

OPTIMIZING COMMUNITY-BASED WASTE MANAGEMENT: A REVIEW OF THE LITERATURE

Ramadha Yanti Parinduri *¹

Universitas Pembinaan Masyarakat Indonesia
yantifkmb@gmail.com

Cut Sah Kha Mei Zsazsa

Universitas Pembinaan Masyarakat Indonesia Medan
cutsasa22@gmail.com

Muhammad Yusup

IAI Nusantara Batang Hari
yusup9253@gmail.com

Abstract

Increased waste production is one of the critical environmental problems worldwide. Optimizing waste management, especially community-based waste management, is considered an efficient solution in addressing this problem. This research uses a literature review approach, where data and information are collected from various sources including scientific journals, articles, research reports, and government documents relevant to community-based waste management. The results show that community involvement and active participation in waste management, environmental awareness education, and incentives are key factors in the success of community-based waste management. In addition, the role of the government is crucial in providing support in the form of favorable regulations, adequate infrastructure, and facilitation of collaboration between the community, government, and private sector. This study also found that the integration of technology in the waste management system contributes to improving the efficiency and effectiveness of the process.

Keywords: Optimization, Waste Management, Community-based.

Introduction

Waste management is one of the crucial environmental issues faced by many countries in the world. The problem of waste is not only related to the volume that continues to increase along with population growth and community consumption, but also related to the management system that has not been optimized (Sari, 2022).

¹ Correspondence author

In many areas, waste disposal is still done carelessly, inefficient waste selection and processing, and lack of public awareness and participation in managing waste (Puspitasari & Hidayat, 2022).

In recent decades, the concept of community-based waste management has emerged as an alternative solution that is considered to increase the effectiveness and efficiency in managing waste (Andayani et al., 2023). This approach emphasizes the active involvement of local communities in the waste management process, starting from segregation, collection, to processing waste into something more valuable. This concept is expected to not only reduce the volume of waste disposed to landfills, but also increase community awareness and responsibility for the environment (Nindya et al., 2022).

Waste management is an urgent environmental issue, due to the huge impact it has on public health, ecosystem balance, and climate change (Abdussamad et al., 2022). The ever-increasing volume of waste, coupled with ineffective and unsustainable management methods, causes serious problems ranging from air, soil, and water pollution, to high greenhouse gas emissions (Saputra & Fauzi, 2022). In addition, inefficient waste management also takes up land that could be utilized for other social and economic purposes (Sulistiyani, 2022). Therefore, there is a high urgency to prioritize optimizing waste management, not only as an effort to mitigate negative impacts on the environment and public health, but also in the context of utilizing waste as a valuable resource.

However, community-based waste management also faces various challenges, both in terms of technical, management, and social aspects (Islami, 2022). On the other hand, there are various waste management initiatives and models in various regions that have been successfully implemented, offering valuable lessons on the factors that support the successful implementation of the concept (Andayani et al., 2023).

Waste management in urban areas faces significant challenges, mainly due to the large volume and complex composition of waste, most of which is generated by domestic and commercial activities. High population density and consumption patterns that tend to lead to abundant waste production are the main challenges. In addition, the limited land for landfills forces the city government to find creative and sustainable solutions in handling waste (Tarigan & Dukabain, 2023). On the other hand, poorly integrated waste management systems often lead to waste not being processed effectively, causing pollution and various health problems (Ningrum et al., 2022). Inefficient waste management and segregation, as well as the

lack of adequate treatment facilities, create major challenges in efforts to reduce the volume of waste disposed of in landfills (Armus et al., 2022).

Meanwhile, waste management challenges in rural areas tend to be different. In many cases, the lack of infrastructure and resources is the main obstacle. The availability of adequate waste management facilities and infrastructure, such as garbage trucks, disposal sites, and recycling facilities are still very limited. The awareness of rural communities regarding the importance of waste management is often still low, with much waste still being burned or carelessly dumped into rivers and vacant lots (Jauhariyah et al., 2023). In addition, understanding of waste segregation and the benefits of recycling is also still limited, so opportunities for more sustainable waste management are underutilized (Maharja et al., 2022). The lack of approaches tailored to the rural context, such as community empowerment and the application of simple technologies for waste management, is one of the challenges that need to be overcome to achieve effective waste management in rural areas (Saputra & Fauzi, 2022).

Considering the challenges faced in both urban and rural areas, there is an urgent need to adopt an integrative and inclusive waste management strategy that caters to the specific needs of each context (Ivakdalam & Far, 2022). In urban areas, increasing the capacity of waste management infrastructure, such as recycling facilities and waste power plants, along with strengthening government policies to support waste reduction initiatives at source, can have a significant impact in reducing the burden on landfills. Public education and awareness campaigns on the importance of waste reduction and segregation should be a regular agenda to change consumption and waste management behaviors (Manyullei et al., 2022).

Thus, effective and sustainable waste management requires a holistic approach that combines policy, community participation, and technological innovation. In the urban context, the focus should be on building adequate and integrated infrastructure, and promoting a culture of waste reduction and recycling. In rural areas, community empowerment and effective use of technology can improve waste management. Integration between local governments, communities, and other institutions is necessary to achieve the goal of better and more efficient waste management. The key is to tailor solutions to the specific needs of each context, while encouraging the involvement of all parties in creating a sustainable waste management model, for the sake of future environmental sustainability.

The importance of conducting a literature review on optimizing community-based waste management sits on the need to identify and analyze various models

and strategies that have been implemented, explore the successes and obstacles faced, and formulate recommendations that can be adopted by other communities in developing a better waste management system. This research is expected to provide new insights and directions in efforts to optimize waste management, so that it can contribute significantly to the solution of global waste problems.

Research Method

The research method used in this study is literature review. The literature review method is a systematic and comprehensive research approach in collecting, reviewing, and analyzing relevant publications for a particular topic or research question (Sio et al., 2024; Nguyen et al., 2024). This method is used to identify, understand, and draw conclusions from previous work that has been done in the same or related fields of study (Kim et al., 2024).

Result and Discussion

Waste Management Concept

Waste management is a process that includes waste collection, transportation, treatment, and disposal. This process is not only focused on the management of waste and hazardous materials, but also includes resource management and environmental protection (Andayani et al., 2023). The goal is to reduce waste generation, increase recycling and recovery, and reduce negative impacts on the environment and human health (Puspitasari & Hidayat, 2022). Modern approaches to waste management involve practices such as waste reduction at source, waste segregation to facilitate recycling, and the use of technologies such as thermal processing and composting to convert waste into more useful forms (Andayani et al., 2023).

In a broader context, effective and sustainable waste management also includes social and economic aspects in the policies made. For example, incentives for recycling, community education programs on the importance of waste management, and government policies that support waste reduction initiatives (Nindya et al., 2022). Community and private sector involvement is also crucial in designing and implementing effective waste management strategies. With increased public awareness and regulatory support, waste management can evolve into a system that not only prevents environmental damage but also improves quality of life and environmental sustainability for generations to come (Abdussamad et al., 2022).

Community-based Waste Management

Community-Based Waste Management (CBWM) is an approach to waste management that prioritizes active community participation in every aspect of the process, from waste reduction at the source, segregation, collection, to waste processing and reuse (Wahyudi & Budiyanto, 2024). This approach emphasizes that an effective solution to the waste problem does not only depend on technical interventions or government policies alone, but also on behavioral changes and active participation from the community itself. By directly involving the community, CBNRM aims to create a more sustainable waste management system, reduce environmental impacts, and increase community awareness and responsibility for their environment (Suryawan & Lee, 2023).

The basic principles of CBNRM include several main things, namely community participation, waste reduction at the source, waste segregation by type, and reuse or recycling as an effort to minimize the amount of waste that ends up in landfills (Djuwendah et al., 2023). The principle of community participation ensures that all individuals in the community, from different backgrounds and ages, are given the knowledge, skills, and opportunities to contribute to waste management. Waste reduction at source is pursued through education to reduce the consumption of unnecessary goods and increase the efficiency of material use (Qomariyah & Hamid, 2023). Waste segregation aims to enable recyclable or compostable materials to be processed further, while reutilization or recycling can reduce the burden of waste entering the landfill, while saving natural resources (Archip et al., 2023). By applying these principles, CBM not only addresses the waste problem from upstream to downstream, but also improves the quality of life of the community through the establishment of a cleaner and healthier environment (Ramang et al., 2023).

The implementation model of Community-Based Waste Management (CBSM) varies across countries, tailored to the local context and needs. In developing countries such as Indonesia, a frequently implemented model is the “waste bank,” a system where people can exchange their segregated waste, especially inorganic waste such as plastic and metal, for money or goods (Phan et al., 2023). This initiative not only encourages waste segregation at source but also provides economic incentives to the community. On the other hand, in the Philippines, there is a model known as the Barangay Waste Management Program, where local communities or neighborhoods (Barangays) develop their own waste

management systems that include waste segregation, composting, and recycling programs, with support from the local government (Fernández-Braña & Dias-Ferreira, 2023). This model prioritizes community involvement and initiative in managing waste, while strengthening cooperation between communities and with the government (Shu et al., 2023).

In developed countries such as Japan, the CBM model is characterized by highly organized technologies and systems that are strictly adhered to by the community. The waste management system in Japan entails a very detailed and strict waste segregation, which involves the community to sort their waste into many different categories (Yodkhayan & Muneenam, 2023). Advanced technologies are used to process different types of waste, including efficient incineration and material recycling, with strict monitoring of emissions and environmental impacts. This shows how community involvement, supported by government regulations and technology, can create a highly effective waste management system (Latanna et al., 2023). In contrast, the Nordic countries implement CBNRM with a focus on the circular economy and sustainability, through innovations in product design for easy recycling and responsible consumption. Each of these CBNRM models reflects how waste management can be adapted to local social, economic, and environmental characteristics, with the community at the center of the initiative (Souza et al., 2023).

Looking at the various implementation models of Community-Based Waste Management (CBSM) in various countries, it becomes clear that community involvement is the main key to success in addressing waste management challenges. Each model, from waste banks in Indonesia to advanced waste management systems in Japan, shows that the approach taken must fit the social conditions, economics, cultural values, and specific needs of the local community (Tilahun et al., 2023). This approach is not only about reducing the volume of waste generated but also about changing people's perception and behavior towards waste, increasing environmental awareness, and encouraging sustainable practices (Ismiraj et al., 2023).

In conclusion, Community-Based Waste Management is not only a solution to the waste management problem itself but also an important tool in building environmental and social sustainability. This initiative demonstrates how individuals and communities can play a direct role in addressing global issues through local action. CBNRM teaches the values of responsibility, collaboration, and innovation, explaining that great change often starts in the community. With

an inclusive, adaptive and participatory approach, CBNRM has the potential to not only reduce waste problems but also build stronger, more sustainable and environmentally responsible communities. Therefore, it is important for the government, private sector, and civil society organizations to continue to support and promote community-based waste management as part of a broader environmental management strategy.

The success of the Community-Based Waste Management (CBWM) model lies in its ability to mobilize the participation of local communities and institutions in sustainable waste management practices. These models have successfully increased environmental awareness among communities, encouraged more responsible behavior towards waste, and significantly reduced the amount of waste that ends up in landfills (Oates et al., 2023). For example, the waste bank program has successfully turned waste into an economic resource, motivating people to segregate waste at home. On the other hand, strict waste management systems such as in Japan show how public education and strong regulations can create discipline and compliance in waste management practices (Sunarti et al., 2023). These successes illustrate the great potential of CBNRM in addressing waste problems, while strengthening communities and reducing environmental impacts (Idilia et al., 2023).

However, the implementation of CBM also faces a number of challenges. One of the main challenges is changing community behavior, which often requires significant time and effort. Although there is awareness about the importance of waste management, not all community members easily adopt waste segregation practices or participation in recycling programs for various reasons, including limited facilities, access to information, or motivation (Pamuji et al., 2023). Another challenge is ensuring the financial sustainability of this CBM model, especially in developing countries where government resources and support may be limited. Strengthening inter-sectoral partnerships and developing innovative business models are key to overcoming this challenge, ensuring sustainable waste management practices are not only environmentally beneficial but also economically beneficial for communities and other stakeholders (Constantino et al., 2023).

Waste Management Optimization

Strategy to increase effectiveness

To improve the effectiveness of Community-Based Waste Management (CBWM), strategies that should be prioritized are education and community engagement. Increasing public awareness and understanding of the importance of waste management through continuous and innovative education could be the key to changing attitudes and behaviors (Yandri et al., 2023). Environmental education programs that are engaging and touch all ages, from children to adults, will help build a more environmentally responsible generation (Constantino et al., 2023). In addition, collaboration with schools, universities, and other educational institutions to incorporate waste management materials into the curriculum can reinforce this understanding from an early age. Providing incentives for participation in waste management programs can also encourage wider community involvement (Pamuji et al., 2023).

Furthermore, infrastructure development and technological support are other important strategies to improve the effectiveness of CBNRM. Improved access to adequate waste sorting and processing facilities will make it easier for communities to participate in recycling and composting systems. Investments in waste management technology, such as mobile applications for waste management education and coordination, as well as the development of more efficient waste collection methods, can strengthen the CBNRM system (Idilia et al., 2023). Good inter-sectoral coordination between the government, private sector, and community is also needed to ensure all aspects of waste management are addressed in a holistic and sustainable manner. These strategies, if implemented effectively, will not only increase the effectiveness of waste management but will also lead to the development of a cleaner, healthier, and more sustainable environment (Sunarti et al., 2023).

Application of technology in waste management

The application of technology in waste management has been a revolutionary step that helps improve the efficiency of collection, sorting, and recycling processes. Technologies such as the Internet of Things (IoT) have enabled the creation of smart bins that can monitor waste levels in real-time, optimize waste collection routes, and even sort waste types automatically (Wahyudi & Budiyo, 2024). For example, some cities have adopted waste bins equipped with sensors to notify waste management officers when the bins are full, ensuring more efficient waste collection and reducing the possibility of waste overflowing onto the streets. In addition, automated sorting technology uses advanced conveyor systems and

scanners that can identify and separate different types of materials, speeding up the sorting process and improving the quality of recycled materials (Suryawan & Lee, 2023).

In recycling, innovations such as the use of high-tech robots and artificial intelligence (AI) for waste sorting have great potential to increase the capacity and efficiency of recycling systems. These robots can work non-stop, sorting material types with much greater speed and accuracy than humans. Artificial intelligence can also analyze data from the waste management process to detect patterns and improve overall operations (Djuwendah et al., 2023). In addition, digital platforms and mobile applications have become vital tools to educate and engage the public in waste management activities, such as drop off locations for recyclables and collection schedules. The use of these technologies not only simplifies and improves the effectiveness of waste management practices, but also makes an important contribution to environmental conservation efforts for generations to come (Qomariyah & Hamid, 2023).

Community and government involvement

Community involvement is one of the crucial aspects in successful waste management. Continuous education and socialization to the community about the importance of good waste management can form positive habits in disposing of waste responsibly (Archip et al., 2023). Waste management programs that involve active community participation, such as waste management from the source (waste banks), household organic waste composting, and recycling programs, can preserve the environment while reducing the burden on landfills. Communities that are actively involved in waste management will feel ownership and responsibility for the cleanliness and sustainability of their environment. Community empowerment through educational activities and field practices, such as waste management training, can increase awareness and skills in managing waste effectively and sustainably (Ramang et al., 2023).

On the other hand, the government has an important role in providing infrastructure, regulations, and facilities that support community-based waste management efforts. Supportive policy schemes, such as incentives for individuals or community groups who are successful in waste management, as well as the establishment of recycling facilities that are easily accessible to the community, are needed to encourage active community participation (Phan et al., 2023). The government can also play a role in ensuring the availability of information on

proper waste management through various communication channels. Cooperation between the government and various parties, including the private sector and communities, in waste management cooperation programs can maximize existing resources and expertise to achieve environmental conservation goals. Thus, synergy between the government and the community is key in creating an effective and sustainable waste management system (Fernández-Braña & Dias-Ferreira, 2023).

Thus, efficient and sustainable waste management requires a combination of technological innovation and the active involvement of both the community and the government. Technologies such as IoT, AI, and robotics can provide solutions to improve efficiency in waste collection, sorting, and recycling, while community participation equipped with education and environmental awareness is fundamental in instilling good waste management practices. The government must support these efforts through policies that facilitate infrastructure, access to information, and incentives for successful waste management programs. A strong synergy and collaboration between the government, the community, and the private sector will create a cleaner, healthier, and more sustainable environment for current and future generations.

Conclusion

The implementation of a waste management strategy that involves the active participation of the community is the key to success in creating an effective and sustainable system. Based on the literature review, it is clear that community-based waste management not only optimizes the collection and recycling process, but also increases environmental awareness and responsibility in individuals. Programs such as composting of organic waste, waste bank system, and community cooperation in waste segregation have been proven to reduce the volume of waste disposed to landfills.

Furthermore, these findings support the idea that government policies that support community-based waste management initiatives are crucial in ensuring the sustainability of these programs. The provision of incentives, whether in the form of financial or non-financial support, policies that favor community-based waste management practices, as well as the development of supportive infrastructure, are some of the steps that can be taken by the government to strengthen community participation. Optimizing waste management with a community-based approach

will not only have a positive impact on the environment but also on improving the overall quality of life of the community.

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