2024, targeting 118 village representatives participating in the Brilliant Village Program, a flagship village empowerment initiative by Bank Rakyat Indonesia (BRI), one of the largest state-owned enterprises (SOEs) in Indonesia. The program specifically focuses on strengthening village-level economic resilience through sustainable innovations, including the establishment and operation of waste banks. The data collection procedure followed a systematic process consisting of:

1) identification of all villages participating in BRI's waste bank initiative;

2) verification of active participation status as of April 2024;

3) distribution of structured questionnaires through official village communication channels;

4) response confirmation and data screening; and

5) coding and preparation for quantitative and qualitative analysis.

Notably, the sample represents the entire population of villages actively engaged in BRI's waste bank empowerment initiatives at the time of the study, making this a census-style purposive sample rather than a random subset. While the absolute number of respondents may appear limited, this is due to the specific and bounded nature of the research population – i.e., all operational waste banks officially supported by BRI under this program. As such, findings are internally valid within the scope of BRI's intervention model and contribute significantly to the body of knowledge on the role of SOEs in rural sustainability programs. No previously published datasets were reused in this study, and all information was collected specifically for this analysis.

To ensure geographic and contextual diversity, participants were selected from rural villages across multiple provinces, capturing variations in demo-

graphic, economic, and environmental conditions. Respondents included village heads, BUMDes (village-owned enterprises) directors, village officials, and members of the consultative body. The selection and formulation of questions were based on theoretical constructs from participation theory, rural development literature, and waste management frameworks. The complete questionnaire, variable coding scheme, and supporting materials are provided in Supplementary File S1, accessible via Zenodo (Antriyandarti, 2025).

The questionnaire was developed specifically for this study, based on a comprehensive review of prior research and the formulated research objectives. It was structured into thematic sections, covering:

1) demographic characteristics of respondents;

2) levels of participation in waste bank activities;

3) perceived environmental and economic impacts; and

4) management challenges.

Questions were formulated to be clear and accessible for rural respondents, combining closed-ended questions for quantitative analysis and open-ended questions to gain qualitative insights.

This analysis involving human participants was conducted in accordance with ethical standards. Participation was entirely voluntary, and all participants were informed about the purpose of the study. Informed consent was obtained before data collection, ensuring that participants understood their rights and the intended use of the information provided. Anonymity and confidentiality were maintained throughout the research process, with no personal identifiers collected. Impartiality was ensured by using neutral phrasing in survey and interview questions and by avoiding any leading language. Since the study posed minimal risk to participants and maintained complete anonymity, formal approval from an ethics committee was not required according to the institutional research guidelines. Nevertheless, we adhered to international ethical norms for social science research involving human subjects.

A logit regression model was used to analyze the quantitative data. This model was chosen due to its suitability for examining the relationship between categorical dependent variables and multiple independent variables (Ciu & Oetama, 2020). The logit model is formulated as Equation (1).

$$\ln\left(\frac{Yi}{1-Yi}\right) = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 LENGHT + \varepsilon_i, \quad (1)$$

where (Yi = 1) – The waste bank contributes to the overall village economy; D_1 – There are routine waste bank activities in the village environment; D_2 – Public awareness regarding the dangers of untreated waste; D_3 – There is socialization or waste bank training; D_4 – Villagers participate in waste bank collection activities; *LENGTH* – Length of establishment of the waste bank (year); $\beta_1, \beta_2, \ldots, \beta_k$ – Coefficient.

This study also used Arnstein's ladder of participation (Arnstein, 1969) as a framework to assess the level of community involvement in waste bank management. The ladder outlines different degrees of participation, ranging from non-participation to complete citizen control, and was applied to analyze insights gathered from interviews and field observations. The qualitative data were then coded and examined to uncover key factors that either support or hinder active community participation in waste bank activities. Additionally, the analysis examined how varying levels of engagement affect the economic well-being of the participating villages. Qualitative codes and thematic categories were developed inductively and validated through intercoder agreement checks.

Respondents were selected using purposive sampling, and efforts were made to maintain geographic diversity. All participants provided informed consent, and confidentiality and anonymity were strictly upheld throughout the data collection process. The study involved 118 respondents comprising village heads, village officials, directors of village-owned enterprises (BUMDes), and members of the village consultative bodies.

http://dx.doi.org/10.21511/ppm.23(4).2025.42

3. RESULTS

There were 118 respondents from villages in various regions in Indonesia. Based on regional distribution, 34% of respondents came from Java, followed by Sumatra (33%), Sulawesi (13%), Bali and Nusa Tenggara (7%), Kalimantan (5%), and Papua (3%). The respondents were village policymakers, including village heads, village officials, BUMDes directors, and members of village consultative bodies. On average, respondents had 4.8 years of experience in village administration, with a minimum tenure of 0.5 years and a maximum of 16 years. All respondents were from villages participating in the New Brilliant Village 2024 program (Bank Rakyat Indonesia, 2024).

More than 83 respondents indicated that people in their villages typically dispose of waste properly in designated bins or waste collection areas. However, some respondents noted that particular residents continued to dispose of garbage around their homes. Additionally, 75% reported that their communities practiced disciplined waste disposal, and 62% stated that village authorities had initiated routine waste management activities. Despite these efforts, only 51% of respondents reported that their village had dedicated waste management facilities.

Of the total respondents, 43% stated that waste banks in their villages operated regularly. The types of waste commonly accepted included paper, newspapers, cardboard, plastics, glass bottles, PET bottles, and used cooking oil. Regarding digital adoption, 13 respondents indicated that waste bank operations had incorporated digital technology to support routine collection and record-keeping activities. Waste banks applied varying fee structures depending on village policy. Monthly membership fees ranged from IDR 10,000 to IDR 30,000, although several villages did not charge any operational fees (Table 1). Waste bank income was primarily generated from sales of recyclable materials.

The study shows that a proportion of waste bank users are willing to invest financially to support waste bank operations. Specifically, 58 out of 118 customers reported willingness to pay higher waste bank management fees. Most respondents indicated that community participation primarily occurs through household waste sorting and delivering recyclable materials to the waste bank. However, participation levels were not evenly distributed across community groups. Respondents consisted mainly of village leaders and managers responsible for waste bank operations. The majority (Table 2) were village heads or other village officials (52.5%) and BUMDes directors (35.6%), demonstrating strong institutional support but also indicating limited participation from general households.

According to the survey, village officials who had been in office for more than five years were generally more active in supporting waste-bank programs. Their experience in dealing with village issues helps them understand how to encourage community involvement. Participation varied across different areas; larger and smaller villages exhibited distinct patterns of engagement. Smaller villages demonstrated stronger collective engagement, while larger villages

Table 1. Public opinion on the amount of waste bank fees

Statement	Enough (respondent)	Pricey (respondent)	Cheap (respondent)
What is the community's opinion on the fee amount?	91	9	18

Table 2. Distribution of respondent position

Position in the village	Total of respondents (%)
Director of BUMDes (BUMDes management)	35.6
Waste bank committee	4.3
Village head	52.5
Village Facilitator (from Kemedes PDTT RI)	1.7
Representatives of the Village Consultative Body (BPD) or Community Leaders	2.5
Representatives of business groups (clusters)	1.7
Young business actors	1.7

encountered greater difficulty mobilizing residents, possibly due to greater social distance and coordination challenges.

Community engagement in depositing waste was not evenly distributed. From the 118 villages surveyed, only 54 reported active participation, while 64 villages had limited or no involvement. In practice, not everyone was able to take part in waste-bank activities. Several respondents mentioned that their village waste bank was not operating actively, while others struggled simply because there were no convenient waste-disposal points nearby, as reported by 53 respondents. There were also cases where residents felt the officers were not very responsive or that the pricing system was not attractive enough, which reduced their motivation to participate. As a result, participation was almost evenly split: 51% of respondents reported involvement in waste-bank efforts, while 49% remained uninvolved. Certain groups were more involved than others. Homemakers often used waste banks to help increase household income, while village youth volunteered in education and awareness programs. Meanwhile, participation among other community groups remained modest.

Despite these variations, many village officials believed that waste banks hold strong potential to improve local economic conditions (Table 3). They identified benefits, including savings from recycling and opportunities to produce products from waste. However, not all villages experienced these benefits. Forty respondents reported that waste banks had not increased BUMDes' revenue, indicating uneven economic outcomes.

The logistic regression analysis was conducted to identify factors influencing the economic contribution of waste banks in rural areas, using 118 observations (Table 4). The results show that routine operational activity (D1) is the strongest predictor, with an odds ratio of 10.38. This indicates that waste banks that collect waste regularly may generate higher economic benefits. Socialization and training activities (D3) also show a significant positive effect, with an odds ratio of 4.57. This finding suggests that public education and outreach play a crucial role in enhancing the performance of waste banks.

On the other hand, public awareness of waste-related risks (D2) and the age of waste banks (LENGTH) do not show a significant effect. This fact means that simply knowing about the dangers of waste or having been in operation for a long time does not automatically result in better economic outcomes. Community participation (D4) shows a positive trend (odds ratio 2.97, at the 90% confidence level), suggesting that increasing public involvement can support economic sustainability, although its effect is not as strong as operational consistency and socialization efforts.

Table 3. Community perception of the benefits of participation in waste bank activities

No.	Statement	Yes	No
1.	Does the community benefit from participating in waste bank activities?	83 respondents	35 respondents
2.	Does the waste bank play a role in increasing BUMDes' revenue?	78 respondents	40 respondents

Table 4. Logistic regression analysis

Variable	β	Sig	Odds ratio
D1	2.339569***	0.001	10.38
D2	–0.260890^{ns}	0.801	0.77
D3	1.519146***	0.007	4.57
D4	1.089733*	0.067	2.97
LENGTH	–0.026980^{ns}	0.816	0.97
Constant	–1.592863	0.090	–
Log likelihood		–47.98197	
Prob > chi^2		0.0000	

Note: *** – Significant at 99% confidence level; ** – Significant at 95% confidence level; * – Significant at 90% confidence level; ns – Non-significant.

http://dx.doi.org/10.21511/ppm.23(4).2025.42

4. DISCUSSION

The study involved respondents from geographically diverse regions to capture differences in socioeconomic backgrounds and village characteristics. Geographic diversity is relevant because spatial factors and individual characteristics can influence survey responses and community behavior, as highlighted by Tomoya et al. (2012). The respondents' positions as village decision-makers provided valuable insights into village-level waste governance. Their average tenure of 4.8 years suggests a relatively strong capacity for policy interpretation and program oversight, consistent with Mahaputra (2022), who emphasizes the role of experience in improving policy quality at the village level.

Overall, waste disposal habits were generally positive, reflecting growing awareness of environmental practices in rural Indonesia. This finding aligns with Farida et al. (2023), who note that household waste behavior has a significant impact on environmental quality. However, the persistence of improper waste disposal in certain areas indicates that awareness is not yet universal. Community initiatives and basic disciplinary practices are taking root, but technical capacity remains limited, as shown by the relatively low proportion of villages equipped with formal waste management facilities. These conditions echo global findings that effective waste management requires community participation, institutional support, and adequate infrastructure (Adekola et al., 2021; Etim, 2024; Hasan, 2004).

The limited operational frequency of waste banks suggests barriers such as insufficient community awareness, low perceived economic benefit, and administrative challenges. Digital technology has begun to support waste bank operations in a small proportion of villages, indicating the early-stage adoption of innovation. This finding reflects the growing role of digitalization in improving transparency and efficiency in grassroots waste management systems (Antriyandarti et al., 2024). Waste bank financial structures vary across villages, reflecting decentralized operational models. Membership fees and waste sale income serve as the core financing mechanisms. Transparent fund management practices are crucial for sustaining trust and ensuring long-term viability (Schnackenberg & Tomlinson, 2014). The variability in fee systems also shows flexible adaptation to local economic capacities and administrative conditions.

Community acceptance of waste banks tends to increase when the benefits are tangible, such as economic gains for the village or empowerment programs for residents. Although many participants are willing to pay more to sustain the system, dissatisfaction may emerge when contributions are viewed as exceeding perceived benefits. This highlights the importance of socialization and clear communication regarding the role of community contributions in sustaining waste bank operations. To strengthen participation, waste bank operators could introduce incentives such as reward schemes for active members or discount mechanisms for frequent waste depositors. Transparent fee structures and accountable fund management play a key role in maintaining trust and ensuring long-term program success. A collaborative approach between village leadership and the community not only reduces landfill burden but also opens opportunities for rural income generation and environmental stewardship. The finding that leadership dominates participation suggests that, while institutional commitment is strong, broader community involvement needs to be strengthened so the program is not overly dependent on village officials.

The findings demonstrate that prior experience in village leadership contributes to a stronger commitment to environmental programs. Officials who have served for longer appear to have a better understanding of how waste banks fit within broader development goals. Strong participation in smaller communities also reflects closer social ties and easier mobilization, while larger villages may require more structured outreach and coordination mechanisms. Although half of the respondents observed active participation in waste bank activities, a substantial share of residents remain uninvolved. Behavioral factors, such as limited environmental awareness, and practical barriers, including inactive facilities and dissatisfaction with service delivery, also play a role. These insights suggest that successful participation depends not only on program availability but also

on perceptions of fairness, convenience, and trust in the system. Homemakers and youth groups show strong potential as drivers of grassroots environmental action. However, inconsistent financial outcomes across villages suggest that waste banks continue to struggle with full integration into local economic planning. Limited contributions to BUMDes revenues in some areas indicate the need for better operational standards, improved coordination, and stronger links between waste banks and village-level economic institutions. Improving transparency, strengthening operational support, and increasing community outreach will be essential steps to boost participation and ensure waste banks serve as both an environmental and economic tool for rural development.

Using Arnstein's ladder of participation as an analytical lens, the findings indicate that most rural communities remain at the consultation level. Residents are generally informed and sometimes asked for input, but they do not yet participate in key decision-making processes. Their involvement is therefore more symbolic than empowering. There is little evidence of non-participation or coerced involvement. Instead, participation largely falls under tokenism, where villagers attend socialization meetings and receive information about waste bank benefits, but decision-making authority remains concentrated among waste bank managers and village officials. Communities often sort waste at the household level, but their role tends to be instructional rather than collaborative. Higher levels of participation, such as shared power or citizen-led management, have not yet been achieved. Strategic control over financial systems, pricing, and marketing of recyclables remains centralized. These findings suggest that while the waste bank system has succeeded in mobilizing basic involvement, more inclusive governance is needed to foster genuine community ownership and promote empowered participation.

The analysis of individual variables revealed that regular waste bank activities (D1) emerged as the strongest driver of economic contribution in the village setting. This finding underscores an important reality: routine matters. The results show that regular waste bank activities (D1) provide the strongest contribution to the village economy, and this becomes clearer when we look at how these activities operate on the ground. Routine practices such as scheduled waste collection, member meetings, and consistent sorting gradually shape community habits. As people keep taking part in these activities, they slowly get used to the idea that their household waste actually has some value. It is not something that happens overnight, but through small, repeated interactions. For a lot of low-income families, the extra money they earn from selling recyclable items, although modest, still helps them cover basic daily expenses. Nugroho (2022) stresses that when waste-sorting and recycling become something people do almost without thinking, the financial effects tend to follow. The small exchanges that happen through these routines help keep money moving at the neighborhood level. Wulandari et al. (2017) also found that families living close to active waste banks often see a slight but meaningful boost in their income simply because they drop off recyclable items on a regular basis. Wilson et al. (2012) reinforce this by explaining that community-based waste systems open new livelihood opportunities, especially through sorting and recycling activities. In some cases, waste banks even offer training in upcycling or handicraft production, widening the economic benefits to include waste pickers, informal recyclers, and other community members. In this context, regularity is not just a management issue: it becomes the core engine that keeps participation and local economic benefits running.

A similar trend is visible in the variable on socialization and training (D3), which also shows a strong positive effect. This suggests that education plays a central role in encouraging participation while improving economic outcomes. In many places, waste banks make use of familiar community networks such as neighborhood groups (RT) to run their training sessions. Because the information is delivered by people the residents already know, the training feels more personal, and the practices become easier to follow. These initiatives are also in line with national programs that encourage the 3R principles (reduce, reuse, recycle), which further strengthen their overall impact (Sabihi et al., 2021). Communities that consistently receive training generally sort waste more effectively in terms of both volume and quality, and this directly affects the waste bank's revenue. This finding is in line with Ismail and Maratur

http://dx.doi.org/10.21511/ppm.23(4).2025.42

Sidjabat (2019), who emphasize that well-designed education programs build empowerment, which is the foundation of rural economic improvement. When residents grasp not only the mechanics of waste sorting but also the reasons their involvement matters, they tend to remain committed. Wilson et al. (2012) make a similar point, noting that improvements in sorting quality often raise the market value of recyclable materials, meaning that educational efforts can translate directly into financial gains.

Participation in waste collection (D4) also shows an encouraging pattern, even though the significance level is only within the 90% confidence range ($p = 0.067$). Despite the somewhat weaker statistical signal, the practical impact is still substantial. As more households contribute their waste on a routine basis, the quantity of recyclables increases, which in turn boosts the earnings of the waste bank and helps strengthen the community's economic well-being. This kind of involvement also nurtures a feeling of shared ownership; residents begin to view the waste bank not as a program imposed from outside, but as a collective resource they help sustain.

Similar patterns have been noted by Babaei et al. (2015) and Zurbrügg et al. (2012). When community members are more actively involved, resources tend to be used more efficiently, and local waste programs become more sustainable. Salazar-Adams and Ramirez-Figueroa (2024) also determined that strong participation can lower operating expenses, giving waste banks the flexibility to direct funds toward other priorities in the community. This suggests that even modest or occasional contributions from residents can meaningfully strengthen local economic resilience.

On the other hand, the variables related to awareness of unmanaged waste (D2) and the duration of a waste bank's operation (LENGTH) did not show meaningful effects. This points to an important nuance: simply knowing about the risks of unmanaged waste does not necessarily translate into economic involvement. In many rural areas, people are already well aware of the environmental and health problems caused by poor waste management, but that knowledge often remains passive. As Rodić and Wilson (2017) note, awareness seldom turns into consistent behavior unless accessible facilities, ongoing guidance, and clear incentives support it. In practice, everyday obstacles such as long distances to the waste bank, lack of transportation, or limited free time can hold people back even when they understand why waste sorting matters. Wilson et al. (2012) similarly emphasize that without adequate infrastructure and financial motivation, participation often stays low, reflecting the persistent gap between what people know and what they are able to do.

When it comes to how long a waste bank has been operating, the findings show that longevity on its own does not necessarily translate into stronger economic outcomes. What ends up making a bigger difference is the quality of management, the program's ability to keep residents involved, and the level of support it receives from outside institutions. There are waste banks that have been operating for many years yet still face difficulties because they lack strong leadership, have limited access to training, or do not receive enough institutional support. By contrast, newer waste banks with solid coordination, transparent financial systems, and strong community involvement can start generating meaningful economic results in a relatively short time. This finding is in line with Zurbrügg et al. (2012), who observed that community waste initiatives tend to work well when they are supported by clear governance, steady institutional backing, and active community participation. These results provide an encouraging message: even newly established waste banks can become effective economic actors when supported with proper capacity building and community-driven management.

Practical challenges in managing waste banks persist. Low public awareness and minimal participation remain significant barriers (Fauziah et al., 2022). Many residents are not fully informed about the environmental, social, and economic benefits of waste segregation. Educational outreach is still lacking, particularly in rural areas. Infrastructure limitations, such as inadequate storage, sorting, and transport facilities, hinder waste bank performance (Pratama et al., 2023). The reliance on community donations and lack of funding from government or private sources further limit growth and operational sustainability.

Institutional and market-related barriers also affect waste bank operations. Weak regulatory frameworks, lack of incentives, and unclear guidelines make it difficult for waste banks to thrive. Market volatility, especially in the pricing of recyclable materials, leads to unstable income. Many participants indicated that the financial returns from depositing waste were not proportional to their efforts. Human resource constraints are another issue, with most waste bank managers working voluntarily and without proper training (Debnath et al., 2023), leading to irregular operations and inefficient management. The lack of monitoring systems also hampers performance evaluation and decision-making.

Community feedback is crucial for improving waste bank programs. Input from residents helps identify operational weaknesses and refine services. However, a survey revealed that 73 out of 118 respondents believed that waste banks had little to no role in enhancing village-owned enterprise (BUMDes) revenue. This performance gap is partly due to outdated, manual systems used by 98 of the waste banks studied. The lack of digitalization hinders transaction tracking, data management, and communication. Respondents also highlighted the need for proper storage facilities to maintain recyclable quality and improve operations. Socialization on waste sorting must be intensified, with the help of environmental cadres, to increase household-level participation. A "pick-up system" where waste bank staff collect sorted waste from homes was suggested to improve convenience and compliance. Feedback mechanisms such as surveys, focus group discussions, and digital platforms are recommended to ensure inclusiveness and responsiveness in program development.

Theoretically, this study strengthens the understanding that the success of community-based waste management is not solely determined by knowledge or program longevity but by active behavioral engagement and institutional structuring. The significance of routine activities (D1), socialization and training (D3), and community participation (D4) highlights that economic benefits arise from consistent, structured, and participatory practices. This supports the theory of community empowerment in sustainable development, where social capital and collective action are central to generating local economic outcomes. Moreover, it nuances previous assumptions that awareness alone (D2) drives change, demonstrating that practical involvement holds more measurable impact than cognitive understanding alone.

In practice, the findings offer clear direction for stakeholders seeking to strengthen waste bank programs. First, operational consistency should be institutionalized: scheduled waste collection, regular meetings, and structured workflows must become standard. Second, socialization and training must be scaled and integrated into local governance agendas to ensure knowledge becomes action. Community training should also address not just sorting, but the economic potential of recyclables. Third, since participation yields tangible benefits, strategies to reduce logistical burdens, such as waste pick-up systems or incentive models, should be explored.

In addition, adopting digital management systems is crucial to improving data transparency, monitoring performance, and building trust with the community. Infrastructure support, such as proper storage and transportation, must also be prioritized to reduce operational inefficiencies. Finally, institutionalizing feedback loops through community surveys, FGDs, or digital platforms ensures that programs remain adaptive, inclusive, and responsive. Together, these insights can inform both policy design and on-the-ground implementation, making waste banks more effective as tools for rural economic empowerment and environmental stewardship.

CONCLUSION

The study aimed to understand how waste banks, a simple institution in waste management, support rural economies and what drives residents to participate in their management. The evidence suggests that waste banks generate economic benefits, primarily through income from recyclables and reduced waste-handling expenses at the village level. Nevertheless, participation from community members

http://dx.doi.org/10.21511/ppm.23(4).2025.42

largely remains in the form of consultation. In other words, while people are willing to share ideas or give feedback, they are not fully included in shaping decisions or managing activities.

These findings suggest that rural waste-bank initiatives still need stronger community-governance structures. Providing residents with more opportunities to influence planning and operations, combined with ongoing outreach and environmental education activities, may help foster trust and encourage long-term engagement. Collaboration among waste-bank managers, village leaders, and citizens is crucial not only for sustaining daily operations but also for ensuring the program remains economically viable for the community.

It is worth noting that the study focused solely on waste banks under a single rural development program, and data were collected at a single point in time. This limits broader generalization. Future research could follow up on these initiatives over a longer period, compare different village contexts, or combine quantitative surveys with in-depth field studies to capture how participation patterns develop and how they influence rural economic resilience.

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ACKNOWLEDGMENTS

We would like to thank PT Bank Rakyat Indonesia (PT BRI) and Universitas Sebelas Maret [Sebelas Maret University] for the funding support and all the respondents who participated in this research. PT Bank Rakyat Indonesia (PT BRI) funded this research with Number 273.1/UN27.22/HK.07.00/2024 and Universitas Sebelas Maret [Sebelas Maret University] with Number 371/UN27.22/PT.01.03/2025.

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