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Evaluation of the Community-Based Waste Management System in Pasuruan City

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ABSTRACT

This study evaluates the performance of the community-based waste management (CBWM) system in Pasuruan City by applying a circular economy perspective. Rapid urbanization and increasing waste generation have placed significant pressure on municipal waste management systems in Indonesia, particularly in small and medium-sized cities. Using a qualitative descriptive approach supported by secondary data from the 2024 Regional Environmental Management Performance Information Document (DIKPLHD), this study assesses the effectiveness of key CBWM initiatives, including the TERPANA (Separated, Processed, Without Residue) program, 3R Waste Management Sites (TPS 3R), Community Self-Help Groups (KSM), waste banks, and landfill methane utilization. The findings indicate that CBWM initiatives have contributed to a reduction of approximately 20.71% in residual waste sent to landfills, despite daily waste generation reaching 451.06 m³ and landfill capacity nearing saturation. The success of these initiatives is driven by the integration of community participation with institutional support, incentive mechanisms, and local policy instruments. Waste banks, numbering 227 active units, have strengthened socio-economic outcomes by transforming waste into financial value, while methane gas utilization has provided alternative energy for 110 households. However, challenges remain, particularly in uneven household waste segregation, limited processing capacity, and the absence of digital waste management systems. This study demonstrates that CBWM effectiveness depends not solely on community engagement, but on its institutional embedding within municipal governance, offering important insights for sustainable urban waste management in Indonesia.

1. Introduction

Waste is an environmental problem that continues to increase along with population growth and economic activity. Urban waste management is a major challenge to sustainable development in Indonesia. Population growth, rapid urbanization, increased consumption, and changing lifestyles have led to a significant increase in household and commercial waste generation (Mubarok et al., 2025). For example, systematic studies show that household waste generation in Indonesia is strongly influenced by socioeconomic factors, residential location, and public awareness of waste management (Wijaya et al., 2024). Waste management is still a persistent problem in Indonesia,

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particularly in metropolitan areas. Waste management in Indonesia continues to be a strategic environmental issue that requires comprehensive and sustainable management. Population growth, urbanization, and increased economic activity are the main drivers of increasing waste generation in urban areas. According to the Ministry of Environment and Forestry (KLHK), Indonesia produces more than 68 million tons of waste annually, with approximately 60% coming from household waste (KLHK, 2023). This situation demonstrates that conventional waste management systems, which focus on collection, transportation, and disposal, are no longer adequate to address modern challenges (Amanda et al., 2024). Waste generation in metropolitan areas, including Pasuruan City, the capital of East Java Province, is influenced by a number of interrelated characteristics, including population growth, the economy, welfare, consumption patterns, security, population behavior, and transportation (Kahfi, 2017). Pasuruan City, as one of the developing cities in East Java, faces major challenges in waste management due to the increasing volume of waste generation which will reach 451.06 m^3 per day in 2024. This increase has an impact on reducing environmental carrying capacity, increasing air and water pollution, and the emergence of public health problems such as diarrhea, dengue fever, and typhus. The Pasuruan City Government has made waste management a top priority, aiming to support the national program "Indonesia Bebas Sampah 2025".

Research conducted by Ningsih and Kurniawati (2021) shows that population growth is directly proportional to the volume of waste generated, while public awareness of waste sorting remains low (Iswanto et al., 2024). Furthermore, most cities in Indonesia still rely on landfills (TPA) as the final point of waste management, with an open dumping system that has the potential to pollute groundwater and air. This has significant impacts on environmental quality and public health (Suryani et al., 2020). The application of the 3R principle (Reduce, Reuse, Recycle) and the development of a circular economy are beginning to emerge as important solutions in urban waste management policies. A study by Fauzi and Setiawan (2022) explains that community-based implementation of 3R initiatives, such as waste banks and 3R waste disposal sites (TPS 3R), has been shown to reduce waste generation by up to 30% in several areas. However, social and institutional factors remain major obstacles, including a lack of local regulatory support, facilities, and incentive systems for communities (Putri & Rachman, 2023). The local government has implemented various innovations, such as the implementation of the TERPANA (Separated, Processed, Without Residue) program, the establishment of Community Self-Help Groups (KSM) to manage the 3R Waste Disposal Sites (TPS), and the development of a digital and socio-economic-based Waste Bank. These innovations align with the national agenda of "Clean Indonesia 2025," which emphasizes the importance of public participation in waste reduction at the source (Pasuruan City Environmental Agency, 2024). Therefore, this research is crucial to analyze the effectiveness of the waste management system in Pasuruan City through an innovation-based approach and community participation. This approach is expected to provide an empirical contribution to the development of more efficient, sustainable, and environmentally equitable waste management strategies.

Unlike many existing studies that emphasize community-based waste management (CBWM) primarily at the household or neighborhood scale, this study contributes to the literature by examining CBWM as an integrated municipal system embedded within a circular economy framework. Previous studies have demonstrated that waste banks and TPS 3R can reduce waste generation and enhance community awareness; however, they often lack empirical evaluation of how these initiatives are institutionalized at the city level and linked to formal policy instruments, fiscal incentives, and energy recovery systems. In Pasuruan City, CBWM is implemented as a coordinated governance mechanism that is backed by budget allocation, municipal regulations, and performance monitoring via the Regional Environmental Management Performance Information Document (DIKPLHD) rather than as a stand-alone community initiative. By describing why and how community-based programs like TERPANA, TPS 3R run by Community Self-Help Groups (KSM), waste banks, and landfill methane utilization have been able to lessen reliance on landfills while producing socioeconomic and environmental benefits, this study fills a significant gap in the literature. This study offers empirical insights on urban waste governance in Indonesian small and medium-sized cities by placing CBWM within a circular economy framework.

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2. Research Method

This study employs a qualitative descriptive approach based on systematic secondary data analysis derived from the 2024 Regional Environmental Management Performance Information Document (DIKPLHD) of Pasuruan City. The use of secondary data is methodologically justified because DIKPLHD constitutes an official, standardized, and audited government document that integrates quantitative indicators and qualitative assessments of municipal environmental performance, including waste generation, waste reduction rates, infrastructure availability, institutional arrangements, and community participation levels. Since the goal of the study is to assess system-level performance and policy effects rather than individual behavioral impressions, primary data collection was not done. The Driving Force Pressure State Impact Response (DPSIR) framework is used in the study to organize the data interpretation. Urbanization and waste generation growth are driving forces; rising waste volume is a sign of pressure; landfill capacity limitations are a reflection of the state; environmental and social risks are indicators of impacts; and community-based innovations like TERPANA, TPS 3R, waste banks, and methane utilization are policy responses. The rigorous and clear connection between data, interpretation, and conclusions is guaranteed by this analytical framework.

3. Results and Discussion

Based on DIKPLHD 2024, Pasuruan City generates approximately 451.06 m³ of waste per day, with an overall waste management service coverage of around 80% of the urban area. However, the remaining landfill capacity at Blandongan Landfill has reached a critical level, with 401,457 m³ out of 433,788 m³ already filled, indicating an urgent need for waste reduction at the source. The implementation of CBWM initiatives has demonstrably reduced pressure on the landfill. The TERPANA program alone contributed to a 20.71% reduction in residual waste transported to the landfill, indicating that source separation and decentralized processing are effective when supported by institutional facilitation and community incentivesWaste management in Pasuruan City has shown significant progress over the past five years. According to the 2024 Pasuruan City Environmental Management and Environmental Management Agency (DIKPLHD), daily waste generation reached 451.06 m³ per day, with waste management capacity covering approximately 80% of the urban area (Pasuruan City Environmental Agency, 2024). Pasuruan City operates one controlled landfill site (TPA) in Blandongan, with a total volume of 433,788 m³, of which 401,457 m3 has been filled. This indicates that the TPA's capacity is nearing its maximum, making waste reduction and reuse a priority. Management efforts are carried out through an integration of local government programs and community initiatives, based on the principles of Reduce, Reuse, and Recycle (3R). The waste collection and transportation system is managed by the Department of Environment, Sanitation, and Parks (DLHKP), while at the community level, active participation is achieved through 3R Waste Management Sites (TPS 3R), Waste Banks, and Community Self-Help Groups (KSM). This multi-layered institutional structure serves as the foundation for implementing a circular economy at the local level (Hakim and Koh, 2024).

The circular economy concept in waste management emphasizes the importance of utilizing waste materials as new resources, rather than as final waste (Geissdoerfer et al., 2017). Pasuruan City has begun adopting this concept through various innovations, such as the TERPANA (Separated, Processed, Without Remainder) program and the utilization of methane gas from the Blandongan Landfill. Through the TERPANA program, household waste is sorted at source and then processed at the 3R TPS using a PSD (Domestic Waste Processing) machine to produce environmentally friendly organic growing media (DLHKP Pasuruan City, 2024). Meanwhile, the utilization of methane gas from the Blandongan Landfill is a concrete example of the implementation of a circular economy in the energy sector. A total of 110 households have utilized methane gas from the decomposition of organic waste as a substitute for LPG. This innovation not only reduces greenhouse gas emissions but also provides economic benefits to the surrounding community.

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The success of the TERPANA program and TPS 3R facilities in Pasuruan City can be attributed to three interrelated factors. First, institutional support from the municipal government ensures the availability of infrastructure, such as PSD machines and operational assistance for 12 active TPS 3R units distributed across four districts. Second, community empowerment through KSM enables localized decision-making and operational flexibility, allowing waste processing activities to adapt to neighborhood conditions. Third, incentive-based participation, including access to compost and economic benefits from recyclable materials, sustains long-term community engagement.

Despite these successes, the DIKPLHD data indicate persistent challenges, particularly uneven household waste segregation and limited processing capacity in several TPS 3R units. These findings suggest that CBWM effectiveness depends not only on community willingness but also on continuous institutional reinforcement.The TERPANA Program is one of the Pasuruan City Government's leading innovations in shifting the waste management paradigm from end-of-pipe to resource-based management. According to a 2024 report by the Environmental Agency for Environment and Forestry (DLHKP), the implementation of this program reduced waste residue sent to landfills by 20.71%. These results align with the findings of Fauzi and Setiawan (2022), who showed that a community-based 3R system can reduce waste generation by 15–30% in urban areas. In addition to technical efficiency, TERPANA's success is also determined by the level of community participation. Residents in Purutrejo and Gadingrejo sub-districts, for example, have been actively involved in household sorting and composting activities. This participation is reinforced by the DLHKP's educational approach and incentive system, such as providing free compost from the 3R waste collection center (TPS) to residents who diligently sort their waste.

By 2024, Pasuruan City had 12 active TPS 3R units spread across four sub-districts. Of these, Gadingrejo Sub-district was the most productively managed area, with seven operating TPS 3R (DLHKP Pasuruan City, 2024). Each TPS 3R was managed by a Community-Based Group (KSM) that played a role in sorting, processing, and distributing recycled products. The KSMs "Bersih Mandiri," "Indah Jaya," and "Ganteng (Gading Tengah)" served as examples of good practices. They processed organic waste into compost and inorganic waste into plastic crafts or simple building materials. Pasuruan City operates 227 active waste bank units, which collectively play a strategic role in transforming waste into economic assets. Programs such as “Waste for Land and Building Tax (PBB) Payment” and “Gold Savings” demonstrate how fiscal and symbolic incentives strengthen participation. Economically, waste bank activities generate tens of millions of rupiah per month, much of which circulates back to households, reinforcing the social sustainability of CBWM. This finding supports the argument that waste banks function not merely as waste collection mechanisms but as community-based circular economy institutions that integrate environmental management with local economic resilience.According to Ningsih and Kurniawati (2021), this type of community involvement increased environmental awareness while providing new economic value for low-income households. However, challenges arose, including limited equipment, operational costs, and fluctuating selling prices for recycled products. The local government has responded to this by providing assistance in the form of shredding machines and incentives for recycled products to maintain the operational sustainability of the 3R TPS.

Pasuruan City is also known for its innovative and integrated Waste Bank system. By 2024, there were 227 active Waste Bank Units (BSU) with thousands of customers saving their waste each month. The "Waste Bank for PBB and Gold Savings" program is a major attraction because it shifts the paradigm of waste as a source of income and social savings (Pasuruan City DLHKP, 2024). According to Putri and Rachman (2023), the waste bank system not only encourages environmentally friendly behavior but also strengthens a community-based circular economy. In Pasuruan City, waste collected in waste banks is distributed to the 3R Waste Recycling Site (TPS 3R) or sold to collectors in the recycling industry. Economically, the revenue generated from waste bank activities reaches tens of millions of rupiah per month, much of which is returned to the community. This program also plays a role in environmental education. Schoolchildren and Family Welfare Movement (PKK) groups are involved as customers, fostering ecological awareness from an early age. Such activities have proven effective in developing sustainable behavior (Suryani et al., 2020).

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Utilizing methane gas from the Blandongan Landfill is a strategic step in implementing waste-to-energy (WtE). A total of 110 households have used this gas for cooking. According to the EEA (2014), implementing WtE can reduce potential carbon emissions by 1.2 tons of CO_2 per household per year. Furthermore, previously wasted methane gas now has economic value, in line with the resource recovery principle of a circular economy (Dawantara et al., 2024). This effort makes Pasuruan City a pioneer in managing energy from domestic waste at the small-city level in Indonesia. However, challenges include maintaining a stable gas supply and maintaining the distribution pipeline system, which requires technical support from the central government and universities.

From an institutional perspective, the Pasuruan City Government has established several supporting regulations, such as Mayoral Decree No. 188/477/423.031/2015 concerning Land and Building Tax (PBB) payments through Waste Banks and Mayoral Regulation No. 38 of 2016 concerning the reduction of plastic bag use. These policies strengthen the legal framework for implementing the 3R principles and expand citizen participation in waste management (Pasuruan City Environmental Agency for Environment and Forestry, 2024). However, weaknesses remain in inter-agency coordination and a lack of digital data-based evaluation. A study by Fauzi and Setiawan (2022) recommends implementing a smart waste management system to integrate real-time data on waste generation, waste banks, and transportation.

Despite ongoing innovation, the main challenge remains in waste reduction at source. Based on 2024 data, approximately 11.84% of waste in Pasuruan City is not optimally managed (Pasuruan City Environmental Agency for Environment and Forestry, 2024). This is influenced by the lack of sorting at the household level, limited collection vehicles, and the ongoing practice of open waste burning in several areas. From an institutional perspective, KSM and TPS 3R still face operational financing constraints and low market prices for recycled products. This issue is similar to the findings of Putri and Rachman (2023), who showed that the sustainability of community-based management systems requires fiscal and technical incentive support from the local government.

The positive impact of a circular economy-based waste management system in Pasuruan City is evident in the improvement in environmental quality and public health. Data from the Health Office shows a decrease in cases of environmentally-related diseases such as diarrhea and dengue fever in areas with active waste banks. Furthermore, community participation in environmental activities has increased through the "Kelurahan Berseri" and "Sekolah Adiwiyata" programs. Another social impact is increased community solidarity. The joint waste management program encourages interaction between residents and strengthens social capital. This aligns with research by Ningsih and Kurniawati (2021), which emphasizes the importance of social capital as a driver of successful sustainable waste management (Wijaya and Laila, 2024).

Sustainability Prospects and Strategies

To maintain this success, Pasuruan City needs to develop a digital waste data management system, strengthen the 3R Waste Management Site (TPS) institution, and expand integration with the private sector in the recycling chain. Implementing the green entrepreneurship concept through recycling business incubation can also create new jobs (Geissdoerfer et al., 2017). From a policy perspective, synchronization between regional and national regulations is necessary so that Pasuruan City's waste management can become a model city with a circular economy perspective. A participatory approach that combines technological, social, and economic aspects is key to the sustainability of this system.

4. Conclusion

This study concludes that community-based waste management in Pasuruan City has demonstrated measurable effectiveness in reducing landfill dependency and supporting circular economy objectives. Empirical evidence from the 2024 DIKPLHD shows that CBWM initiatives particularly the TERPANA program, TPS 3R managed by Community Self-Help Groups, and waste banks have reduced residual waste disposal by 20.71%, despite increasing daily waste generation and limited landfill capacity. These findings confirm that decentralized waste processing

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at the community level can significantly alleviate pressure on municipal waste infrastructure. The success of CBWM in Pasuruan City is not merely the result of voluntary community participation, but rather the outcome of strong institutional integration. Municipal policies, incentive-based mechanisms, infrastructure provision, and continuous facilitation by local government agencies play a decisive role in sustaining community engagement. Waste banks function not only as waste reduction instruments but also as socio-economic platforms that reinforce public participation through tangible financial benefits. Meanwhile, methane gas utilization at the landfill level illustrates how CBWM can be extended toward energy recovery, contributing to environmental and economic co-benefits. Nevertheless, the study identifies persistent challenges, including inconsistent household waste segregation, limited operational capacity of some TPS 3R units, and the lack of digitalized waste monitoring systems. Addressing these issues will require strengthening institutional capacity, expanding technological support, and enhancing behavioral change strategies at the household level. Overall, this research contributes to academic discussions by demonstrating that effective CBWM requires institutional embedding within municipal governance structures, positioning Pasuruan City as a relevant model for sustainable waste management in small and medium-sized urban contexts in Indonesia.

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