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Community Empowerment-Based Waste Management as an Effort to Realize a Sustainable Village Environment

Muhammad Khoirul Umam[1]*, Nurfazah Fitriyani[2], Ahmad Ferdiansyah Pratama Nurrasa[3]
Politeknik Siber Cerdika Internasional, Indonesia
Corresponding Author: muhammad_khoirul@polteksci.ac.id*,
nfazah3@gmail.com, ahmadferdiansyahpratamanurrasa@gmail.com

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ABSTRACT

Background: Rural waste management requires locally appropriate systems that combine environmental protection and community participation.

Objective: This study examines community empowerment-based waste bank management in Kumbung Village, including waste utilization, local innovations, and implications for environmental cleanliness and economic opportunities.

Methods: A descriptive qualitative single-case study was conducted using interviews, non-participant observation, and documentation. The manuscript identifies waste bank managers, village officials, and community members as information sources; their numbers, selection criteria, and fieldwork dates were not reported. Data were interpreted descriptively through data reduction, presentation, conclusion drawing, and source and technique triangulation.

Results: The documented practices include household waste collection, separation of organic and inorganic materials, maggot cultivation, sale of recyclable materials, and high-temperature treatment of residual waste. The study describes community involvement and potential economic uses of recovered materials, alongside irregular collection schedules, uneven participation, and institutional management constraints. Available records do not establish waste-volume changes, household participation rates, or income gains numerically.

Conclusion: Kumbung Village illustrates how community participation and locally adapted processing practices can be combined within a rural waste bank. The contribution is a contextual description of this integrated arrangement rather than evidence of a causal or quantitatively measured impact. More systematic operational and financial records are needed to assess its sustainability.

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INTRODUCTION

Waste problems are a serious environmental issue in both urban and rural areas. Population growth, changing consumption patterns, and single-use materials increase pressure on household waste systems. In rural settings, infrastructure constraints, limited awareness, and insufficient institutional support can encourage environmentally harmful disposal practices (Khoirul & Abdurokhim, 2024). The cited source concerns MSME productivity rather than waste; this citation requires author verification and replacement with a relevant source.

Waste management in rural areas is hampered by poor infrastructure, low public awareness, and economic challenges. Limited waste management facilities result in indiscriminate waste disposal and open incineration, which has the potential to pollute the environment and endanger health (Vinti & Vaccari, 2022). Lack of understanding of waste sorting further exacerbates this situation. In addition, budget constraints at both the village and household levels hinder the implementation of sustainable waste management solutions, thus encouraging cheap waste management practices that have a negative impact in the long term (Kohli et al., 2024).

A waste bank is a strategy in sustainable waste management, which combines technical, social, economic, and institutional aspects. By involving community participation and applying the 3R (Reduce, Reuse, Recycle) principles, waste banks serve to transform waste into valuable resources, encourage environmental education, and empower the economy. This approach has been proven effective in various communities, raising awareness of waste management through training and education programs, and facilitating dialogue and knowledge exchange through participatory methods such as workshops and focus groups (Bilgies et al., 2024).



Figure 1. Location of the Kumbung Village Waste Bank

Waste banks can connect waste sorting and recycling with community participation, environmental education, and economic incentives. Their long-term viability nevertheless depends on governance, operational efficiency, and sustained participation (Yandri et al., 2024). Community participation, practical training, and cooperation among residents, village governments, and other stakeholders are important for maintaining waste bank activities (Nugroho et al., 2025).

The potential environmental and economic benefits of waste banks depend on consistent application of waste reduction, reuse, and recycling, together with continued institutional support (Firmansyah et al., 2024). Kumbung Village is one of the villages that has initiated waste bank management based on community empowerment. Waste management in this village is carried out through a household waste collection system, organic and inorganic waste sorting, and the use of waste with economic value.

In addition, Kumbung Village develops organic waste processing innovations through maggot cultivation and the use of high-temperature combustion furnaces to reduce the volume of residual waste. This practice shows that there are local efforts in integrating environmental and economic aspects in village waste management. However, empirically, the implementation of waste banks at the village level still faces various challenges. Several studies show that many waste banks have not run optimally due to weak management, low continuity of community

participation, and limited innovation in the use of processed waste (Budiyarto et al., 2025).

On the other hand, ideal waste management policies and concepts emphasize the importance of a system that is sustainable, participatory, and economically valuable (Zhang et al., 2024). Meanwhile, real conditions on the ground often show incompatibilities between concepts and practices, such as management that is still partial, not yet integrated, and dependent on certain actors.



Figure 2. Waste Management Process

Weak Management and Administration causes waste banks to experience problems with inadequate administrative systems, resulting in stagnation and inactivity. For example, in Margoyoso Village, the lack of documentation and good management is a significant issue until a participatory approach is implemented to improve the administrative system (Muhamad A et al., 2025). Low Community Participation makes Community Involvement crucial for the success of waste banks. However, research shows that participation is often low, as seen in Kotabaru Village, where limited awareness and involvement hinder effective waste management (Firdausi, 2024).

The potential economic benefits of waste are not fully realized due to challenges in marketing recycled products and limited innovation in product development (Ahmad, 2022; Rinwantin et al., 2025). Implementing structured documentation and governance systems can increase transparency and

operational readiness, as demonstrated by revitalization efforts in Margoyoso Village (Muhamad A et al., 2025). Continuous education and participatory approaches can increase community awareness and participation, as evidenced by the success of engagement in Suka Makmur Village (Firmansyah et al., 2024). Developing networks, increasing management capacity, and innovating recycled products can optimize the economic potential of waste banks, as seen in a case study from Bentur RW V Purwosari (Rinwantin et al., 2025).

Normatively, waste banks are expected to be able to improve environmental cleanliness, strengthen community participation, and provide a sustainable economic impact. However, in practice, many waste banks only function as waste collection sites without strengthening institutional aspects, technological innovation, and optimizing economic value. Therefore, a study is needed that is able to reveal how waste banks can be managed more comprehensively and contextually in accordance with the socio-economic characteristics of rural communities.

Previous studies on waste banks have generally focused on aspects of improving environmental cleanliness or economic analysis of waste sales (Antriyandarti et al., 2025). Several other studies have highlighted the role of waste banks in changing people's behavior towards waste management. However, there are still relatively limited studies that examine the integration between community empowerment, local technological innovation, and economic value in a single model of waste bank management in rural areas. In addition, the use of maggot as a solution for organic waste management and the use of high-temperature incinerators as local innovations are still rarely studied in depth in the context of village waste banks.

Community empowerment is a major theme in the management of waste banks, as seen at the Manunggal Karso Waste Bank in Paju Village, where efforts are being made to increase community participation even though the current level is still low (Sukoco et al., 2024). The Carnation Waste Bank shows the success of community empowerment through programs such as The Gade Clean and Gold, which provides economic incentives such as saving gold and promoting knowledge about waste treatment (Novanti et al., 2023). In Perbawati Village, waste bank activities have strengthened social relationships and provided additional income, although challenges such as poor management and low participation still exist (Arrobi et al., 2023).

Waste banks make a significant contribution to the local economy by integrating waste management with economic activities, as evidenced by the WK Nur Waste Bank in Weru Kidul Village, which has increased community

income through various programs (Khotimah et al., 2025). The Salam Village Waste Bank has changed people's views of waste, highlighting its economic potential and reducing environmental pollution (Asnawi, 2023). While research does not comprehensively cover technological innovations such as the use of maggots or high-temperature combustion furnaces, the Carnation Waste Bank's focus on maggots' cultivation shows a step towards innovative organic waste management solutions (Novanti et al., 2023).

These studies indicate recurring challenges in participation, management capacity, and economic utilization. Their relevance to Kumbung Village lies in identifying operational conditions that may constrain an otherwise promising community-based approach. An integrated analysis of community participation, organic-waste processing, residual-waste treatment, and economic utilization can provide a more contextual understanding of village waste bank management.

The novelty of this research lies in examining community empowerment, maggot-based organic-waste utilization, residual-waste treatment, and economic opportunities together within the Kumbung Village waste bank. The study aims to describe the management system, examine how organic and inorganic materials are utilized, and identify operational challenges and development opportunities. Its practical benefit is to inform village officials and managers about participation, governance, and recordkeeping priorities; its scholarly implication is a contextual account of how social and technical practices intersect.

RESEARCH METHOD

This research employed a descriptive qualitative single-case study design focused on the Kumbung Village waste bank. The unit of analysis was its community-based waste management system, including participation, collection, sorting, processing, utilization, and institutional arrangements. The original manuscript identifies Kumbung Village as the research site but does not provide the district, regency, province, fieldwork dates, or a documented informant count. These details must be confirmed from field records before submission. The original data sources include waste bank managers, village officials, and community members; their recruitment procedure and sampling criteria have not been specified.

1. Problem identification, by examining household waste management conditions, the level of community participation, and operational challenges in waste bank management.

2. Field data collection, through interviews with waste bank managers and village officials, as well as direct observation of waste collection, sorting, and processing activities.
3. Analysis of the waste bank management system, focusing on operational mechanisms, the management and utilization of organic and inorganic waste, the implementation of waste management innovations, and the role of village institutions in supporting the sustainability of waste banks.
4. Evaluation of impacts, by assessing the contribution of waste bank management to environmental cleanliness and the economic value generated for the village community.

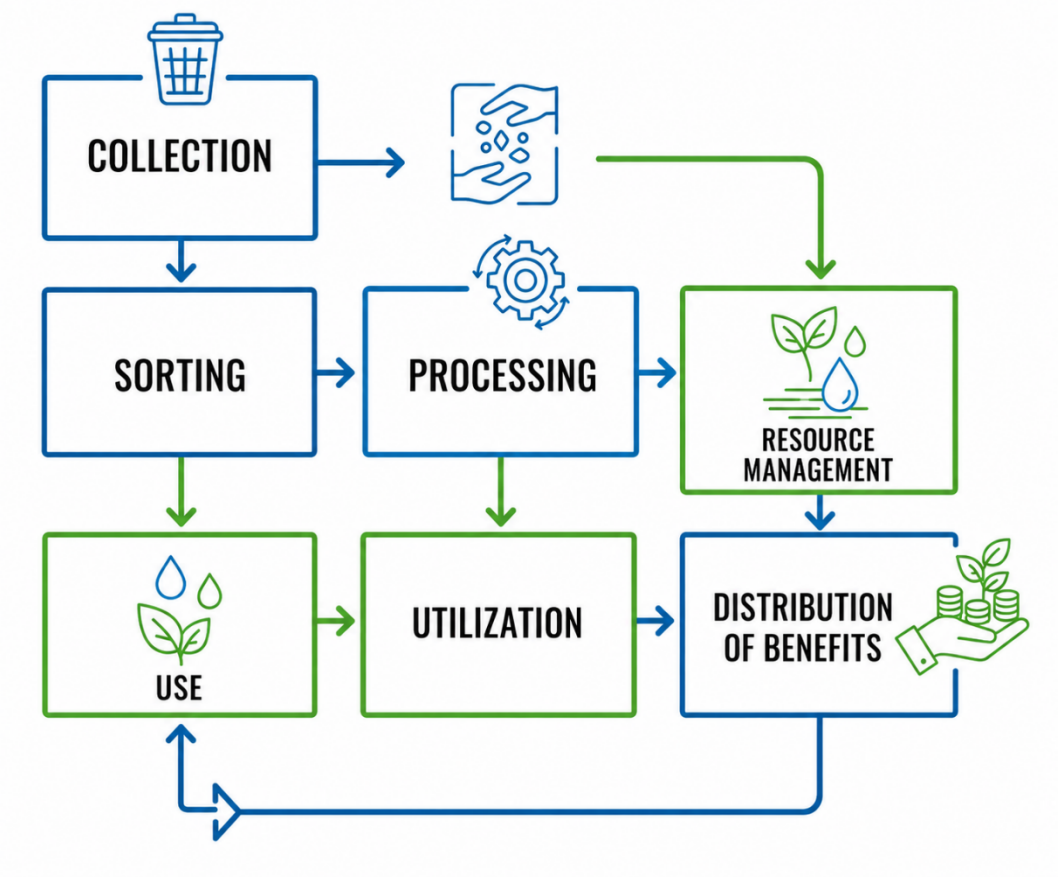


Figure 3. Waste Bank Management Flow Based on Community Empowerment

Through this strategy, the study sought to formulate an effective, contextual, and sustainable approach to community empowerment-based waste bank management at the village level. Data collection comprised interviews, non-participant observation, and document review. Interviews addressed management practices, participation, and operational challenges; observations covered household collection, waste sorting, maggot cultivation, residual-waste treatment, and interactions among managers and residents.

Reviewed documents were described as operational records, collection schedules, waste-type and volume records, and village policies.

The original manuscript does not supply a dated interview guide, observation checklist, participant codes, or a verified list of documents; these cannot be reconstructed reliably without the underlying research materials. Non-participatory observations were conducted directly during waste bank management activities, including waste collection from residents' homes, sorting of organic and inorganic waste, waste processing through maggot cultivation and residue incineration, the use of processing equipment, and interactions between waste bank managers and the community.

Documentation was used to complement interview and observation data, including waste bank operational records, waste transportation schedules, data on waste types and volumes, records of management activities, and village regulations or policies related to waste management. Although waste banks have considerable potential to improve waste management, challenges such as financial limitations and low community participation remain, highlighting the need for stronger institutional support and effective community engagement strategies (Ahmad, 2022; Amalia & Tauran, 2023).

The qualitative material was organized through data reduction, data display, and conclusion drawing, following the analytical framework attributed to Miles, Huberman, and Saldaña (2014). Themes covered management, community participation, waste utilization, local processing practices, and institutional sustainability. Credibility was approached through comparison across interview sources and between interviews, observations, and documents. No audit trail, coded verbatim quotations, or documented consent procedures were supplied. The authors should verify village authorization, informed consent, voluntary participation, confidentiality, and anonymization before making any research-ethics compliance statement.



Figure 4. Conceptual Scheme for Sustainable Village Waste Management

RESULT AND DISCUSSION

Waste Bank Management as an Implementation of Village Community Empowerment

The results of the study show that waste bank management in Kumbung Village is a form of real implementation of the community empowerment approach in environmental management. This finding answers the formulation of the first problem regarding how the waste bank management system is implemented at the village level. Empirically, waste bank management is not only carried out as a technical activity for waste collection and processing, but also as a social system that involves the active role of the community and the village government.

Table 1. Profile of the Kumbung Village Waste Bank

No	Aspects	Remarks
1	Name of the Waste Bank	Kumbung Village Waste Bank
2	Location	Kumbung Village
3	Form of Management	Based on community empowerment
4	Managers	Village people and village officials

No	Aspects	Remarks
5	Activity Objectives	Rural households
6	Purpose	Improve environmental cleanliness and economic value

Source: Field research data (2025)

Residents reportedly contributed household waste and monthly payments, suggesting participation in waste management activities. Nevertheless, uneven participation and irregular transportation schedules indicate that community involvement alone does not guarantee stable operations. This pattern is consistent with the participation challenges described by Sukoco et al. (2024) and the administrative constraints reported by (Muhamad Arief Afandy et al., 2025). Because household counts and dated operational logs are unavailable, the scale and regularity of participation cannot be quantified.

Waste Utilization as a Strategy to Increase Environmental and Economic Value

The findings of the study further answer the formulation of problems regarding the use of organic and inorganic waste in the waste bank system of Kumbung Village. The separation of waste into organic and inorganic is the main foundation in management, which allows the optimization of waste utilization according to its characteristics. Inorganic waste that has a selling value is used as a source of income, while residual waste is reduced in volume through controlled combustion.

Table 2. Community Empowerment-Based Waste Bank Management System

Management Stages	Main Activities	Actors Involved	Remarks
Collection	Household waste collection	Residents	Done regularly
Sorting	Organic and inorganic separation	Managers & Staff	Processing basis
Processing	Waste treatment by type	Managers	Based on local innovation
Utilization	Economic value utilization	Managers	Recycling & maggot
Benefit distribution	Sharing of economic results	Society	Encourage participation

Source: Observation and interview results (2025)

Organic waste was reportedly processed through maggot cultivation, an approach that converts organic waste into feed protein and residual fertilizer (Siddiqui et al., 2022), while recyclable inorganic materials were separated for

sale. These practices illustrate the potential connection between environmental management and economic utilization discussed by Khotimah et al. (2025). However, unlike studies reporting economic outcomes, the Kumbung Village material does not document sales receipts, income totals, or waste weights. Consequently, any contribution to household income or reductions in waste volume should be interpreted as a potential benefit, not a measured effect.

Local Technology Innovation and Its Relevance to the Sustainability of Waste Banks

The results of the study show that the use of high-temperature waste incinerators is a form of local technological innovation that plays an important role in overcoming the limitations of residual waste management. This innovation answers the problems that often arise in the management of village waste banks, namely the limitation of final disposal facilities. Ash from burning that is reused as a planting medium shows that there are efforts to minimize the environmental impact of the waste processing process.

Table 3. Types of Waste and Patterns of Their Utilization in Kumbung Village

Types of Garbage	Source	Processing Method	Utilization Results
Organic	Household waste	Maggot cultivation	Animal feed & economic value
Inorganic	Plastic, bottle, metal	Sorting & sales	Community income
Residue	Untreated waste	Controlled combustion	Volume reduction
Ash burning	Combustion residue	Reuse	Planting media

Source: Documentation of waste bank activities (2025)

The combination of waste sorting, maggot cultivation, and high-temperature treatment distinguishes the practices described in this case from the administrative focus of Muhamad A et al., (2025) and the participation emphasis of Firdausi (2024). This is a difference in documented activities, not evidence that the technology is environmentally superior. In particular, combustion emissions, operating temperatures, and ash safety were not measured; environmental safety claims require technical verification, given that low-temperature combustion of household waste can release gaseous and particulate pollutants harmful to nearby residents (Wang et al., 2023).

Implications of Waste Bank Management on the Environment and Society

Field descriptions suggest less visible waste accumulation and reduced littering in the areas observed. These observations are compatible with the environmental aims of waste bank programs, including the sustainability indicators discussed by Yandri et al. (2024). Nevertheless, the manuscript contains no standardized cleanliness assessments or before-and-after waste measurements. Therefore, improved cleanliness should be reported as an observed or perceived condition rather than a demonstrated causal impact.

Table 4. Waste Management Innovation Based on Local Technology

Types of Innovation	Function	Environmental Benefits	Economic Benefits
Maggot cultivation	Processing organic waste	Reduces odor & volume	Selling value products
High temperature combustion furnace	Processing residual waste	Reduce pollution	Management efficiency
Ash utilization	Recycling of residual products	Reducing final waste	Planting media

Source: Researcher analysis (2025)

The waste bank offers potential opportunities for income from recyclable materials and organic-waste processing, in line with the economic possibilities identified by Khotimah et al. (2025). The current evidence does not permit a statistical or monetary estimate of benefits. Further assessment would require dated transaction records, operating costs, participant counts, and consistent measurement of material flows.

Implications of Research and Direction of Further Research

Conceptually, the case suggests that community-based waste bank management is best understood through the interaction of participation, operational organization, and locally selected processing practices. Practically, village authorities and waste bank managers could prioritize regular collection schedules, transparent administration, participation records, and safety assessments for residual-waste treatment. These are implications of the descriptive findings, not experimentally validated interventions.

Table 5. The Impact of Waste Bank Management on the Environment and Community Economy

Impact Aspects	Pre-Condition	Condition After	Implications
Environmental cleanliness	Garbage piling up	Cleaner environment	Improved health
Waste management	Unstructured	More systematic	Increased efficiency
Community income	No economic value	There is an added value	Rural economic opportunities

Source: Interview and observation results (2025)

Table 6. Challenges and Potential for Village Waste Bank Development

Aspects	Field Findings	Impact	Potential Solutions
Management	Administration is not optimal	Unstable operations	Strengthening governance
Participation	Uneven	Low sustainability	Continuous education
Innovation	Still limited	Low economic value	Product development
Institutional	Depends on specific actors	Prone to stagnation	Village policy support

Source: Researcher analysis (2025)

This single-case qualitative study is limited by missing quantified baseline and follow-up measurements, unreported informant characteristics, and absent coded interview excerpts. The before-and-after labels in Table 5 should therefore be treated as qualitative descriptions requiring validation, rather than measured changes. Future research should record waste weights, household participation, revenues, operating expenses, and environmental indicators over time and compare findings across villages.

CONCLUSION

This study shows that community empowerment-based waste bank management in Kumbung Village integrates community participation, waste sorting, maggot cultivation, and residual waste treatment to support environmental sustainability and create economic opportunities. The findings highlight the importance of local innovation and village institutional support in strengthening waste management. However, operational constraints,

uneven community participation, and limited management capacity remain challenges to long-term sustainability.

Therefore, stronger governance, continuous community engagement, and appropriate technological innovation are needed to improve waste bank management. This study contributes to understanding waste banks as integrated environmental, social, and economic systems. Further research should quantitatively assess environmental and economic outcomes to provide stronger evidence of their long-term impacts and support the development of sustainable waste management models in rural communities.

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