



Optimizing Community-Based Waste Management: A Business Model Canvas Approach to Waste Bank Sustainability

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Abstract. Urban waste management in Indonesia is becoming increasingly challenging due to rapid population growth and changing consumption patterns that generate larger volumes of waste. One alternative approach that supports the principles of the circular economy is community-based waste management through waste banks. This study aims to analyze the business model of the Karya Mandiri New Waste Bank in Tebing Tinggi City using the Business Model Canvas (BMC) framework and to formulate development strategies for its sustainability. This study employs a qualitative descriptive approach with data collected through interviews, observations, and documentation. Findings indicate that the waste bank has implemented essential waste management activities, including collection, sorting, and environmental education programs. However, several obstacles still hinder its operational sustainability, such as limited community participation, inadequate resources, and unstable revenue streams. BMC analysis indicates that key elements, particularly the value proposition, channels, and revenue streams, have not been effectively optimized. Therefore, strategic improvements are needed through strengthened partnerships, increased community participation, diversification of revenue sources, and the utilization of digital technology. Optimizing the waste bank business model can help reduce landfill leakage, prevent marine plastic pollution, lower greenhouse gas emissions, and support Sustainable Development Goals (SDGs) 12 and 14 through sustainable waste management practices.

Keywords: Waste Bank; Circular Economy; Business Model Canvas; Waste Management; Sustainability

1. Introduction

Waste issues in Indonesia's urban areas continue to rise in tandem with population growth, economic activity, and changes in people's lifestyles. These conditions have led to an increase in waste volume and placed significant strain on existing waste management systems. The Ministry of Environment and Forestry reports that the national waste generation reaches approximately 68.5 million tons per year, with the largest proportion originating from household activities (1). If this increase is not balanced by an adequate management system, the capacity of final disposal sites will become increasingly overburdened, thereby increasing the risk of environmental pollution and public health hazards.

In recent years, waste management has no longer been viewed as a purely technical issue but is closely linked to social, institutional, and community behavioral aspects. Previous research indicates that the effectiveness of urban waste management is significantly influenced by citizen engagement, the capacity of local institutions, and the patterns of interaction among the actors involved in the system (2). This perspective aligns with the

principles of the Circular Economy (CE), which views waste as a resource that retains value and can be reintroduced into the economic cycle. Within this framework, the community is not merely positioned as a waste generator but also as a key actor determining the success of waste reduction, sorting, and value recovery practices. Therefore, a community-based approach is a relevant strategy for promoting the implementation of the circular economy within local-level waste management systems.

An example of community-based waste management in Indonesia is the waste bank. The model has emerged as a social innovation that links environmental goals with economic benefits through the collection, sorting, and sale of recyclable waste. Waste banks are seen as a way to reduce waste volume while encouraging communities to take a more active role in managing household waste. Various studies indicate that waste banks can enhance environmental awareness, broaden community participation, and create economic opportunities at the local level. Nevertheless, several studies also reveal that the sustainability of waste banks often faces recurring challenges, such as unstable community participation, limited managerial capacity of operators, inadequate operational facilities, and dependence on market conditions for recycled materials (3); (2)). In addition, 4) emphasize that weak policy support and the suboptimal integration of waste banks with local waste management systems are also factors hindering their sustainability.

This conditions are also relevant to the waste management situation in Tebing Tinggi City. According to data from the Central Statistics Agency, the population of Tebing Tinggi City in 2023 was estimated to be between 175,000 and 180,000 people (5). Referring to Indonesia's urban waste generation standard of 0.5–0.7 kg per capita per day, the estimated daily waste generation in this city is approximately 85–119 tons per day (1). The magnitude of this potential waste generation indicates that waste management in Tebing Tinggi requires a system capable not only of transporting and disposing of waste but also of promoting more optimal waste sorting and recycling. In practice, waste management in the region is still dominated by collection and disposal to landfills, while sorting and recycling activities have not yet developed to their full potential. This situation indicates that waste management issues in Tebing Tinggi still require strengthening at the institutional level, increased community participation, and the development of more sustainable management models.

One community-based organization working toward these goals is the Karya Mandiri New Waste Bank in Tebing Tinggi. This waste bank has been carrying out the basic functions of community-based waste management, but it still faces challenges in maintaining the continuity of its operations. The issues that arise are not only related to low community involvement but also concern limited facilities, weak economic value development, and the absence of a stable revenue model. This indicates that the sustainability challenges of waste banks cannot be adequately addressed solely through a social participation approach but must also be analyzed from the perspective of the organization's business model

So far, most research on waste banks has focused primarily on environmental aspects, changes in community behavior, and policy support. Studies that specifically assess the sustainability of waste banks through a business model perspective remain relatively limited, particularly in the context of medium-sized cities such as Tebing Tinggi. In fact, the success of waste banks is heavily influenced by their ability to create value, reach their target audience, manage resources, build partnerships, and develop revenue streams that support the organization's sustainability. Therefore, an analytical approach is needed that can systematically describe the relationships among these elements.

In this study, the approach used is the Business Model Canvas (BMC). BMC was chosen because it can map nine key elements of a business model: customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. In the context of a waste bank, the use of the BMC enables a more targeted identification of the organization's strengths, weaknesses, and development opportunities, from social, economic, and institutional perspectives. Additionally, the business model approach has been employed in several studies to explain the integration of social mission, economic sustainability, and environmental objectives in the management of waste banks based on sociopreneurship (6).

Based on the above discussion, this study aims to analyze the business model of the Karya Mandiri New Waste Bank in Tebing Tinggi City using the Business Model Canvas approach and to formulate development strategies that can support its operational sustainability. This study is expected to provide a theoretical contribution to the development of community-based waste management studies from a circular economy perspective, while also offering practical insights for waste bank managers and local governments in designing more effective and sustainable waste management strategies. Furthermore, improving the business model of waste banks not only reduces pollution, but also creates green jobs, decreases methane emissions from landfills, and protects vulnerable communities living around waste disposal sites from environmental health hazards, thereby supporting the Sustainable Development Goals (SDG) 13 (Climate Action) and SDG 11 (Sustainable Cities and Communities).

Circular Economy (CE) emerged as a response to the limitations of the linear economic model, which relies on a take-make-dispose pattern. In this approach, materials, energy, and products are kept in the usage cycle for as long as possible through strategies of reduction, reuse, repair, remanufacturing, and recycling. (7)) explain that the circular economy is a regenerative system that seeks to minimize waste and maximize the recovery of resource value. Thus, waste is no longer viewed merely as residue, but as material that can still be reused within the economic system.

In the context of waste management, the implementation of the circular economy (CE) demands not only technical innovation but also changes in governance, public behavior, and patterns of interaction among stakeholders. 8 emphasize that circular economy practices often highlight environmental and economic dimensions more prominently, while social aspects do not always receive balanced attention. In fact, at the local level, the success of the circular economy is heavily influenced by community participation, institutional capacity, and systemic support that enables behavioral changes to occur sustainably. Therefore, waste management based on CE principles must be understood as a process that combines resource efficiency with the strengthening of social and institutional aspects

Circular economy (CE) principles are becoming increasingly relevant in urban systems, as cities serve as both major sources of waste generation and primary hubs of material consumption. Emphasize that advancing sustainable cities requires the integration of the circular economy, clean production, and multi-stakeholder participation in resource management. It means that the success of implementing a circular economy at the city level depends heavily on the ability of the government, communities, businesses, and the public to work within an interconnected system. Within this framework, community-based initiatives such as waste banks can be positioned as one of the local instruments supporting the transition toward more circular waste management.

Waste banks represent a form of social innovation in waste management that has gained widespread traction in Indonesia. This model operates through a system of collecting, sorting, weighing, recording, and selling recyclable waste, with community members serving as participants. Unlike conventional waste management systems, which focus primarily on transportation and disposal, waste banks position residents as key actors in the process of reducing waste at the source. Thus, waste banks serve not only ecological functions but also social and economic ones.

Several studies indicate that waste banks contribute to increased environmental awareness, expanded community participation, and the realization of economic benefits at both the household and community levels. (9) found that waste bank management can support a more efficient waste management system while simultaneously fostering local economic development. Similar findings were also reported by 10, who highlighted the role of waste banks as a means of community empowerment through education, strengthening environmental literacy, and fostering the habit of waste sorting. In this context, waste banks do not merely function as a place for waste transactions but also as a space for social learning regarding environmental management.

However, various studies also indicate that the sustainability of waste banks still faces significant challenges. 4) note that community participation is often inconsistent, while the organization's financial sustainability remains weak due to dependence on the recycled materials market and limited revenue. Research results by (11) also confirm that public interest in participating in waste management is heavily influenced by adaptability, supporting resources, and the intensity of environmental education. In addition, limited facilities, weak managerial capacity, and a lack of integration with the regional waste management system are factors that often hinder the development of waste banks. In other words, although waste banks have great potential as community-based waste management instruments, their success is highly dependent on the quality of governance and the support of the surrounding system.

2. Methods

Data collection in this study was conducted through in-depth interviews and direct observation. The research was carried out at Karya Mandiri New Waste Bank, located in Tebing Tinggi City, over a three-month period beginning in October 2023. The researcher employed a qualitative approach using the case study method to obtain an in-depth understanding of the actual conditions of waste bank management at the operational level. This approach enabled the researcher to gather detailed information through direct interaction with the research subjects, including waste management activities, organizational structure, operational models, and the relationships between managers, the community, and local government.

In-depth interviews were conducted four times with four informants selected using purposive sampling techniques, namely the deliberate selection of participants based on their involvement and knowledge regarding the operations of Karya Mandiri New Main Waste Bank in Tebing Tinggi City. The informants consisted of Mr. Iskandar as the founder and head of the waste bank, Mrs. Khairani as the Head of Lalang Subdistrict, and two waste bank members actively involved in waste

management activities. The selection of these informants aimed to obtain relevant information regarding waste bank operations, community participation, institutional support, and challenges in implementing the circular economy concept.

In addition to interviews, direct field observations were conducted to understand waste management activities, such as waste collection, sorting, storage processes, and the use of operational facilities. These observations helped the researcher verify information obtained from interviews and gain contextual insights into the actual conditions of the waste bank. Documentation techniques were also used as additional data sources through the collection of activity photographs, operational records, and documents related to waste management activities. All collected data were then classified and analyzed through the stages of data reduction, data presentation, and conclusion drawing. The analysis was further strengthened using the Business Model Canvas (BMC) approach by mapping nine key elements: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (12

3. Results and Discussion

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

Based on the results of the research, Karya Mandiri New Waste Bank in Tebing Tinggi City has carried out the basic functions of community-based waste management. Operational activities such as collection, sorting, and preliminary processing of waste have been carried out routinely. In practice, several types of inorganic waste have been successfully sorted and managed to the point of being ready for sale or simple recycling. This indicates that a management system has been established, albeit on a limited scale. However, the economic value derived from these activities has not yet been optimized in a sustainable manner. The buying and selling of recycled products remains sporadic and has not yet made a significant contribution to the organization's or the community's income. Situations are influenced by limited market access and the absence of a structured marketing system. Additionally, low community participation is a major obstacle to increasing the volume of recycled products. Not all community members consistently sort and deposit waste, resulting in an unstable supply of raw materials. Conversely, limitations in supporting infrastructure, such as sorting equipment and storage facilities, also hinder the operational effectiveness of waste banks. Therefore, efforts are needed to strengthen community participation and provide supporting facilities to enhance the sustainability and economic value of waste management practices. These findings align with various studies indicating that waste banks generally make a significant contribution to waste reduction but still face structural and operational challenges (4; (11)

For a thorough understanding of the situation, an analysis was conducted using the following nine BMC elements:

1. Customer Segment

Key stakeholders in a waste bank system include local residents who act as customers, as well as waste collectors and recycling industries serving as end buyers. In practice,

residents serve as the primary source of waste supply, which determines the operational sustainability of the waste bank. However, community participation remains uneven, with only a portion of residents actively involved in waste drop-off activities. This condition is exacerbated by low public awareness regarding the sorting and management of household waste at the source. Many residents still mix organic and inorganic waste, thereby reducing the quality of recyclable materials. Consequently, the volume and quality of waste received by the waste bank become unstable. This indicates that customer segmentation is not yet fully optimized, as it has not been able to reach and activate the full potential of the community as customers. Additionally, the lack of specific outreach strategies targeting various community groups contributes to the low level of engagement. Therefore, efforts to raise awareness and implement more targeted segmentation strategies are needed to increase community participation and support the sustainability of the waste bank.

2. Value Propositions

Waste banks offer major benefits through waste volume reduction, increased economic benefits for the community, and enhanced environmental awareness. These benefits align with the principles of the circular economy, which views waste as a resource that still holds value and can be reused. In practice, waste banks serve not only as waste collection sites but also as tools for environmental education for the community. However, the economic benefits received by participants remain relatively small and are insufficient to significantly drive community participation. This situation indicates that the value proposition offered has not yet fully met expectations regarding economic benefits. Previous research indicates that the success of waste banks is heavily influenced by the balance between the economic and social benefits perceived by the community (9). Additionally, other studies confirm that low economic incentives can reduce the public's interest in consistent participation (4). Consequently, waste banks need to develop value innovations, such as processing recycled products with higher market value or providing incentives based on customer activity. Strengthening this added value is crucial so that waste banks are not merely viewed as environmental initiatives but also as economic activities that provide tangible benefits to the community. Thus, enhancing the value proposition can encourage broader participation while reinforcing the program's sustainability.

3. Channels

The channels used to reach the community are still dominated by conventional methods, such as face-to-face meetings, socialization activities, and word-of-mouth communication. This approach is quite effective in building social relationships and trust at the community level; however, it has limitations in reaching a broader audience. The limited use of digital technology has resulted in information related to waste bank activities not being disseminated optimally. Consequently, the potential participation from a wider segment of the community has not been fully maximized. Research indicates that the use of digital platforms can enhance community engagement through faster, more transparent, and interactive information dissemination (11). In addition, digital approaches enable more efficient recording and monitoring systems in waste management. Another study suggests that integrating technology into waste management systems can improve operational effectiveness while strengthening community participation 13. Therefore, waste banks need to develop digital-based communication strategies, such as utilizing social media,

applications, or other information platforms. The use of digital channels not only expands the reach of information but also enhances transparency and accountability in management. Thus, a combination of conventional and digital channels can serve as an effective strategy to increase community participation and ensure the sustainability of waste banks.

4. Customer relationship

The relationship between waste banks and their customers is generally built through direct, personal interactions based on trust. Routine activities such as waste weighing and savings record-keeping serve as the main means of maintaining this relationship. This pattern tends to be informal, yet it is quite effective in fostering social closeness at the community level. However, this relatively simple approach is not yet supported by a structured customer relationship management system. As a result, customer engagement tends to fluctuate and largely depends on individual motivation. Research indicates that sustainable relationships require systems capable of maintaining community loyalty and participation consistently (14). In addition, community-based approaches need to be supported by innovations such as reward programs or participation-based incentives. Strengthening these relationships can also be achieved through more intensive and transparent communication between managers and customers. Thus, customer relationships are not only social in nature but also serve as a strategic element in maintaining the operational sustainability of waste banks.

5. Revenue streams

If managed optimally, the main source of income for waste banks can come from the sale of inorganic waste to collectors or recycling industries. However, this has not yet been realized, as waste bank activities are still focused on raising community awareness. As a result, waste banks do not yet have a primary source of revenue. To carry out their operational activities, waste banks rely on support from local governments, particularly in the form of material assistance. This condition causes revenue streams to be unstable and difficult to predict. Research shows that dependence on a single source of income is one of the main factors hindering the sustainability of waste banks (4). Therefore, diversification of revenue sources is needed, such as developing value-added recycled products or establishing partnerships with the private sector. Other studies also indicate that digital-based business model innovation can open new market opportunities in waste management 13. This diversification is essential to enhance the organization's financial resilience. Thus, strengthening revenue strategies is key to supporting the sustainability of waste banks.

6. Key resources

The main resources in waste bank operations include management personnel, supporting facilities, and the community network as customers. The role of the management team is crucial, as they serve as the primary drivers in carrying out operational activities and coordination. However, the limited number and capacity of human resources often become obstacles in program development. In addition, the available facilities are generally still basic and insufficient to support larger-scale operations. Research shows that improving human resource capacity, particularly in management and entrepreneurship, has a significant impact on the success of waste banks (15). On the other hand, the community's social network is also an important asset that supports program sustainability. Therefore, strengthening resources should not be limited to physical

aspects but also include enhancing human capacity and social networks. Investment in these resources is a strategic step to improve operational effectiveness. Thus, the sustainability of waste banks largely depends on the quality and readiness of the resources they possess.

7. Key activities

In general, the main activities of waste banks include the collection, sorting, weighing, and sale of waste with economic value. These activities form the core of operations that support the principles of 3R-based waste management (reduce, reuse, recycle). At Bank Sampah Karya Mandiri New in Tebing Tinggi, the main activities are still largely focused on routine environmental education and have not experienced significant innovation. This results in limited added value generated from these activities. Research shows that developing activities such as training, education, and product innovation can improve the effectiveness of waste management (10). In addition, integrating creative economic activities based on recycling can increase product value. Therefore, diversification of activities is needed to expand the program's impact. Thus, the main activities should not only focus on education and waste collection but also on creating economic value.

8. Key partnership

Partnerships in waste bank management generally involve the community, local governments, and several other supporting stakeholders. These partnerships play an important role in supporting waste distribution and ensuring operational sustainability. However, the limited scope of partnerships remains one of the main challenges in program development. The involvement of the private sector and educational institutions is still not optimal. Research shows that multi-stakeholder collaboration is crucial in supporting circular economy-based waste management systems (16). In addition, partnerships with the industrial sector can provide access to broader and more stable markets. Government support is also needed in the form of policies and program facilitation. Therefore, strengthening partnership networks is an important strategy to enhance the capacity and sustainability of waste banks. Thus, broader collaboration can strengthen the position of waste banks within the waste management ecosystem.

9. Cost structure

The cost structure of waste banks includes operational expenses such as collection, transportation, and incentives for management personnel. In addition, costs are allocated for facility maintenance and other supporting activities. The relatively small scale of operations results in suboptimal cost efficiency. On the other hand, limited revenue makes cost management a significant challenge. Research indicates that efficient cost management is crucial for maintaining the sustainability of community-based organizations (9). Therefore, efficiency strategies are needed, such as optimizing resource utilization and seeking support from external partners. Assistance from the government or CSR programs can also help reduce operational costs. Furthermore, the use of technology can improve cost management efficiency. Thus, effective cost structure management is a key factor in ensuring the sustainability of waste banks.

Based on the above explanation, the following BMC diagram was created:

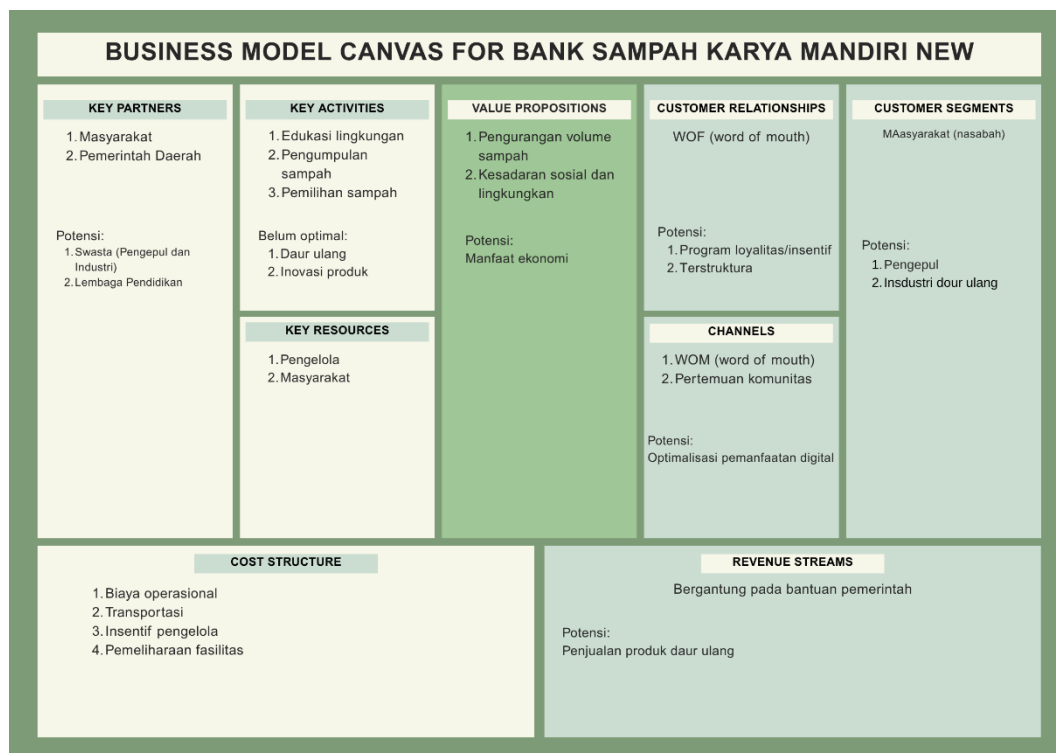


Figure 1. Business Model Canvas for Bank Sampah Karya Mandiri New

Bank Sampah Karya Mandiri New’s business model indicates that the organization remains focused on social and environmental aspects, with its primary activities centered on education and waste collection. However, its revenue streams have not yet been fully developed, meaning its financial sustainability still depends on external support. Additionally, limitations in terms of resources, communication channels, and partnerships have prevented the organization from maximizing the value it generates. Therefore, strengthening the value propositions, channels, and revenue streams is necessary to make the business model more sustainable.

Conclusions

Based on the research findings, Bank Sampah Karya Mandiri New in Tebing Tinggi City has implemented the basic functions of community-based waste management through waste collection, sorting, and environmental education activities. The existence of this waste bank demonstrates considerable potential in supporting the implementation of circular economy principles at the local level, particularly in reducing waste volume and increasing public awareness of the importance of sustainable waste management. However, the analysis using the Business Model Canvas (BMC) approach indicates that the current business model has not yet been fully optimized. The main challenges include low community participation, limited resources, unstable revenue streams, limited partnerships, and the continued use of conventional communication channels.

Therefore, Bank Sampah Karya Mandiri New is still in the institutional strengthening phase and requires more integrated development strategies to achieve operational sustainability. These strategies may include increasing community participation, diversifying revenue sources, utilizing digital technology, and strengthening collaboration among government institutions, the private sector, and the community. Optimizing the waste bank

business model not only supports more effective waste management, but also contributes to reducing pollution, lowering greenhouse gas emissions, creating green jobs, and supporting the achievement of the Sustainable Development Goals (SDGs).

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Conflicts of Interest

The authors declare no conflict of interest.

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