

The Optimization Model Of The Waste Bank Program As A Sustainable Waste Management Solution In Bandung City

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Abstract

Waste management is a major challenge in the city of Bandung due to the increasing volume of domestic waste and rapid urbanization. One of the efforts to overcome this problem is through a community-based waste bank program which aims to reduce the amount of waste and provide economic benefits for residents. This study aims to analyze the waste bank optimization model in increasing the effectiveness of sustainable waste management and its impact on the socio-economic welfare of the community. Using a descriptive qualitative method, data was collected through in-depth interviews with three waste bank managers in the city of Bandung. The results of the study show that the main obstacles in the management of waste banks include limited funding, low community participation, and lack of supportive regulations. Therefore, the proposed optimization model includes three main strategies: diversification of funding sources through partnerships with the private sector and economic incentives for the community, increasing the capacity of human resources in the operational management of waste banks, and strengthening policies and government support in the provision of clearer infrastructure and regulations. By implementing this strategy, the waste bank can further contribute to sustainable waste management and improve the socio-economic welfare of the community in the city of Bandung.

A. INTRODUCTION

Environmental pollution is one of the main factors that trigger ecosystem degradation. As an integral part of the natural environment, humans coexist with other natural elements, forming a mutually influencing relationship. In carrying out their activities, humans also play a role as environmental managers on this earth. However, human actions often contribute to the deterioration of environmental quality. This has an impact on important aspects related to overall human health, comfort, and well-being. Therefore, maintaining environmental quality is a shared responsibility to ensure the sustainability of future generations' lives, Sodikin Dalam (Nggadi et al., 2022). Waste is one of the biggest environmental challenges facing modern society today. Population growth and urbanization have led to a surge in waste volume, especially in urban areas. Waste that accumulates in urban areas has a bad impact on soil, water, and air pollution (Utami & Hasibuan, 2023). The city of Bandung, located in West Java Province, is often referred to as "Paris van Java" because of its diverse potential to be a center of economic growth, tourism, and culture. In addition, the city of Bandung is also recognized as one of the centers of the creative industry that plays an important role in supporting the development of the creative economy in Indonesia. However, behind these various potentials, the city of Bandung faces serious challenges in environmental management, especially related to the high volume of waste produced. Data shows that the volume of waste in the city of Bandung is still a serious threat, the data is presented as follows :

Table 1 Amount of Municipal Waste Bandung Period 2017 – 2023

	sajian	TON						Total
		2017	2018	2019	2020	2021	2022	
bps_nama_kabupaten_kota	tahun							
KOTA BANDUNG		401,933	470,358	489,106	488,661	467,003	464,108	400,147
	Total	401,933	470,358	489,106	488,661	467,003	464,108	400,147
								3,181,317

Source : opendata.bandung.co.id

Based on table 1 regarding the number of waste, the volume of waste in the city of Bandung shows fluctuations from 2017 to 2023. In 2017, the amount of waste produced reached 401,933 tons. This figure continues to increase in the following years, with the peak occurring in 2019, which is 489,106 tons. However, after that, there was a gradual decline, where the amount of waste in 2023 was recorded at 400,147 tons, lower than in previous years. Overall, the total accumulated waste produced by the city of Bandung during the period 2017 to 2023 is 3,181,317 tons. This data shows that despite efforts in environmental management, the volume of waste remains a significant challenge for the city of Bandung. This indicates the need for a more effective waste management strategy to reduce its impact on the environment. One of the efforts to reduce the volume of waste is to form a waste bank. Waste banks play a crucial role in community-based waste management in Indonesia. As an institution that collects and manages recyclable waste, waste banks not only help reduce the volume of waste that ends up in landfills, but also provide economic and social benefits for the community. This concept is rooted in the principle of circular economy, where waste is

converted into a resource of value (Puspita et al., 2023). Main Functions of Waste Banks in Waste Management:

1. **Reducing the Amount of Waste:** The waste bank invites the public to sort and collect waste that still has recycling value, such as plastic, paper, and metal. This effort has proven to be effective in reducing the amount of waste that ends up in landfills as well as encouraging the implementation of the 3R (Reduce, Reuse, Recycle) principle (Rubiyanor et al., 2016).
2. **Improving the Economic Welfare of the Community:** Through a waste-based savings system, waste banks provide economic benefits to the community. Waste deposited by residents is valued and recorded in a savings book, which can be exchanged for money, necessities, or other services. This model has shown a positive impact in increasing income, especially for low-income communities (Viareco et al., 2024).
3. **Increasing Environmental Awareness and Culture:** Community involvement in waste bank activities actively encourages changes in mindset and habits in managing waste. The education provided by waste bank managers not only increases environmental awareness, but also creates a sustainable recycling culture at the household level (Rubiyanor et al., 2016).

In the city of Bandung, the waste bank community has a significant role in solving waste problems while supporting the improvement of the community's economic level. With a daily waste volume of 1,300–1,500 tons, the existence of a waste bank is a strategic step in waste management. The waste bank serves as a means for the community to store inorganic waste that has been sorted, such as plastic, paper, and metal, which is then weighed and recorded in a passbook. The savings can be cashed out or exchanged for daily necessities, even precious metals. In addition to reducing the amount of waste that ends up at the Final Disposal Site (TPA), this initiative has a positive economic impact on residents. Until now, the city of Bandung has three Main Waste Banks located in Kiarcondong, Coblong, and West Bandung Districts, and is supported by 152 Unit Waste Banks spread across 30 urban villages, making it easier for the community to participate in this program.

Capacity Building

Capacity building is a multifaceted process that aims to improve the abilities and competencies of individuals and organizations so that they can carry out their functions and achieve goals effectively. In the context of organizational management, capacity building specifically refers to systematic efforts to improve the skills, knowledge, and overall effectiveness of personnel involved in the management and governance of an organization. This process is essential to foster an environment that supports adaptability, innovation, and sustainable growth, especially in response to the evolving demands of the external environment. One fundamental aspect of capacity building is the recognition that organizational leaders play a crucial role in shaping their organizational capacity. As highlighted by Leeman et al., (2016) effective capacity building initiatives must be tailored to meet the specific needs of different levels within an organization, including leadership, middle management, and frontline practitioners, (Leeman et al., 2016). This hierarchical approach ensures that leaders are motivated to adopt and support new interventions, while



middle managers are equipped with the necessary skills to implement and sustain these changes. Furthermore, practitioners must be empowered to intervene effectively, thus creating a cohesive and capable organizational structure.

The relationship between individual and organizational capacity building is also important. Brix (2019) emphasizes that capacity building is not just an individual effort, but a social product that arises from interactions between individuals in an organization, (Brix, 2019). This linkage shows that fostering a culture of collaboration and knowledge sharing is essential to improve the overall capacity of the organization. By promoting an environment where employees feel empowered to contribute their insights and expertise, organizations can leverage the collective strength of their workforce to drive innovation and improve performance. In addition, the sustainability of capacity building efforts depends on the organization's readiness to change and its leadership commitment. Goldberg and Bryant (2012) argue that successful capacity building is often based on the willingness of organizational leaders to support and facilitate change initiatives, (Goldberg & Bryant, 2012). This leadership commitment is critical, as it sets the tone for the entire organization and influences an individual's willingness to engage in capacity building activities. When leaders actively champion capacity building efforts, they create a supportive environment that encourages employees to embrace new practices and develop their skills. In addition to leadership support, the design and implementation of capacity building interventions should be based on a thorough understanding of the organization's needs and existing capabilities. Bryan and Brown (2015) emphasized the importance of proactive capacity building, where participants are intentionally involved in learning and implementing effective management practices, (Bryan & Brown, 2015). This proactive approach requires a comprehensive assessment of the current state of the organization, including strengths, weaknesses, and areas for improvement. By aligning capacity building initiatives with the specific needs of the organization, stakeholders can ensure that resources are used effectively and that desired outcomes are achieved.

Furthermore, the evaluation of capacity building efforts is essential to assess their impact and effectiveness. Triastuti et al., (2021) highlighted the need to evaluate capacity building initiatives to control organizational performance and accountability, (Triastuti et al., 2021). This evaluation process should include various dimensions, including leadership effectiveness, knowledge transfer, and overall organizational accountability. By systematically measuring the outcomes of capacity building interventions, organizations can identify areas for further development and refine their strategies to improve performance. The integration of capacity building into an organization's culture is another important aspect that influences its success. Decorby-Watson et al., (2018) noted that capacity building should be seen as an ongoing process, not a one-time event, (DeCorby-Watson et al., 2018). This perspective encourages organizations to continue to invest in the development of their personnel and foster a culture of learning and improvement. By embedding capacity building into the organization's ethos, organizations can ensure that their workforce remains adaptable and responsive to changing circumstances.

Furthermore, the role of partnerships and collaboration in capacity development cannot be overstated. Uprety (2024) discusses how collaborative efforts among civil society organizations can enhance governance and capacity development outcomes (Uprety, 2024). By engaging external stakeholders, organizations can access additional resources, expertise,



and support that can bolster their capacity-building initiatives. These partnerships can also facilitate knowledge exchange and the sharing of best practices, further improving the effectiveness of capacity development efforts. Challenges related to capacity development, particularly in resource-constrained settings, require innovative solutions and adaptive strategies. O'Connell et al. (2017) emphasize the urgency of developing capacity-building activities in response to rapid socio-environmental changes, particularly in sub-Saharan Africa (O'Connell et al., 2017). This urgency highlights the need for organizations to prioritize capacity enhancement as a crucial component of their strategic planning and resource allocation processes. By recognizing capacity-building as a fundamental organizational priority, organizations can better position themselves to navigate complex challenges and capitalize on emerging opportunities.

Additionally, integrating technology into capacity-building efforts can enhance the effectiveness and reach of these initiatives. Keter (2023) discusses the importance of strengthening knowledge management capacity to improve organizational productivity (Keter, 2023). By leveraging technology to facilitate knowledge sharing and collaboration, organizations can create more efficient processes and enhance their overall capacity. This technological integration can also support remote learning and training initiatives, making capacity-building efforts more accessible to a broader audience. The evaluation of capacity-building interventions must also consider the long-term sustainability of the changes implemented. Millar and Doherty (2018) emphasize that capacity development should address specific organizational needs and be integrated into the organization's strategic framework (Millar & Doherty, 2018). This alignment ensures that capacity development efforts are not only effective in the short term but also contribute to the long-term sustainability and success of the organization.

In the context of waste banks, capacity development requires enhancing the capabilities of management teams, community members, and local governments to ensure sustainable waste management practices. This discussion will explore various models and strategies for capacity development in waste banks, particularly considering the hypothesis that there is a deficiency in waste bank management and a lack of government support, especially in financial aspects.

One effective model for capacity development in waste banks is the integration of training programs focused on waste management practices, financial literacy, and community engagement. The involvement of various stakeholders, including government agencies, market managers, and community members, is crucial for the operational success of waste banks (Budiyanoro, 2023). Training programs can be designed to enhance the skills of waste bank managers in areas such as financial management, operational efficiency, and community outreach. By equipping managers with these skills, waste banks can improve their operational sustainability and increase community participation.

Additionally, the use of technology plays a vital role in enhancing the capacity of waste banks. Erdiansyah et al. (2016) highlight the importance of utilizing Geographic Information Systems (GIS) to monitor waste bank activities and identify potential locations for new waste banks (Erdiansyah et al., 2016). By implementing technological solutions, waste banks can streamline their operations, improve data collection, and enhance communication with stakeholders. This technological integration not only facilitates better management practices



but also empowers community members to take a more active role in waste management efforts.

The establishment of partnerships between waste banks and local governments is another crucial aspect of capacity development. Muljaningsih et al. (2022) emphasize the need for waste bank managers to effectively communicate with the private sector and local governments to secure infrastructure support and resources (Muljaningsih et al., 2022). Such collaborations can lead to the development of joint initiatives that enhance the capabilities of waste banks, such as co-training programs, funding opportunities, and resource allocation. By fostering these partnerships, waste banks can create a stronger support system to address the financial challenges they face.

Beyond training and partnerships, community engagement is essential for the success of waste banks. Asteria and Heruman (2016) argue that raising awareness and educating community members about waste management practices is crucial for fostering a culture of participation (Asteria & Heruman, 2016). Capacity-building initiatives should include outreach programs that inform residents about the benefits of waste banks, the importance of recycling, and how they can contribute to waste management efforts. By actively engaging the community, waste banks can increase participation rates and enhance their overall effectiveness.

Furthermore, the implementation of a clear governance structure within waste banks can significantly enhance their management capabilities. Kurniawan et al. (2021) suggest that adopting a zero-waste approach based on the circular economy paradigm can provide a framework for effective waste management (Kurniawan et al., 2021). This approach encourages waste banks to establish clear policies and procedures that guide their operations, ensuring accountability and transparency. A well-established governance structure not only improves the efficiency of waste banks but also builds trust among community members and stakeholders.

Financial sustainability is a critical challenge for waste banks, and addressing this issue requires innovative funding models. In her research, Putri (2023) discusses how waste banks can enhance the local economy by implementing a system that allows residents to exchange waste for valuable products or services (Putri, 2023). By creating economic incentives for participation, waste banks can generate revenue to support their operations. Additionally, securing grants and funding from governmental and non-governmental organizations can provide the necessary financial support to enhance capacity-building efforts.

The role of local governments in supporting waste banks cannot be overstated. Susanto (2024) emphasizes the need for local governments to establish municipally owned enterprises specifically tasked with managing waste bank operations (Susanto, 2024). Such initiatives can provide waste banks with the financial and logistical support they need to thrive. By aligning waste bank operations with local government policies and initiatives, waste banks can leverage additional resources and expertise, ultimately strengthening their capacity to manage waste effectively.

Moreover, continuous evaluation and feedback mechanisms are essential for improving the capacity of waste banks. Shiratina suggests that implementing green marketing strategies can help waste banks maintain sustainability and attract community support (Shiratina, 2023). By periodically assessing the effectiveness of capacity-building initiatives



and making necessary adjustments, waste banks can ensure that they remain responsive to community needs and the challenges they face.

In addressing waste management issues in Bandung, various strategies have been implemented, including waste bank programs aimed at reducing waste volume while providing economic benefits to the community. However, the effectiveness of these programs still faces challenges, particularly in terms of optimization and the sustainability of their impact. Based on the discussion above, the research problem in this study is formulated as follows: How can waste bank programs be optimized to enhance the effectiveness of waste management and their impact on the environment and community well-being in Bandung? By formulating this research problem, the study aims to provide strategic recommendations for improving more sustainable waste management effectiveness.

Research Methods

This study employs a descriptive qualitative method, referring to Creswell's (2014) perspective, which states that qualitative research aims to understand the deeper meaning of observed phenomena through direct data collection from sources (Creswell, 2014). This approach was chosen because it allows researchers to explore the processes and dynamics of waste bank management in depth, utilizing interviews as the primary data collection technique. In-depth interviews are conducted with waste bank managers, including key administrators, operational coordinators, and individuals involved in distribution and community education, to obtain information about operational mechanisms, challenges faced, and the impact experienced by the community.

The collected data is analyzed thematically following Creswell's (2014) steps, which include data collection, organization, and codification, leading to the conclusion based on relevant findings. Miles et al. (1994) further emphasize that in qualitative research, a systematic data analysis process helps identify key patterns that provide a comprehensive understanding of the studied phenomenon (Miles et al., 2014). Through this method, the study is expected to make a significant contribution in describing the strategies and challenges of waste bank management, as well as its impact on the environment and the community.

Results and Discussion

The research findings were obtained through interviews with three waste bank managers in Bandung City. Analysis was conducted using a descriptive qualitative method to illustrate the actual conditions of waste bank management and the challenges faced. The study's findings are linked to the concept of capacity development, which emphasizes the importance of enhancing individual and organizational skills in managing sustainability programs. The interview results indicate that each waste bank operates under different systems but encounters similar constraints in terms of funding, community involvement, and regulatory support. This section will elaborate on the findings by integrating them with the theoretical framework used in the study, aiming to formulate an optimization model that can improve the effectiveness of waste banks in sustainable waste management.

KOBERSIH Waste Bank



The Koberasih Waste Bank, an acronym for *Komunitas Belajar Bersih* (Clean Learning Community), was established in August 2020 at Pijung Campus, Ciburial Village, Cimenyan District, Bandung Regency. The establishment of this waste bank stemmed from the need for educational activities for children during the COVID-19 pandemic, as well as the unorganized waste management issues in the area. The operational model of Koberasih Waste Bank integrates educational programs with waste management. In every session, children are required to bring inorganic waste, which is then sorted and weighed. The collected waste is sold to the central waste bank, and the proceeds are used to support learning activities, such as purchasing stationery and educational materials. This model reflects the Capacity Development principle proposed by Brix (2019), where environmental education becomes an integral part of enhancing individual and community capacity in waste management. Although the concept is innovative and has received positive responses from the community, Koberasih Waste Bank faces several challenges that hinder its sustainability, including :

1. **Limited Human Resources :** The waste bank is managed voluntarily by a small group of individuals who have other primary jobs. The limited number of managers and available time creates difficulties in maintaining consistent operations. According to Leeman et al. (2016), this challenge can be addressed through continuous training and a more effective distribution of roles within the organization.
2. **Lack of Government and Community Support :** Koberasih Waste Bank does not receive assistance from the government or other external parties, so all activities are carried out independently. Additionally, community involvement remains limited, especially among adults. While children participating in waste-sorting activities show great enthusiasm, broader community awareness and participation are still low. Goldberg & Bryant (2012) suggest the need to establish partnerships with the private sector and government to secure more stable resources.
3. **Challenges in Waste Collection and Storage System :** The waste bank's operational system requires managers to collect waste from residents' homes, which demands extra effort and time. Moreover, the waste storage facility used belongs to a resident and is only temporary, limiting operational flexibility. Efforts to improve operational efficiency can be made by enhancing the logistics system and storage facility management through the involvement of various stakeholders (Bryan & Brown, 2015).

To enhance the effectiveness and sustainability of the waste bank program, an optimization model based on Capacity Development is needed. This model focuses on improving the capabilities of organizations and individuals to manage waste more effectively.

1. **Strengthening Human Resource Capacity :** Recruitment and training of waste bank managers are crucial steps in improving operational effectiveness. Training can cover waste bank management, waste sorting techniques, and strategies to increase community participation. In the context of Capacity Development, Millar & Doherty (2018) emphasize that enhancing skills and knowledge is a critical step for organizations to grow sustainably.
2. **Government Policy and Regulatory Support :** Supportive regulations are essential for waste bank programs, whether in the form of incentives, access to waste



management facilities, or mandatory household waste sorting policies. Organizational Capacity Development, as discussed by DeCorby-Watson et al. (2018), highlights the importance of regulations as an instrument that helps waste banks gain legitimacy and access broader resources.

3. Increasing Community Participation : Awareness and education about the importance of waste banks need to be intensified, especially among adults. Strategies that can be implemented include:

- a) Involving community leaders and heads of households as change agents.
- b) Organizing incentive programs for residents who actively sort waste.
- c) Enhancing the involvement of local communities, such as youth organizations (*karang taruna*), in waste bank activities.

This model aligns with the Capacity Development theory proposed by Triastuti et al. (2021), which states that increasing awareness and community participation is a key element in building community-based organizational capacity.

4. Partnerships with the Private Sector and Community Groups : Diversifying funding sources can be achieved through partnerships with the private sector, such as recycling companies or creative industries that use recycled materials. Collaborating with other communities can also support education and advocacy efforts. Capacity Development underscores the importance of inter-organizational collaboration as a key factor in ensuring operational sustainability (Uprety, 2024).

Bumi Bebeb Waste Bank

Bumi Bebeb Waste Bank operates a community-based waste management system that actively involves residents at the neighborhood (*RW*) level. Every Saturday, residents deposit their sorted waste at the waste bank, where it is further processed before being sent to the main waste bank. This model reflects the principle of the circular economy, in which waste holds economic value and can be reintegrated into the production system (Puspita et al., 2023). Although the management system is in place, several challenges remain. Government support is still limited, with assistance only provided in the form of incentives through the *Kampisman Award*, which offers a relatively small and unsustainable amount of funding. Additionally, operational funding relies entirely on waste sales, with minimal incentives for administrators. Supporting facilities, such as a plastic shredding machine that could enhance the economic value of waste, have yet to be realized due to budget constraints.

Beyond financial factors, community participation remains uneven. Awareness campaigns are ongoing, but some residents are still reluctant to sort waste at home. To enhance engagement, the waste bank management integrates environmental education with *Posyandu* (integrated health services for mothers and children), requiring mothers to bring used plastic bottles during baby weigh-ins. This initiative aims to foster early awareness of the importance of community-based waste management. To further optimize the waste bank program, a capacity-building approach can be implemented. According to Leeman et al. (2016), capacity development in social organizations should encompass leadership, member training, and broader community involvement. Therefore, the optimization strategy for the waste bank can focus on three key aspects :



1. **Diversification of Funding Sources** : Limited operational funds remain a major challenge for the sustainability of the waste bank. Therefore, one optimization model that can be implemented is establishing partnerships with the private sector and government to secure alternative funding sources. Muljaningsih et al. (2022) emphasize that waste banks collaborating with external parties—such as recycling companies or donor organizations—can improve their financial stability. For Bumi Bebeb Waste Bank, partnership opportunities can be explored through corporate social responsibility (CSR) programs, government grants, or collaboration with digital waste management startups. With additional funding, the waste bank could invest in equipment such as plastic shredding machines, which can increase the economic value of collected waste.
2. **Enhancing the Capacity of Managers and the Community** : More intensive training for both waste bank managers and the community is essential to improve program effectiveness. Currently, training sessions are sporadic and lack a structured schedule. However, Goldberg & Bryant (2012) highlight that systematic and continuous training is crucial for building organizational capacity. To address this, a structured training module should be developed, covering technical aspects (waste sorting, processing waste into recycled products) and managerial aspects (waste bank financial management, marketing strategies for recycled products). With enhanced capacity, the waste bank can develop a more professional and long-term business model.
3. **Strengthening Policies and Regulations** : Regulatory support from local governments needs to be improved to provide more concrete assistance for waste banks. Currently, waste bank regulations in Bandung City are limited to small incentives, with no sustainable long-term assistance mechanisms. Kurniawan et al. (2021) suggest that waste bank management should be integrated into community-based circular economy policies, where waste banks not only serve as temporary storage facilities for recyclable waste but also function as environmental education centers and hubs for social innovation. If the local government actively promotes regulations benefiting waste banks, such as subsidies or tax incentives for companies that collaborate with them, the program's sustainability will be more secure.

Suka Asih Waste Bank

The Suka Asih Waste Bank has implemented several innovative strategies to optimize waste management. Initially, the waste bank faced challenges due to the low awareness of waste segregation among the community. To address this issue, the management introduced the "waste donation" concept, encouraging residents to donate economically valuable waste for social programs. This initiative directly benefits the community, as funds generated from waste management are used for charitable donations and social activities.

Additionally, the Suka Asih Waste Bank established a cooperative that provides basic necessities and savings and loan services for waste management workers. This cooperative serves as an economic solution, helping the community avoid high-interest loans. The management also utilizes maggots as an effective organic waste treatment method, which produces livestock feed.



Collaboration with the Environmental Agency (DLH) has provided support in the form of waste management equipment, although the assistance remains limited and requires further expansion.

1. **Capacity Building for Managers and the Community :** Research findings indicate that the Suka Asih Urban Waste Bank program focuses on capacity building at both the management and community levels. Leeman et al. (2016) emphasize that effective capacity development must involve all levels within an organization, including leadership and the community. In this context, the waste donation initiative not only encourages active community participation in sorting and donating waste but also fosters a culture of sustainable participation. Brix (2019) states that capacity building is not merely an individual effort but a social product that emerges from interactions among members of an organization. The waste donation concept initiated by waste bank managers serves as a form of collaboration that strengthens the community's capacity to actively engage in environmental management.
2. **Innovative Model for Economic Welfare :** The establishment of a waste bank-based cooperative to enhance community economic welfare aligns with Bryan & Brown's (2015) theory, which suggests that capacity building can be achieved by creating systems that support economic sustainability. Through this cooperative, the management provides basic necessities and savings and loan services, helping residents avoid high-interest debt traps. Furthermore, Putri (2023) emphasizes that waste banks can improve community economies through an incentive system that allows waste to be exchanged for products or services of economic value. In this regard, the Suka Asih Urban Waste Bank cooperative has successfully implemented a similar approach, delivering tangible benefits to the community.
3. **Utilization of Maggot Technology for Organic Waste Management :** The use of maggots as an organic waste management method supports the circular economy paradigm described by Kurniawan et al. (2021). This approach highlights the importance of adopting zero-waste strategies to create a more effective environmental management system. By utilizing maggots, organic waste, which was previously an environmental problem, can be converted into economically valuable livestock feed. Additionally, this method demonstrates innovation in sustainable waste management. Erdiansyah et al. (2016) mention that technology in waste management can enhance operational efficiency and generate significant added value. The implementation of maggot technology in Suka Asih serves as a concrete example of how simple technology can provide effective environmental solutions.
4. **Role of Regulations and Government Support :** Government support, particularly from the Environmental Agency (DLH), in providing waste management equipment represents a relevant form of collaboration, in line with Triastuti et al. (2021), who highlight the importance of policies and regulations that support community-based environmental management efforts. However, the limited support received indicates the need to strengthen government commitment to sustaining waste bank programs. Goldberg & Bryant (2012) emphasize that successful capacity building often depends on leaders' willingness to support and facilitate change. In this context, regulatory strengthening and increased government support could be key factors in ensuring the



long-term sustainability of waste bank programs in Bandung. Moreover, continuous evaluation of waste bank program effectiveness is crucial to identifying challenges and making necessary adjustments. Triastuti et al. (2021) state that a systematic evaluation process can enhance accountability and program performance.

CONCLUSION

This study reveals that waste bank management in Bandung City faces various challenges, including limited human resources, lack of policy support, and low community participation. Through a capacity-building approach, the research finds that optimization efforts can be achieved by strengthening individual and organizational skills, improving supportive regulations, and building strategic partnerships with the private sector and communities.

Each waste bank analyzed in this study operates with a different model but encounters similar issues.

- a. Kobersih Waste Bank highlights the importance of environmental education integration in waste management but struggles with limited human resources and external support.
- b. Bumi Bebeb Waste Bank applies a community-based approach but remains dependent on unsustainable government incentives.
- c. Suka Asih Urban Waste Bank successfully develops an innovative model based on cooperatives and maggot technology, yet still requires stronger regulatory support.

To enhance the effectiveness of waste bank programs, the author formulates a series of strategic optimization steps to improve performance:

- a. Human Resource Development – Strengthening the capacity of waste bank managers through recruitment, continuous training, and mentoring.
- b. Partnerships with the Private Sector and Communities – Collaborating with private companies and community organizations to diversify funding sources and operational support.
- c. Enhancing Community Participation – Intensifying public outreach and involving community leaders in environmental advocacy.
- d. Policy and Regulatory Support – Encouraging incentives, subsidies, and access to waste management facilities through government regulations.

The optimization model for waste bank effectiveness requires a holistic approach encompassing various strategic aspects:

- a. Human resource development is a key factor in enhancing managerial capacity through recruitment, continuous training, and mentoring.
- b. Partnerships with the private sector and communities play a crucial role in diversifying funding sources and ensuring sustainable operational support.
- c. Active community participation must be reinforced through intensive awareness campaigns and engagement of community leaders in environmental advocacy.
- d. Government policy and regulatory support serve as a critical element in strengthening the ecosystem for sustainable waste management.

Through the synergy of these steps, waste bank programs can operate more effectively and make a significant contribution to better environmental management.



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