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The Strategy of the Yogyakarta City Government in Implementing a Sustainable Zero Inorganic Waste Policy

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ABSTRACT

This research aims to analyze the implementation of the Zero Inorganic Waste policy enacted by the Yogyakarta City Government, focusing on waste sorting strategies, infrastructure support, and challenges encountered in managing inorganic waste. The qualitative methodology involves field observations, in-depth interviews, and focus group discussions with various stakeholders. The research findings indicate that while this policy has successfully raised public awareness about waste separation, significant challenges remain, such as low public participation, limited infrastructure, and insufficient education efforts. Therefore, the government must increase resource allocation for waste management infrastructure and develop more effective educational programs to encourage behavioral change. This study's contribution to urban waste management literature lies in its emphasis on the importance of a participatory and systematic approach to waste management and the need for public behavioral change to achieve sustainability goals. The conclusions of this study provide valuable insights for policymakers and practitioners in formulating more effective waste management strategies in Yogyakarta and other urban areas. This research also offers substantial theoretical contributions, particularly regarding the importance of participatory and systematic approaches in urban waste management and the necessity for societal behavioral changes to achieve sustainability objectives.

Keywords: *Infrastructure; Government; Management; Zero Waste Policy*

1. Introduction

Waste management issues in urban areas, including Yogyakarta City, have become increasingly urgent with population growth and rising waste volumes (Kalia et al., 2022). This is due to the complexity of factors impeding a complete solution to waste problems (Parvez et al., 2021) despite waste management being a primary environmental concern in Yogyakarta. According to Rasool et al., the main contributing factors to waste issues include societal paradigms, behaviors, and awareness (Rasool et al., 2024). Meanwhile, waste disposal, technology, and budgeting are the primary technical challenges (Mensah & Ampofo, 2021).

With its limited area, high population density as a tourist destination, and high levels of consumption and production, Yogyakarta City has become one of the largest waste producers in the Special Region of Yogyakarta (Widyaningsih & Ma'ruf, 2017). According to 2022 environmental service data, Yogyakarta generated 327.4 tons of waste per day in 2021, ranking second in the Special Region of Yogyakarta. Of this amount, 99.34% was managed, with a 22.68% reduction in waste and 76.78% handled (Pemerintah Kota Yogyakarta, 2022). Data from the Department of Environment shows that 76.78% of waste falls under the "handled" category; however, waste issues often remain a source of polemic and conflict within the community. The increasing volume of waste each year, with disposal at the Piyungan Transfer Station and landfill as the only endpoints, indicates that the current waste handling processes are suboptimal and fail to reduce waste volumes.

By the end of December 2022, Yogyakarta City generated 360 tons of daily waste, a 10% increase from the previous year (Pemerintah Kota Yogyakarta, 2022). Waste banks managed 2% and 29% of this total by scavengers/traders (Pemerintah Kota Yogyakarta, 2022). Approximately 260 tons of waste per day from Yogyakarta City were disposed of at the Piyungan landfill, the only final disposal site (Pemerintah Kota Yogyakarta, 2022). Waste composition consists of 45% non-organic and 55% organic waste. The rising volume of waste each year, combined with limited waste management facilities, poses a significant challenge for the Yogyakarta City Government (Pemerintah Kota Yogyakarta, 2022).

Despite a waste bank program with 479 points across Yogyakarta City, it has only managed to absorb 2% of its total waste (Pemerintah Kota Yogyakarta, 2022). Primary waste collection relies on 13 depot locations (Pemerintah Kota Yogyakarta, 2022). In this context, special attention is required given that Piyungan Landfill, the city's only final disposal site, is expected to reach its maximum capacity by 2023, creating an urgent waste management issue in Yogyakarta City (Warta Jogja, 2023).

The emergency has led to environmental issues and community conflicts due to waste accumulation at depots following the closure of the Piyungan Landfill (Warta Jogja, 2023). This situation arises from the lack of a landfill within Yogyakarta City. Meanwhile, environmental pollution issues have worsened, particularly evident in the high levels of river pollution (Pemerintah Kota Yogyakarta, 2022) in the city's main rivers—Kode Kali, Gajahwong, Winongo, and Manunggal. The water quality index in the city is classified as highly polluted, with a score reaching 38.44 (Pemerintah Kota Yogyakarta, 2022).

This situation is concerning as water, the primary life source for the community, is affected by waste pollution, leading to agricultural land degradation (Lehmann, 2019). The policies implemented by the city government have not provided a fundamental solution, as they fail to address the lack of infrastructure and the need for education to raise public awareness (Zafarullah & Huque, 2018). This reflects the need for a shift in mindset and behavior toward waste management (Nittala & Moturu, 2023), with Yogyakarta City still reliant on the Piyungan Landfill.

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The Yogyakarta City Government initiated the Zero Non-Organic Waste Policy through the Mayor's Circular (Dinas Lingkungan Hidup Kota Yogyakarta, 2023), which aims to reduce the volume of waste disposed of by focusing on separating waste into organic, inorganic, and residual categories. This step is expected to decrease the waste disposed of at both Transfer/Depot Stations and the landfill. However, implementing this policy faces various challenges, such as limited waste management infrastructure, low community participation in waste reduction programs, an increasing volume of waste, and limited human resources.

The Mayor of Yogyakarta's Zero Waste Inorganic Movement Policy needs further review, as it focuses on household obligations without including major waste-generating sectors such as industry, which contributes a larger waste volume (Pemerintah Kota Yogyakarta, 2022). Moreover, given the inadequate infrastructure support, this policy lacks clarity on the government's role and facilitation (Pemerintah Kota Yogyakarta, 2022). Thus, the policy puts more pressure on the community than providing a comprehensive solution.

Law No. 18 of 2008 on Waste Management addresses waste management comprehensively for economic benefits, public health, and environmental sustainability (Republik Indonesia, 2008). Previous studies have examined waste policies as a research subject in recent years. Several cities worldwide have successfully implemented zero-waste policies. For example, San Francisco in the United States set a zero-waste target with a strict approach to recycling and composting, achieving significant waste reduction (Allen et al., 2012). Kamikatsu in Japan is another example, where a policy to separate waste into 45 categories has drastically reduced landfill waste since 2003 (Joga, 2018; Wulandari & Deniar, 2023). Seoul in South Korea uses a weight-based waste collection fee system for each household, encouraging waste reduction and recycling, increasing recycling rates to 66% (Joga, 2018).

In Europe, Ljubljana in Slovenia became the first capital city to set a zero-waste target in 2014, using a waste visibility system that involves the community and is supported by recycling centers (Samudra et al., 2023). Canberra, Australia, also introduced a zero-waste strategy through sustainable waste management, engaging the community and businesses in reducing waste at its source (Flint, 2001). Additionally, supporting infrastructure is crucial in waste sorting (Marpaung & Qodir, 2009). Unlike previous studies exploring various regulatory aspects as determinants of public awareness in zero-waste policy implementation, this study will analyze infrastructure limitations and community participation, evaluate end-waste management, and assess the influence of budgeting and human resources on implementing the Sustainable Inorganic Zero Waste Movement. This study will address this gap by focusing on zero-waste policy in Yogyakarta City.

2. Literature Review

2.1. Policy Implementation

Implementation in the Big Indonesian Dictionary refers to implementation or implementation, which is an action carried out by individuals or groups in government or private organizations to achieve goals set through policy decisions. (Hayat, 2018). Policy implementation is a common process in administrative actions and can be studied in specific programs (Suaib et al., 2022). Policy implementation is the execution of decisions regarding basic policies, generally regulated by law, and can also take the form of important executive instructions on legislative decisions (Purba et al., 2022).

Implementation is a crucial stage in the public policy process (Keinänen et al., 2019). After policies or programs are selected, they must be implemented to have an impact and achieve their goals (Banfi & Gaudinat, 2019). Policy implementation is widely interpreted as a tool of

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public administration in which policy actors, organizations, procedures, techniques, and resources are collectively organized to implement public policies and achieve goals (Edward III & Subarsono, 2008).

Factors influencing policy implementation with a top-down approach (Helmy et al., 2018). Donald Van Metter and Carl Van Horn's model (Subianto 2020) consists of six variables that influence public policy performance: (1) policy goals, (2) resources, (3) implementer characteristics, (4) implementer attitudes, (5) organizational communication, and (6) economic, social, and political environments. Four variables determine the success and failure of policy implementation: (1) Communication, successful policy implementation requires implementers and the community to know the policy through transmission, clarity, and consistency in implementing the policy; (2) Resources, implementer and financial resources, staff as the main resource, information, authority, and supporting facilities such as good infrastructure, without which policy or program implementation will not succeed.

(3) Disposition with indicators of disposition effects, bureaucratic arrangements, and incentives; (4) Bureaucratic Structure, with two indicators: a) SOP, a procedure or guideline that is routinely planned and allows implementers to carry out a series of activities following the minimum standards set, and b) organizational fragmentation to spread responsibility for programs or activities tailored to their respective fields. Implementation can run effectively if the organizational structure has been well-fragmented (Tachjan, 2006). Implementing the inorganic zero waste policy in Yogyakarta City will be examined based on four factors that influence it: communication, resources, disposition, and bureaucratic structure.

2.2. Waste Management Model

Reduce, Reuse, and Recycle are key concepts of responsible consumer behavior towards the environment, aimed at educating the public to avoid excessive behavior, limit the consumption of non-renewable resources, and promote reuse and recycling (Purnomo, 2021). Reducing, as the first step in the reduce reuse recycle concept, is the best way to minimize the impact of waste on the environment and the Earth (Sutisno And Henriyan 2018). This involves reducing the materials and resources used, such as fuel and water, through smart shopping practices (Armus et al., 2022).

Saving money Smart shopping practices include making a shopping list, avoiding single-use items, and choosing durable or reusable products (Yahya, et al,. 2022). Implementing reduction includes limiting unnecessary purchases and considering actual needs before buying (Amicarelli & Bux, 2021). In practical terms, reducing means not buying new items if existing ones can still be repaired or reused (Laor et al., 2018).

Reuse, or reusing, involves taking old items that might otherwise be discarded and finding new uses for them (DeLorenzo et al., 2019). Implementing reuse in daily life includes selling unused items, giving them to friends in need, or repurposing them into something with a different function (Valkama et al,. 2022). Simple practices such as turning off lights when not in use, unplugging electronics, and fixing leaky faucets can also effectively reduce resource consumption (Golandaj & Kallihal, 2021).

The third stage, recycling, prevents products that cannot be reused from being sent to landfills by transforming them into new items or products (Alonso-Muñoz et al., 2022). Recycling involves converting old materials into new versions or something entirely different (Chen & Lee, 2020). Although it requires time, energy, and costs, recycling remains a better option than sending items to landfills (Amicarelli et al., 2022).

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The concepts of reduce, reuse, and recycle are highly effective approaches to reducing waste (Mensah & Ampofo, 2021). The Yogyakarta City Government can implement these concepts in policies and strategic programs to address waste issues in the city. Implementing these 3R concepts can also be enhanced through appropriate technology approaches.

3. Research Methodology

This research uses a qualitative approach to analyze the role of the Yogyakarta City Government in implementing the Sustainable Inorganic Waste Zero Movement policy (Jelahut, 2022). The study collects secondary and primary data through field observations, interviews, and Focus Group Discussions (Sahir, 2022). Observation sites include waste disposal depots, waste banks, and residential areas in Yogyakarta City, selected using the purposive sampling method described by Craswell (in Nurmalasari, 2018).

Data collection through Focus Group Discussions (FGD) involved participants selected from various stakeholders, including the Regional People's Representative Council of Yogyakarta City, the Environmental Agency, the Regional Planning and Development Agency, the Cooperatives and Small and Medium Enterprises Agency, waste bank managers, and community leaders from areas affected by this policy. The FGD aimed to explore and gather perceptions, challenges, and opportunities encountered in implementing the inorganic waste zero policy in Yogyakarta City.

Meanwhile, in-depth interviews were conducted with authorities and individuals with deep insights into waste management in Yogyakarta City, including officials from the Environmental Agency, waste depot managers, and local environmental activists. Interview informants were selected using a purposive method, where data and informants were chosen according to the required data, and snowball sampling was used as needed for field data. These interviews aimed to explore the effectiveness of the policy, technical challenges, and the public's response to the Inorganic Zero Waste Movement in Yogyakarta City. Data analysis was conducted using the approaches of Data Condensation, Data Display, and Conclusions Drawing (Sahir, 2022).

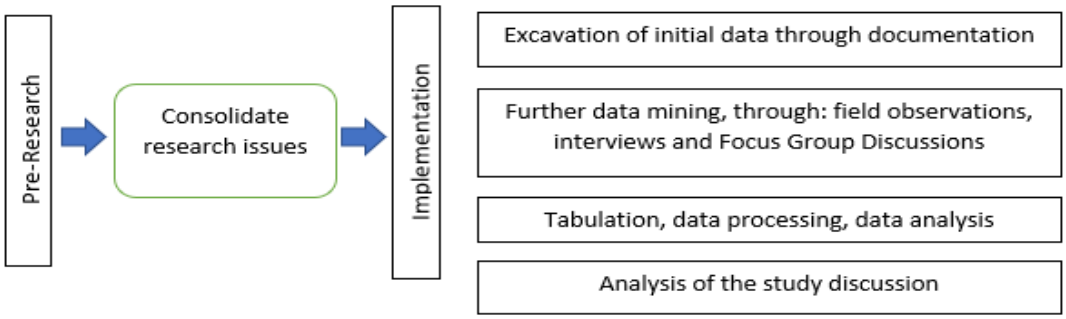

Figure 1. Research Stages

Based on Figure 1 above, there are two stages, namely:

1) Pre-implementation of research is the stage before carrying out the research, which is making preparations for consolidating ideas and issues and equalizing the perceptions of the competent regional organizations.
2) Carrying out research is a further stage after equalizing perceptions. The implementation of research is the entire series of processes for implementing the research substance. Starting with initial data mining, then further data mining (in primary and secondary data), data analysis process, data collection, and study analysis.

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4. Results and Discussion

4.1. The Policy of Zero Inorganic Waste in the City of Yogyakarta

The environmental service data of Yogyakarta City in 2022 shows that 76.78% of waste is categorized as handled waste. However, the waste issue has become a source of controversy and conflict in the community. The volume of waste continues to increase yearly, with disposal at the Piyungan Waste Disposal Station and TPA as the only final disposal sites in Yogyakarta City. This indicates that the waste management process is suboptimal, and the waste volume reduction in Yogyakarta City has failed.

The Inorganic Zero Waste policy in Yogyakarta City aims to reduce the waste volume generated, especially from the industrial and household sectors. The government emphasizes separating waste into organic, inorganic, and residual categories through the Mayor's Circular No. 660/6123/SE/2022. This step is expected to reduce the burden on waste stations/depots and final disposal sites (TPA) and raise public awareness about sustainable waste management.

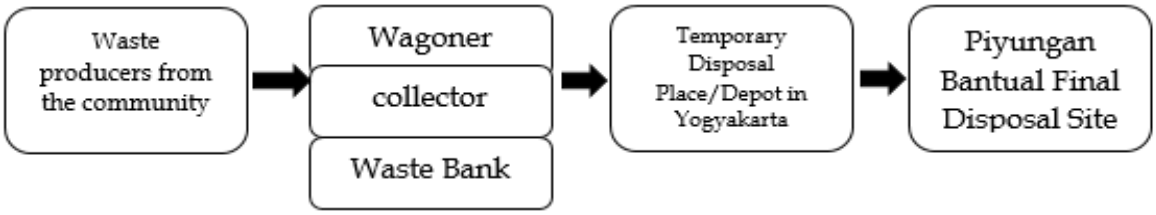

Figure 2. The Waste Management Process Flow in Yogyakarta City

Figure 2 illustrates the waste management process flow before implementing Mayor Regulation No. 660/6123/SE/2022 on the Inorganic Zero Waste Movement. The waste management process in Yogyakarta City involves sorting, collection, transportation, processing, and disposal at the final disposal site (TPA). However, in its implementation, this policy faces significant challenges and obstacles.

The main constraint is the lack of adequate facilities at collection points. Many waste collection locations lack appropriate facilities, often causing organic and inorganic waste to mix. This reduces the effectiveness of the expected process and hinders optimal waste processing. Due to these limitations, waste sorting is not done directly at the source. Instead, the community collects unsorted waste, and sorting is done independently by the community, waste banks, or third parties such as scavengers, traders, or sellers who capitalize on the economic value of the waste. Before this regulation was enforced, sorting was done independently based on the economic benefits of the items.

In addition, poor coordination among stakeholders is also a challenge. Waste management conflicts are often placed solely on the shoulders of the Environmental Agency, leading to ineffective policy implementation and a decrease in public participation. Another challenge is the low awareness and culture of waste sorting among the community, which impacts the achievement of waste reduction targets. Third, the lack of awareness about the culture and behavior of the community has not significantly affected the achievement of the waste reduction targets. From a planning perspective, the Yogyakarta City Government has not fully focused on the increasingly urgent waste management issues, and the supervision of policy implementation has also been weak, resulting in the Inorganic Zero Waste Movement not being maximally implemented.

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The Mayor's Regulation No. 660/6123/SE/2022 on the Inorganic Zero Waste Movement aims to reduce waste sent to the Piyungan Bantul Landfill. The main strategy is the initial sorting of waste, which is classified into inorganic, organic, and residual categories. Restrictions are applied to collecting and disposing of organic and residual waste, while final disposal (Piyungan Landfill) only includes organic waste. The flow of the waste management process in Yogyakarta City based on this policy can be seen in Figure 3.

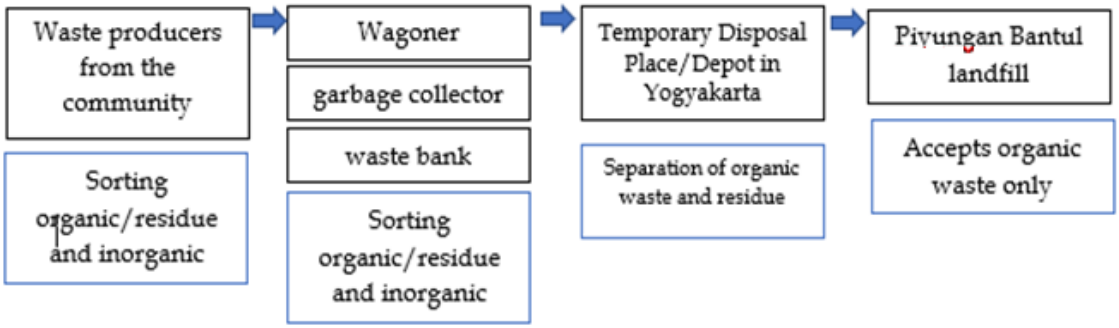

Figure 3. The Waste Management Process Flow in Yogyakarta City in 2023

Figure 3 illustrates the waste sorting process from producers to final disposal, focusing on sorting by type to reduce waste volume at the landfill and achieve the target of zero inorganic waste in Yogyakarta City. The government emphasizes the technology for managing organic and residual waste. Although the authority of local governments in waste management is regulated by Law No. 18/2008 and Government Regulation No. 27/2020, the Inorganic Zero Waste Movement policy has not fully embraced the ideal waste management concept of 3R (Reduce, Reuse, and Recycle), as shown in Figure 4.

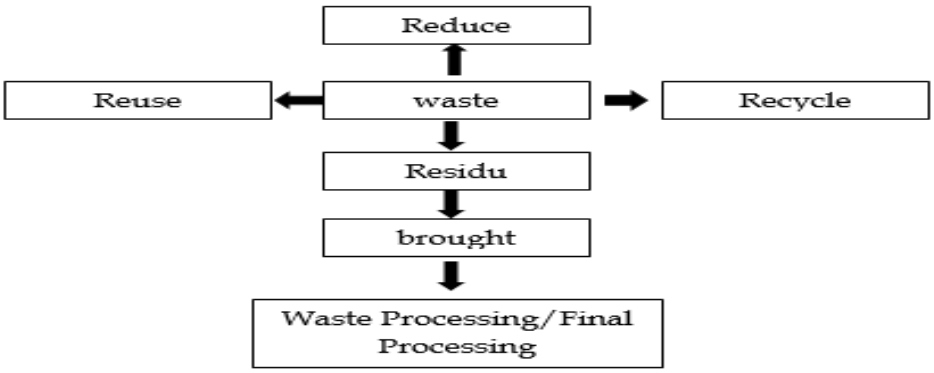

Figure 4. A New Paradigm in the Waste Management Cycle Process

Figure 4 illustrates the waste management process flow that applies the 3R model, emphasizing sorting, collection, transportation, and final processing. The 3R principles play a key role; specific techniques are used to view waste as a manageable product. The Reduce stage aims to decrease consumer lifestyles and promote reusable items. The reuse stage focuses on utilizing waste materials through repeated use, while the recycling stage emphasizes sorting and utilizing local processing for new products.

Waste agents such as waste banks, scavengers/collectors, or vendors are involved in recycling to gain economic benefits. The Reduce and Reuse stages require the formation of mindsets and behaviors at the individual level within the community. The City of Yogyakarta has adopted the 3R principles in waste management, as evidenced by innovations outlined in

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the Yogyakarta City Environmental Management Performance Report (Pemerintah Kota Yogyakarta, 2022). The importance of collaboration in waste management is highlighted through collaboration between the Yogyakarta City Environmental Agency, the Community Empowerment and Family Welfare Agency, the Environmental Sanitation Agency, Non-Governmental Organizations, Environmental Observers, and Environmental Facilitators (Damanhuri & Padmi, 2010). They have led activities to guide and support RW Waste Banks in 45 neighborhoods to reduce waste through product innovations, increase human resource capacity related to waste bank management, and improve community welfare through waste management.

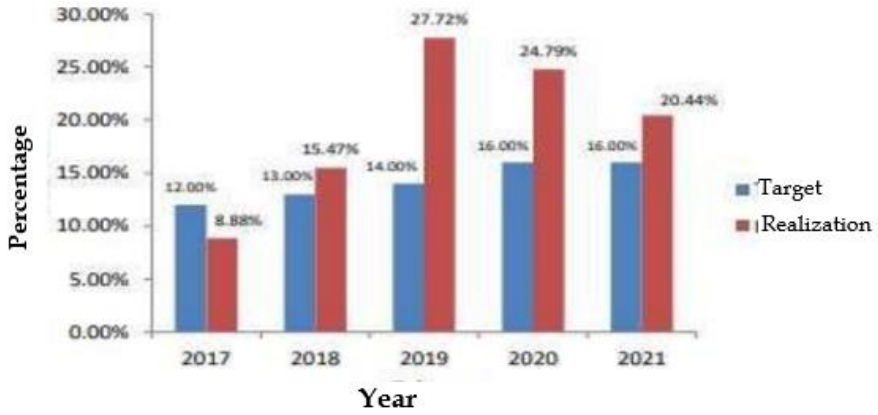

Figure 5. The Percentage of Waste Management Achievement for the 3R (Reduce, Reuse, Recycle) from 2017 to 2021

Source: Yogyakarta City Environmental Management Performance Report 2021

The data in Figure 5 illustrates the achievement of waste management targets using the 3R principles from 2018 to 2021, which align with expectations. However, there was a decline in the percentage of program realization during this period, reaching 7.28%, indicating a less positive behavioral change in implementing waste management programs. The target set by the government was low, at only 16%, suggesting that this policy has not yet become a top priority in waste management.

Waste segregation is a key step to achieving community independence in waste management. The Zero Inorganic Waste Movement policy aims to foster independent behavior among the community, particularly concerning inorganic waste, hoping to reduce waste volume in Yogyakarta City. However, this policy has not fully provided the ideal facilities for the community, leading to debates regarding the readiness of waste segregation facilities, the lack of comprehensive education on waste, declining enthusiasm for community-based waste banks, changes in the roles and positions of waste collectors/scavengers, and conflicts related to waste disposal restrictions. This aligns with what Bustomi et al. stated, that waste management is influenced by targeted policies and supported by public participation (Bustomi et al., 2022). Therefore, adequate facilitation is needed in the form of infrastructure, stronger policies, mass education for individuals, and the government's effective management of physical facilities to improve waste management. While this responsibility rests not solely with the government, every community member also plays a crucial role in waste reduction efforts (Pemerintah Kota Yogyakarta, 2022).

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4.2. Infrastructure

Infrastructure in waste management in Yogyakarta City remains a significant barrier to implementing the zero waste policy. Waste management infrastructure refers to various physical facilities, systems, and infrastructure designed and built to manage waste efficiently and environmentally. The success of waste management is crucial to supporting sustainable development across various sectors. Here are some key elements of waste management infrastructure.

1) Technological facilities

Technology infrastructure is a key component in meeting waste management needs for non-organic and organic waste, as regulated in Article 6 of Law No. 18 of 2008. This provision establishes that the regional government is responsible for waste management and must provide infrastructure and waste management facilities in line with environmental principles. This is further reinforced by Article 4 of Regional Regulation of the Special Region of Yogyakarta No. 3 of 2013, which regulates the duties and authority of local governments in managing household and similar waste. With a strong legal foundation, developing waste management technology infrastructure becomes the government's obligation.

However, in the empirical context of Yogyakarta City, challenges in providing waste management technology infrastructure remain very real. Despite clear regulations, the implementation on the ground shows that many facilities are still inadequate. For example, most waste collection points are not equipped with proper sorting facilities, leading to the mixing organic and inorganic waste. This has implications for the effectiveness of waste processing at the Piyungan Landfill, which is already experiencing overload due to the continuously increasing volume of waste.

The following is the daily waste volume from 2021 to 2023 in Yogyakarta City.

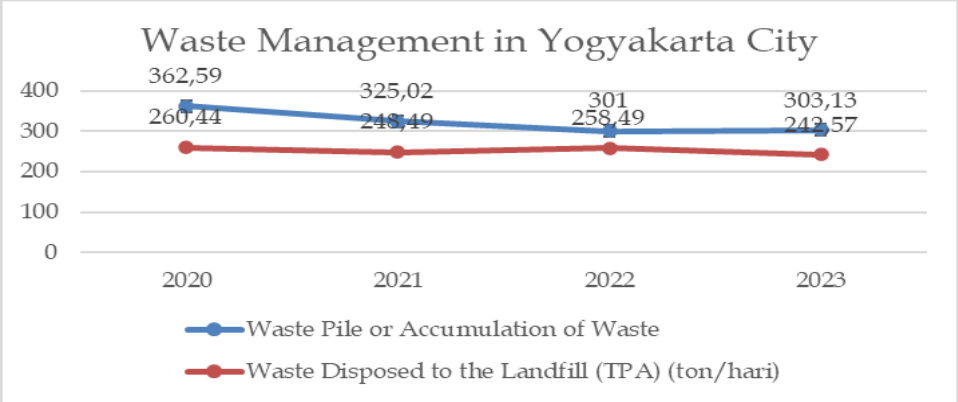

Figure 6. Volume of Waste at Temporary Waste Disposal Sites and Waste Piles
Source: Dinas Lingkungan Hidup, 2023

Waste management in Yogyakarta City, when viewed from the volume of waste, is obtained from the formula: The volume of waste handled (transported to the landfill plus waste managed independently) divided by the waste generation/production. In 2023, up to June, the average waste generation was 303.13 tons/day, with the amount of waste disposed of at the landfill (TPA) being 242.57 tons/day.

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Table 1. Volume of Waste Disposed of at the Piyungan Landfill

Waste from Yogyakarta City is Processed at the Integrated Waste Management Site/Piyungan Landfill			
No.	**Month**	**Ton/Month**	**Ton/Day**
1	January	8.415,95	271,48
2	February	7.266,73	259,53
3	March	7.653,16	246,88
4	April	6.750,01	225,00
5	May	7.460,51	240,66
6	June	6.355,37	211,85
TOTAL		**43.901,73**	**1.455,39**
Average		**7.316,96**	**242,57**

Source: LKIP Dinas Lingkungan Hidup Kota Yogyakarta, 2022

The waste volume data at the Piyungan landfill shows a complex pattern of increases and decreases, corresponding with variations in the population's activities in Yogyakarta City. Although not all months follow the same trend, it still results in a significant average overall.

2) Institutional arrangements

The Environmental Agency plays a primary role, organized through the Waste Management Division, which is divided into two subgroups: waste management substance and cleanliness fee management substance. Despite its significant role, the agency addresses limitations with the assistance of the Class A cleanliness fee management Technical Implementation Unit.

The Mayor's Regulation Number 138 of 2017 governs the responsibilities of heads of relevant agencies regarding operational costs of cleanliness, including planning, programs, budgeting, fee collection, administration, household affairs, and performance analysis. The waste reduction policy of the Yogyakarta City Environmental Agency includes target percentages for waste reduction and transportation. In the context of waste management in Yogyakarta City, several challenges have been faced by the Environmental Agency and the Waste Management Division. These challenges include limited infrastructure, issues in final waste processing, budgeting constraints, and limited human resources in waste management. Nevertheless, the waste reduction performance from 2021 to 2023 is shown in Table 2.

Table 2. Waste Reduction Performance Targets for 2021-2022

Year	Target (%)	Achievement (%)
2021	24,00	62,35
2022	26,00	62,68
2023	15	19,29

Source: LKIP Dinas Lingkungan Hidup, Tahun 2023

In 2021, the waste reduction target performance reached 24% of the government target, achieving 62.35%. For 2022, the waste reduction target was set at 26%. This means that about 23% of the population of Yogyakarta City, or approximately 96,866 people, was served by the waste reduction policy of the Environmental Agency in 2021, which also includes waste transportation performance as part of waste management. In 2023, the waste reduction target

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dropped to 15%, with an actual achievement of 19.29%. This decline reflects the challenges faced in waste management.

In 2021, the waste transportation activities successfully covered 101.89% of the government's target, reaching 417,091 people. Although the waste transportation performance target for 2022 was set at 99.47%, the actual achievements for both indicators exceeded the government's target. While not all households participated in the waste transportation fees, nearly all households in Yogyakarta City were served.

The improvement in waste management performance is reflected in the 2021 fiscal year data from the Yogyakarta City Environmental Agency, which includes residents around the Integrated Waste Management Site 3R, customers of the Waste Bank, and residents served by the Waste Depots. Thirteen out of 107 Waste Depots serve approximately 50.073% of the population of Yogyakarta City.

Waste management by the Yogyakarta City Environmental Agency has seen a decrease in volume since 2020. In 2021, the volume of waste taken to the Final Disposal Site reached 248.98 tons per hour, with a waste generation rate of 325.02 tons per hour. Around 23% of the waste could not be sent to the Final Disposal Site, while 66.43 tons per hour was managed using the 3R principles.

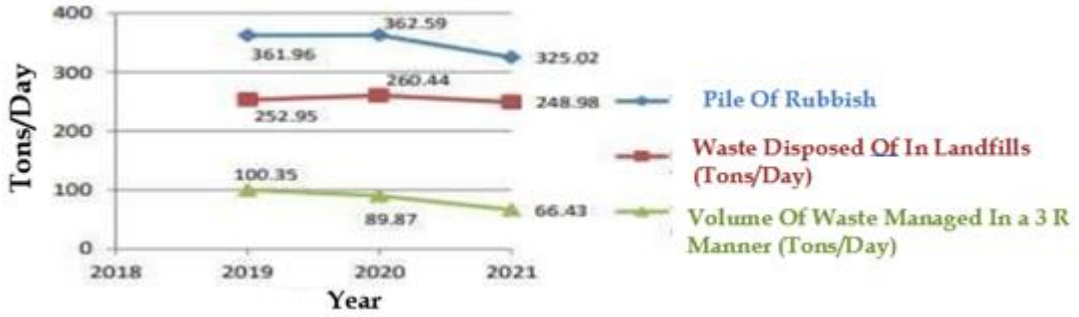

Figure 7. Waste Management Graph for Yogyakarta City in 2021
Source: LKIP DLH Yogyakarta City (2021)

The Yogyakarta City Environmental Agency recorded slightly improved waste management performance, growing by 0.43% from 2020 to 97.04% in 2021. The waste management includes disposal at the Final Disposal Site and management through the 3R principles. The total volume of waste handled reached 315.41 tons per day, including 66.43 tons per day managed through 3R, exceeding the previous target of 16%. However, empirically, the 3R handling appears to be inconsistent with the community's conditions regarding the waste management process.

The Waste Bank, regulated by the Ministry of Environment and Forestry Regulation No. 14 of 2021, is a waste management facility based on the 3R principles. Managed by community groups, it can be established by various parties such as the community, businesses, or local governments. The Waste Bank aims to serve as an educational facility, promoting behavioral change in waste management and implementing Circular Economy principles.

The development of Waste Banks is a social engineering effort to teach waste sorting and raise awareness about waste management. The requirements for establishing a Waste Bank involve waste management, facilities, and governance. Waste management facilities are crucial in forming Waste Banks, especially during the reduction and handling stages. The Waste Bank management concept includes reduction through the reuse of waste without further processing

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and waste handling through sorting, collection, and processing following the regulations outlined in the Ministry of Environment and Forestry Regulation No. 14/2021.

In Yogyakarta City, Waste Banks are operated by community groups at the neighborhood or village level as an initial institution to reduce waste in the area. Most Waste Banks in Yogyakarta focus on reducing inorganic waste by sorting and channeling it to collectors or waste traders. However, organic waste management is still not optimal, despite the Yogyakarta City Environmental Agency's implementation of organic waste composting training programs at the household level and the distribution of composters. Challenges in managing organic waste include more intensive processing, utilization of composting space, and environmental comfort impacts. Data from the Mayor's Regulation No. 32/2022 on the Waste Management Master Plan in Yogyakarta City for 2021 shows the existence of 513 Waste Banks at the neighborhood level, with an activity level of about 80%.

In 2022, the number of Waste Banks in Yogyakarta City increased to 575, a 12% rise from the previous year. Although the target set by the Yogyakarta City Environmental Agency for 2023 is 616 Waste Banks, requiring a 7% increase, the goal is to bring waste management closer to the community, serve as an educational platform, and instill good habits through community involvement at the local level. While not yet fully active, the presence of Waste Banks is considered an effective effort in waste reduction and management.

Figure 8. Distribution of Waste Banks in Yogyakarta City
Source: Yogyakarta City Environmental Service 2022

The Waste Bank in Yogyakarta City is divided into three categories: Pioneer (highly accomplished and able to mentor other waste banks), Innovative (emphasizing added value through innovation), and Regular (focused on waste sorting and collection within the community). The Regular category dominates in number, but its activity levels are less optimal, impacting the waste banks' overall performance. The community runs waste banks with a minimum of 10 members, has a management structure, and receives support from the Environmental Agency through official decisions. Waste bank communities focus on education and innovation in community-based waste management to achieve a circular economy.

The Waste Management Institution in Yogyakarta City is a community-level institution established by the local government to improve the effectiveness of waste management in the community. The Waste Management Institution collaborates with community-based organizations, such as waste banks, to act as a facilitator, optimize waste banks, and serve as an intermediary to continue the government's waste management programs. The functions of the Waste Management Institution include optimizing waste banks, ensuring the sustainability of

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waste management programs, and ensuring government control in implementing waste management policies.

3) Budget

The budget is one of the obstacles in waste management in Yogyakarta City. The waste management budget for Yogyakarta City, managed by the Environmental Agency, saw a significant increase in the revised 2022 Regional Budget (APBD). The budget reached IDR 77,826,471,212, a 36% increase from the previous year and double that of 2021. This increase is primarily allocated for operational spending on goods and services, followed by capital expenditures, while personnel spending receives the smallest allocation despite its large budget value. With capital expenditures dominating at 41%, personnel operational spending at 28%, and operational spending on goods and services at 31%, this budget reflects the government's commitment to improving waste management in Yogyakarta City.

Table 3. Yogyakarta City Expenditure Allocation

Description	Amount
Operational Shopping for goods & Services	42%
Capital Expenditures	30%
Employee Operational Expenditure	28%
Total	**100%**

Source: Dinas Lingkungan Hidup pada tahun 2022

The budget allocation for the Environmental Agency of Yogyakarta City in the revised 2022 Regional Budget (APBD) reached 31% for capital expenditures (approximately IDR 24,578,403,490), 31% for goods and services (approximately IDR 31,619,280,822), and 28% for personnel expenditures (approximately IDR 21,628,786,900). Although the capital expenditure allocation has not yet reached the target of 40%, 2.8% or IDR 2,180,866,049 of the budget has not been absorbed. Regarding program allocation distribution, the focus of Yogyakarta City's environmental services is seen in the Waste Management Program, with a realization of IDR 37,819,576,921. This budget allocation reflects the priority given to environmental services in improving the effectiveness of waste management in Yogyakarta City.

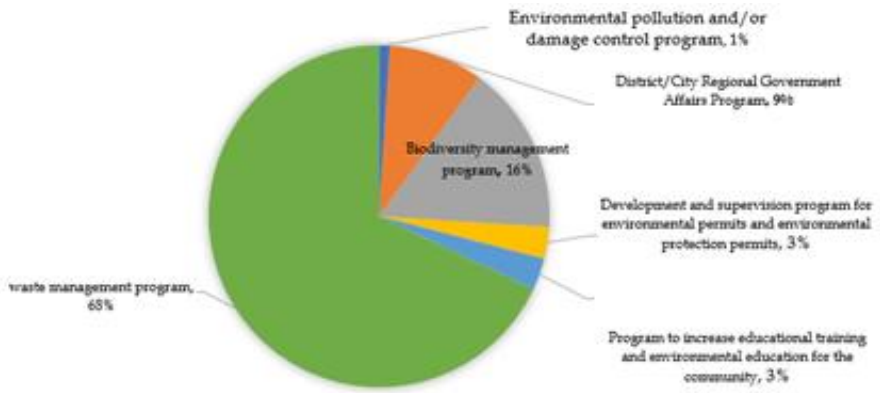

Figure 9. Program Budget Allocation of the Yogyakarta City Environmental Agency for 2022

Source: Yogyakarta City Environmental Service 2022 Regional Expenditure Budget and Revenue

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The waste management budget allocation in Yogyakarta City reaches 68% of the total budget, reflecting the urgency of waste management as a strategic development issue. It is divided into three subprograms: Waste Management (IDR 11,792,510,774), Community Participation Enhancement in Waste Management (IDR 1,153,288,347), and Coordination and Synchronization of Waste Management Infrastructure Provision (IDR 24,873,777,800). Although the ideal allocation for waste management should be 3% of the total APBD, the actual allocation reached 2.2% in 2022. There has been a gradual increase since 2018, demonstrating the Yogyakarta City government's commitment to increasing the waste budget allocation and addressing waste issues. The policies formulated in the form of programs and activities represent the government's consistency in tackling problems; as stated by Putra et al., "A program is a form of commitment from policy stakeholders to provide a solution-oriented approach" (Putra et al., 2023).

4.3. Sustainable Zero Inorganic Waste Movement Strategy

The Yogyakarta City Government is committed to addressing the waste problem that negatively impacts the city's image as the capital of the Special Region of Yogyakarta. Since January 2023, the "Sustainable Zero Waste Organic Waste Movement" policy has been designed to reduce the volume of waste sent to the nearly full landfill. This policy is supported by the Mayor of Yogyakarta's Circular Letter No. 660/6123/SE/2022, which emphasizes the reduction of inorganic waste through optimal management, sorting, and recycling.

In its implementation, the Yogyakarta City Government faces several challenges, such as limited infrastructure for waste verification and processing, human resources, and land for waste management. Many facilities still lack support for the verification and processing of waste. According to the Yogyakarta City Environmental Agency, although efforts have been made to improve management, the existing infrastructure is still insufficient to meet the growing waste management needs of the population, which is increasing due to population growth and changing consumption patterns. The lack of human resources in the management sector is one of the main issues. With only 275 waste workers serving a population of around 450,000 people, this ratio is disproportionate, leading to a high workload for the available staff. The limited land for the final disposal site (TPA) is a serious problem in Yogyakarta. The closure of the Piyungan TPA and its relocation to the smaller Nitikan TPA (3,500 m² compared to the previous 13 hectares) has exacerbated this situation. This has made it difficult to accommodate the increasing volume of waste, triggering larger environmental issues if not properly addressed.

Therefore, the Yogyakarta City Government has developed several concrete steps to address the waste problem through the Sustainable Zero Inorganic Waste Movement. First, the role of the community and waste bank initiatives should be strengthened, as well as the establishment of waste banks. Second, implementing regulations on the use of environmentally friendly packaging in restaurants. Third, incentives should be provided for residents who produce high-quality recycled products. Fourth, the community should be involved in environmental cleanliness awareness campaigns, training, and education to minimize using inorganic materials. This strategy is crucial for creating a cleaner urban environment. However, its success requires more integrated planning, including investment in sustainable waste processing technologies.

Several cities in Indonesia have implemented waste management policies with a zero-waste approach. In 2020, the Provincial Government of DKI Jakarta banned single-use plastic bags. It implemented Refuse Derived Fuel (RDF) technology, which processes inorganic waste into

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alternative energy (Sari & Salam, 2022). The combination of technology and strict regulations shows that waste reduction can be promoted through policies that integrate environmental and economic aspects. In Bandung, the "Kang Pisman" program (Reduce, Sort, Utilize) emphasizes waste sorting at the household level and optimizes waste banks in each neighborhood (RW). Despite challenges related to changing public mindsets, Bandung has successfully engaged residents in active waste management within their communities (Suhendar, 2021).

Surabaya utilizes the concept of waste banks, allowing residents to exchange waste for points that can be used for public services. In collaboration with private companies through CSR, this program has positively impacted waste reduction at the city level (Kristanti & Haryati, 2023);(Noviyanti et al., 2023). A technology-based approach, collaboration with the private sector, and community education have proven effective. Yogyakarta City could consider similar methods to strengthen the impact of the "Sustainable Zero Inorganic Waste Movement."

Nevertheless, the policy strategy of the Sustainable Zero Inorganic Waste Movement in Yogyakarta City is commendable, even though it has not yet achieved a maximum impact on the amount of inorganic waste production. Launched in January 2023, this movement has started to show initial results with a reduction in the volume of waste sent to the Piyungan landfill. The government continues to conduct outreach and encourage community participation in the zero-inorganic waste movement.

The policy strategy of the Sustainable Zero Inorganic Waste Movement in Yogyakarta City is commendable despite not yet achieving maximum impact on the amount of inorganic waste production. Launched in January 2023, this movement has begun to show initial results with a decrease in the volume of waste disposed of at the Piyungan Landfill. The government continues to conduct outreach and encourages community participation in the zero-inorganic waste movement.

Data from the Yogyakarta City Government indicates a decrease in waste volume of approximately 15 tons per day after implementing the zero inorganic waste movement policy. Previously, the volume of waste disposed of at the Piyungan Landfill from Yogyakarta City reached around 260 tons daily. However, the data does not detail the reduction by waste type, such as organic, inorganic, and residual. The Yogyakarta City Government acknowledges that there is still a mixing between organic and inorganic waste, especially because the public can dispose of residual waste such as diapers, sanitary pads, and tissues that have no commercial value and require special handling for recycling.

The Yogyakarta City Government must continue the Zero Inorganic Waste Movement's policy strategy by relying on the Mayor's circulars and engaging in community outreach and education processes to encourage waste segregation. In the long-term strategy, policy formulation integrating technology and industrialization in inorganic waste processing is needed to turn it into a resource that provides economic benefits and positive social-environmental impacts. Both of these strategies should be implemented concurrently.

According to Mareta Hexa Sevana (environmental services Staff), the Zero Inorganic Waste Movement policy in the Yogyakarta City area has successfully reduced waste volume, especially inorganic waste managed through waste banks. Waste harvesting activities have also become more efficient, with waste weighing from waste bank customers, which previously took months, now being done within a week or less. Positive impacts are seen on scavengers in depots, who used to collect one sack of waste from morning till noon, but after this policy, they can achieve the same amount in the afternoon. This movement also supports the separation of organic and inorganic waste at Temporary Collection Points and reduces the amount of inorganic waste taken to the Piyungan Landfill.

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Based on Law No. 23 of 2014 concerning Regional Government, waste and the environment are mandatory affairs of regional governments. In the context of services, mandatory affairs are tasks the Yogyakarta City Government must carry out to provide good public services. Therefore, the policy strategy for addressing waste issues becomes a high-priority policy to meet the demands of these mandatory affairs.

The condition of Yogyakarta City, which has limited land and depends on the Piyungan Landfill, is a priority in development planning. Data from the Central Statistics Agency shows that most of the area of Yogyakarta City (97% of 32.5 km2) has the potential to produce waste, covering various main production activities. This reflects Scheinberg's statement (2010) that waste management can fail if the waste is too much, located in the wrong place, or not close enough to adequate recycling or disposal facilities. Yogyakarta City faces challenges, such as the final disposal site being far from the waste source and recycling facilities at temporary dumping sites/depots being inadequate for waste processing.

Frequent conflicts at the Piyungan Landfill between residents and landfill operators have led to the closure of access to the landfill. The consequences include the accumulation of waste at various temporary dumping sites and residential areas, as illustrated in online news reports in Yogyakarta.

Figure 10. Queue of Waste Carts at the Temporary Waste Disposal Site
Source: Jogja Daily, 2022

Figure 10 reflects the empirical condition in Yogyakarta City due to the lack of waste management facilities. This experience urges the Yogyakarta City government to continue addressing the issue through policy development and implementation. This problem has become a strategic issue because the service sector, which is the main sector of Yogyakarta City, demands comfort and orderliness in all sectors of the city's environment. Good environmental conditions are a primary asset that supports service activities, industries, and tourism in Yogyakarta City.

Criticism against the Yogyakarta City government refers to its inability to quickly read, plan, analyze, and organize policies in emergencies. This is supported by Mayor Regulation No. 67 of 2018, which regulates waste management from households and industries. Concrete steps for integrated waste management are realized through Mayor Regulation No. 32 of 2022 concerning the Masterplan for Waste Management in Yogyakarta City for 2022-2031. However, the Yogyakarta City government requires four years to take systematic steps and formulate ideal waste management development planning.

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On December 12, 2022, the Yogyakarta City Government issued Mayor's Circular No. 660/6132/SE/2022 regarding the Mandatory Zero Inorganic Waste Movement. This step addressed technical age issues and conflicts at the Piyungan Landfill that affect waste management in Yogyakarta City. This circular aims to reduce the volume of waste dumped at the Piyungan Landfill, extend the technical life of the landfill, and ensure that the Yogyakarta City Government's Temporary Collection Points only receive residual and organic waste. The community must segregate waste at its source, and this circular includes ten provisions that must be adhered to as part of the "Zero Inorganic Waste Movement."

This circular regulates several provisions that must be followed by various parties in Yogyakarta City to support the Zero Inorganic Waste Movement. First, active participation is required from heads of government agencies, government offices, school principals, business actors, and community members in waste management. Second, waste management must involve efforts to reduce and handle waste. Waste reduction efforts involve limiting waste generation, recycling, and reusing waste. Meanwhile, waste handling involves segregation, collection, and disposal of waste.

The sorting, collection, and distribution of waste at the household level involves separating organic and inorganic waste and prioritizing the delivery of the inorganic waste to the local Waste Bank. Similar policies also apply to schools, government offices, and businesses. The organizers are responsible for waste management in the Yogyakarta City area for mass activities.

Additionally, Temporary Waste Disposal Sites may only be used for organic waste, and inorganic waste cannot be disposed of there. The government has formed a Task Force to monitor the handling of inorganic waste, and the Civil service police Unit and related agencies are authorized to enforce compliance with these provisions. These ten provisions are expected to positively contribute to the sustainability of the Organic Waste Zero Movement in Yogyakarta City.

Mayor's Circular Letter No. 660/6132/SE/2022 is considered a tactical step that needs support to address the issue of waste volume reduction. Through this policy, the Yogyakarta City Government has successfully reduced waste volume by 45 tons daily until March 2023. However, further efforts are needed to achieve the waste reduction target of up to 100 tons per day at the Piyungan Landfill by the end of 2023. This policy is seen as a strategic step in waste management in Yogyakarta City, but further efforts are needed to make it a sustainable habit in society.

The organic waste zero movement policy focuses on the principles of waste management 3R, namely waste volume limitation, recycling, and/or reuse of waste. Although these steps are not easy to implement in a society accustomed to conventional waste disposal, the main issues related to waste are related to paradigms, behaviors, and awareness. Increasing living standards and consumption patterns among the public can increase waste volume, thus requiring effective waste management methods and efforts to reduce waste disposed to landfills.

The community's understanding, paradigms, and responsibility are key to successful waste management. The policy of organic waste zero, besides being an urgent response to reduce waste volume, also marks the beginning of shaping the mindset and habits of society in taking responsibility for waste with the principles of sorting, reduction, and utilization of waste. However, adequate facilities and clear supervision are needed throughout the area to achieve sustainability in this policy. The alignment of rights and obligations of the community also needs to be considered to prevent potential conflicts due to this new system.

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Empirical conditions show that implementing Mayor's Circular Letter No. 660/6132/SE/2022 in Yogyakarta still faces several serious issues. The lack of support facilities and adequate systems, especially at waste collection points, as well as the absence of sufficient facilities and infrastructure for waste sorting, are among the main obstacles. Additionally, the lack of coordination among stakeholders in waste distribution is also a challenge, causing waste management actors at the community level not yet to feel the positive benefits of the policy.

The socialization and education efforts, which are still not massive enough, especially among non-institutional sectors, also need to be enhanced to shape communal awareness regarding the 3R policy. Clear and systematic supervision throughout the city is key to the success of the organic waste zero movement policy, with a focus on strong control. Additionally, clearer regulations are needed for large-scale waste producers, such as industries and businesses, to make organic waste management more effective and have a significant positive impact.

Criticism of the organic waste zero movement policy in Yogyakarta highlights the need for follow-up actions to make the policy comprehensive and sustainable in waste management. Since the Regional long-term development plan 2005-2025, strategic waste management issues have raised concerns about Landfills in other districts, which can threaten the city's health. Although technical-technological development policies are expected to focus on reducing and processing daily waste, the Yogyakarta City Government still lacks a clear action plan. This indicates a lack of agility in Yogyakarta's policy implementation and waste management planning.

4.4. Sustainable Inorganic Waste Management Strategy

The waste issue in Yogyakarta involves an increase in waste accumulation by residents in the lower areas, suboptimal systems, and policy planning for waste management in the processing stages, and constraints in managing final waste at Temporary Waste Disposal Sites and Piyungan Landfill due to suboptimal systems and technology upstream. A sustainable approach from the government is needed to address the waste management issues in Yogyakarta.

Waste processing issues are closely related to Sustainable Development, which emphasizes development to meet current needs without sacrificing the needs of future generations. Roseland (in Rasool et al., 2023) suggests several initiatives for sustainable waste management, such as providing information and education, fostering cooperation and partnerships, enhancing understanding of composters, implementing waste reduction reward programs, and using Eco-labeling.

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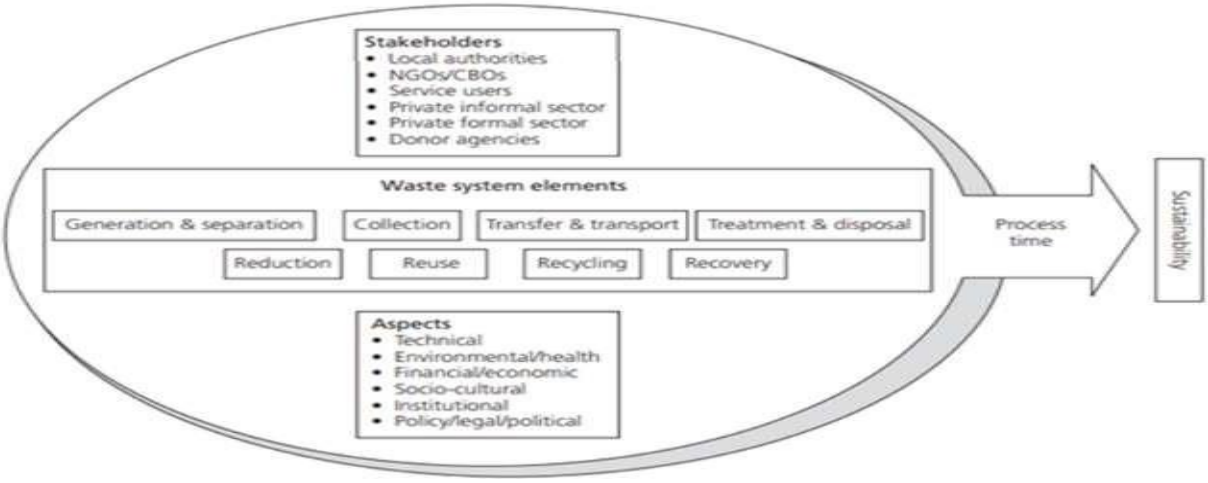

Figure 11. ISMW Framework (Integrated Sustainable Waste Management)

Sustainable waste management in Yogyakarta City adopts the ISMW approach with three main dimensions. First, the stakeholder dimension emphasizes the involvement of all relevant parties, including the government, private sector, and community, to create synergy in waste management. Second, the waste management system dimension focuses on developing an efficient and effective system to minimize environmental impact and maximize economic benefits. Third, the strategic dimension emphasizes formulating planned and integrated strategies to achieve sustainable waste management goals. By applying this approach, Yogyakarta City aims to create a coordinated, participatory, and sustainable waste management system that aligns with sustainable management principles.

In waste management in Yogyakarta City, various stakeholders, including households, government agencies, universities, businesses, waste banks, and NGOs, play an active role. Universities focus on establishing 3R-based management locations, while businesses support sorting and reducing waste volume at their establishments. Waste banks add economic value through processing and marketing waste products, and NGOs participate in community education and empowerment on waste issues. The City Government, through the Environmental Agency, is responsible for policy design, technical implementation, and oversight to achieve the zero inorganic waste target.

Waste management in Yogyakarta follows a planning process that includes collection, sorting, transportation, recycling, and disposal. This policy follows a hierarchical scheme, starting with waste reduction through sorting at the household level, distribution for recycling, and final disposal at the landfill. Although its implementation aligns with policy targets and processes, variations in waste handling schemes within the community have been empirically observed.

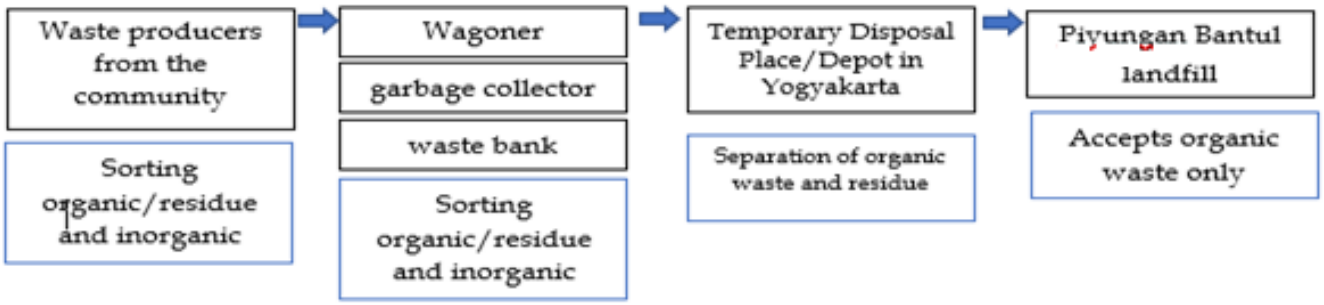

Figure 12. Waste Handling Process in Yogyakarta City

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The process diagram above reflects the ideal Zero Inorganic Waste Movement policy implementation in Yogyakarta City. This process outlines the sequence of steps from the waste source to the final disposal site, which in the context of Yogyakarta City is the Piyungan landfill. This stage aligns with the Waste System Elements in sustainable and integrated waste management, as illustrated in the image below.

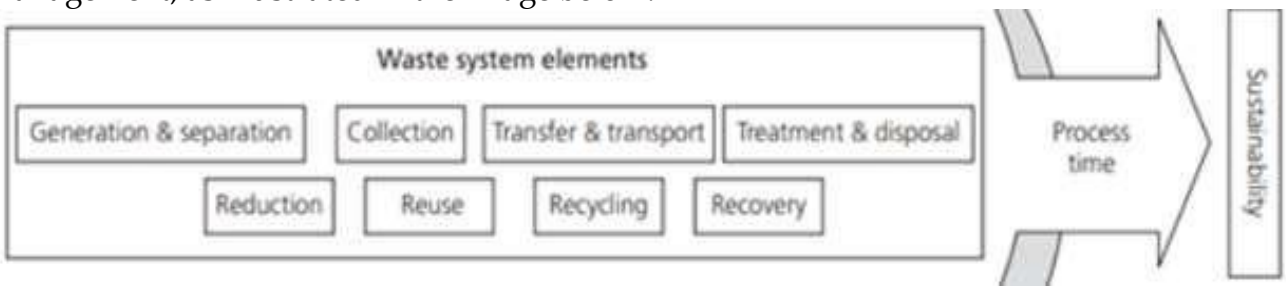

Figure 13. Waste System Elements Process

The "generation and separation" stage involves sorting at the source (households, institutions, and businesses). The waste is sorted, collected, and distributed to handling facilities (waste banks, depots/temporary waste storage sites, and landfills) through waste traders, transporters, or waste banks. Each facility handles the waste according to its designated route, including processing and disposal, following the reduction, reuse, recycling, and recovery principles. The technical aspects depend on the characteristics of the waste, the amount of waste, and local conditions. There are advantages in Surabaya and Bandung, such as higher household-level separation rates and more widely distributed waste bank infrastructure. In Surabaya, the integrated waste bank system allows residents to exchange waste for points that can be used for various public services, encouraging active community involvement (Diyanah et al., 2019). Meanwhile, Bandung manages the "Kang Pisman" program, which focuses on sorting and utilizing waste in each neighborhood (RW), creating high community engagement and minimizing the amount of waste that needs to be transported to the landfill (Ekawati & Cahyati, 2020).

The Strategic Dimension in Integrated Sustainable Waste Management includes two important aspects. First, the financial-economic aspect relates to cost allocation in the waste management system, the impact of environmental services on the economy, the efficiency of urban waste management, the macroeconomic dimension in resource utilization, and the potential revenue from ISWM. Surabaya has successfully developed revenue from waste management through collaboration with the private sector, where companies contribute to waste management through CSR. Bandung has also built a waste bank infrastructure with support from the private sector, which encourages government expenditure and maximizes the economic value of managed waste. Second, the environmental aspect focuses on the impact of waste management on land, water, and air.

Similarly, in Surabaya and Bandung, biodigesters have been integrated into waste banks to reduce environmental impacts from organic waste (Tiaraningrum & Pratama, 2022). This technology can minimize soil, air, and water pollution. In the context of Yogyakarta City, with the presence of the Nitikan TPS3R as the main facility, it is possible to enhance supporting facilities such as biodigesters or RDF (Refuse Derived Fuel) technology to reduce pollution from non-biodegradable waste.

The political aspect of waste management involves political boundaries, legal frameworks, and decision-making processes. The institutional aspect includes social and political structures, the division of institutional functions, and institutional capacity. The socio-cultural aspect

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relates to the influence of culture on waste, variations in waste management practices within the community, and public participation. Waste management implementation is influenced by local conditions, particularly socio-cultural factors and infrastructure. The public's mindset, still viewing waste as something to be discarded, affects their behavior and lack of responsibility in handling waste. Strategic infrastructure, such as Reduce-Reuse-Recycle Waste Disposal Sites (TPS3R), must meet technical requirements, involve both the government and the community, and be located in accessible and environmentally friendly areas. The success of Surabaya and Bandung is also driven by community involvement in sorting and managing waste. Surabaya conducts intensive education in local communities, while Bandung integrates the waste bank program down to the RW level, with the involvement of RW/RT leaders.

The Yogyakarta City Waste Masterplan, following Mayor Regulation No. 32 of 2022, emphasizes the development of TPS3R (Reduce-Reuse-Recycle Waste Disposal Sites) as a center for integrated waste management activities. Activities at TPS3R include sorting waste by type, composting, and packaging recyclable materials. Waste sorting is conducted for several types of waste, such as household hazardous waste (B3), paper, plastic, metal/glass, and organic waste. The TPS3R facility includes communal containers, sorting areas, composting areas, and supporting facilities such as drainage, clean water, electricity, barriers, and storage for recyclable materials and compost products, as well as an optional biodigester.

In line with the waste management planning in Yogyakarta City, as regulated by Mayor Regulation 32 of 2022, the target for developing TPS3R (Reduce-Reuse-Recycle Waste Disposal Sites) in Yogyakarta City is set for 2025. There is only one TPS3R in Yogyakarta City, TPS3R Nitikan, aiming to meet this target. The Yogyakarta City Medium-Term Development Plan 2017-2022 set a target for 3R waste management of 17% and a service satisfaction rate of 76.11%, with a budget allocation of IDR 18,951,177,397.00. Given the large target for 3R waste management, there is a need to optimize and increase the number of TPS3Rs owned by the city government and independently operated.

The development planning for TPS3R (Reduce-Reuse-Recycle Waste Disposal Sites) in Yogyakarta City, as outlined in the 2017-2022 Regional Medium-Term Development Plan, highlights the spread of waste disposal sites (TPS) that lead to issues such as scattered waste, odors, and disease risks. The Regional Medium-Term Development Plan aims to reduce the number of TPS by centralizing them at one location and replacing them with integrated communal waste processing installations. The waste management development policy in Yogyakarta City needs to emphasize the consolidation of TPS into large, centralized indoor TPS, which has the potential to function as TPS3R. In Surabaya, the distribution of waste banks in various strategic locations has successfully reduced waste piles at traditional TPS and encouraged the community to sort waste at the source. Bandung has also implemented the centralization of TPS to improve waste management efficiency and reduce odors and disease transmission risks.

Implementing large, centralized indoor TPS can be a solution for Yogyakarta in addressing TPS capacity issues, reducing the number of illegal TPS, and optimizing waste management. These communal processing centers can also have modern waste management technologies to support sustainability, as implemented in other major cities.

5. Conclusion

The Yogyakarta City Government initiated the Organic Waste Zero Movement through the Mayor's Circular Letter No. 660/6123/SE/2022, which successfully reduced the amount of waste sent to the Piyungan landfill by involving community participation in separating organic

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and inorganic waste. However, this policy has not comprehensively addressed the issue of inorganic waste production, requiring a change in public behavior in line with the 3R concept. Implementing this policy has increased participation and productivity in waste banks, although limited by the government's infrastructure constraints, which could hinder the management of inorganic waste.

The Organic Waste Zero Movement policy focuses on waste collection and sorting without fully integrating the 3R (Reduce, Reuse, Recycle) concept. The 3R concept is crucial for changing public behavior to reduce, reuse, and recycle waste. The main goal of this movement is to generate as little inorganic waste as possible, or even none. However, household waste sorting remains uneven and requires stricter supervision. The infrastructure for managing inorganic waste in Yogyakarta City is also not optimal and requires adjustments to support the zero organic waste movement policy.

The government can strengthen waste management infrastructure, collaborate across government organizations, and partner with the private sector to drive innovation in waste management technology, as well as implement data-driven policies that can monitor and evaluate the effectiveness of policies sustainably. Future research could examine comparisons with other cities successfully implementing similar policies.

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7. Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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