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ZERO WASTE PROGRAM TO SUPPORT SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN URBAN AREAS

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Abstract :

Urban waste generation continues to rise along with population and consumption growth, while capacity management still relies on downstream handling so that waste reduction at the source remains suboptimal; this is the main problem underlying the study. This study aims to analyze the implementation of the zero waste program in Surabaya City and its contribution to achieving the Sustainable Development Goals (SDGs). A qualitative descriptive approach with a case study design was used. The population comprised waste management stakeholders in Surabaya City, with a sample of ten informants selected purposively, including environmental agency officials, field officers, 3R waste facility managers, waste bank administrators, environmental cadres, residents, business actors, collector partners, and academics. Data were collected through interviews, observation, and documentation, supplemented by 2024 secondary data, then analyzed using the Miles and Huberman interactive model through data reduction, data display, and conclusion drawing, and validated through triangulation. The results show that Surabaya manages approximately 99% of its waste, yet source reduction only reached 7.43% and residue at 3R facilities reached 47%, with a composition dominated by organic waste at 55.5%; community participation is the decisive factor for success. It is concluded that the zero waste program contributes to SDGs 11, 12, and 13, but its sustainability requires strengthening source separation, community education, and shifting the success indicator from the volume of waste handled toward the volume prevented, reused, and recycled

Keywords : *zero waste, waste management, sustainable development, circular economy, urban*

INTRODUCTION

Rapid urban population growth has made waste management one of the most pressing environmental challenges of the 21st century. The Global Waste Management Outlook report states that global municipal solid waste generation is projected to increase from 2.3 billion tons in 2023 to 3.8 billion tons in 2050, with potential handling costs reaching USD 640.3 billion per year if no significant intervention is made (UNEP, 2024). In Indonesia, this pressure is particularly felt in urban areas, which are centers of both consumption and waste production. Data from the National Waste Management Information System (SIM) records reported waste generation reaching approximately 31.9 million tons in 2024, with 35.7% of this remaining unmanaged (SIPSN, 2024). Broader estimates place national waste generation at approximately 42.1 million tons per year, with approximately 58% of this still inadequately collected, while approximately 346.5 kilotons of plastic waste leak into the marine environment annually (Zahrah et al., 2024). Unmanaged waste triggers leachate pollution, greenhouse gas

emissions from landfills, and poses health risks to densely populated urban communities. This gap between waste generation rates and management capacity is the central problem of this research: how urban areas can reduce waste generation while sustainably increasing the value of their resources.

The root of this problem is intertwined with accelerated urbanization. Wikurendra et al. (2024) noted that Indonesia's urban population jumped from 30.9% in 1990 to 53.12% in 2015, while regional budgets allocated to the waste sector are generally less than 5%, and the majority of final waste processing sites still operate as open dumps. The management model, which relies on the collect-transport-dispose paradigm, has proven unsustainable because it simply transfers the problem to the final disposal site without breaking the chain of generation. Various community-based initiatives, such as waste banks, have developed and shown positive results in raising public awareness (Marlina, 2024; Meylanisa et al., 2025), but they are generally localized, fragmented, and not yet integrated into the overall city system. This is where the research gap lies: previous studies tend to focus on single community case studies and have not systematically linked zero-waste programs to the achievement of Sustainable Development Goals (SDGs) targets at the city scale.

This research is based on three complementary theoretical foundations. First, the zero waste concept, which views waste not as a residue to be discarded but as a resource that must be circulated through a management hierarchy: avoid, reduce, reuse, and recycle. This concept was formalized by Zaman and Lehmann (2013) through the Zero Waste Index as a tool to measure the performance of waste management systems towards a zero-waste city, and serves as the main theoretical reference for this research. Second, the circular economy theory emphasizes closing material cycles so that product value is maintained for as long as possible. Puntillo (2023) asserts that circular economy-based business models in the waste sector contribute directly to achieving the SDGs, while Wikurendra et al. (2024) offer the 5R framework (reduce, reuse, recycle, refurbish, renew) as an operational bridge. Third, the sustainable development framework (SDGs), specifically Goal 11 on sustainable cities and human settlements, Goal 12 on responsible consumption and production, and Goal 13 on addressing climate change. Specifically, SDG target 12.5, which emphasizes substantial waste reduction through prevention, reduction, recycling, and reuse, serves as the meeting point for these three theories. This theoretical framework is used to understand how zero-waste programs function as instruments that connect everyday waste management practices with the 2030 global agenda, while also providing a basis for assessing the extent to which these programs truly contribute to urban sustainability.

The novelty of this research lies in its attempt to integrate the concept of zero waste as a unified city system explicitly mapped against SDG indicators, rather than simply assessing the success of a single community program in isolation. While previous research has focused on the role of waste banks or partial community-based management (Marlina, 2024; Meylanisa et al., 2025), this research links the entire zero waste chain from source reduction, reuse, and

recycling with measurable achievements in Goals 11, 12, and 13. This approach also addresses the Indonesian urban context, which is rich in initiatives but lacking a comprehensive evaluative framework, often judging the success of a program solely on the volume of waste collected without linking it to broader sustainable development indicators. Thus, the research's novelty addresses a gap left by previous studies and provides an assessment model that connects local actions with global commitments.

Based on this background, the objectives of this study are: (1) to analyze the implementation of the zero waste program in urban areas; (2) to identify the contribution of the zero waste program to achieving SDGs indicators, especially Goals 11, 12, and 13; and (3) to formulate supporting and inhibiting factors for the sustainability of the zero waste program in urban areas.

The benefits of this research span two dimensions. Theoretically, this research enriches the body of waste management studies by linking the concepts of zero waste, the circular economy, and the SDGs framework in a single, integrated analytical model, thereby serving as a conceptual reference for further research. Practically, the research findings are expected to serve as a reference for city governments in formulating sustainability-oriented waste policies, for businesses in developing circular business models, and for the public in increasing participation in waste reduction at source. Thus, this research not only highlights the problem but also offers a solution that aligns with Indonesia's commitment to the 2030 sustainable development agenda.

RESEARCH METHOD

This study uses a qualitative approach with a descriptive research type. The qualitative approach was chosen because this study seeks to understand in depth how the zero waste program is implemented and how it contributes to achieving the Sustainable Development Goals (SDGs) indicators in urban areas, rather than to statistically test the relationship between variables. The descriptive type is used to describe the phenomena, processes, actors, and meanings that occur in the field as they are (natural settings). The design used is a case study, which allows researchers to examine the zero waste program as a unified system in a real urban context, so that the chain of waste reduction, reuse, and recycling can be read comprehensively and contextually.

The research was conducted in Surabaya, East Java Province. This location was purposively selected, considering that Surabaya is a metropolitan city with a high waste generation rate and a variety of community-based waste management initiatives such as waste banks and sustainable villages that are relevant for assessing the implementation of the zero-waste concept and its relationship to the urban SDGs agenda. The research period is planned to last approximately three months, encompassing the pre-survey phase, data collection, and verification of findings.

The data in this study consists of primary and secondary data. Primary data were obtained directly from the field through interviews and observations of the implementation of the zero waste program. Secondary data were obtained

from policy documents, waste management performance reports from the Surabaya City Environmental Agency, data from the National Waste Management Information System (SIPSN), and relevant scientific publications. The combination of these two types of data was used to ensure that the analysis results were not solely based on informant perceptions but were also verified by official documents and data.

Data collection techniques were conducted in three ways. First, participant observation of waste sorting, collection, and processing activities at the source and processing facility levels. Second, in-depth semi-structured interviews to explore the experiences, constraints, and strategies of program actors. Third, a documentation study of regulations, reports, and waste statistics was conducted. Informants were selected using purposive sampling techniques, supplemented by snowball sampling when necessary. Research informants included officials from the Surabaya City Environmental Agency, waste bank managers or administrators, environmental cadres, and residents actively involved in the program. Informants were selected based on their involvement and understanding of the zero waste program, ensuring that the data obtained was truly relevant to the research focus.

Data analysis used the interactive analysis model of Miles, Huberman, and Saldana (2014) which consists of three simultaneous activity flows: data condensation or reduction, data display, and conclusion drawing/verification. The collected data was reduced by selecting information relevant to the implementation of zero waste and SDGs indicators, then presented in the form of narrative descriptions and matrices so that the patterns are easily understood, and finally conclusions were drawn that were continuously verified throughout the process. To ensure the validity of the data, this study applied source triangulation and technical triangulation, namely comparing the results of interviews between informants and matching them with the results of observations and documents. With this procedure, the research findings are expected to have an adequate level of credibility and transferability as a basis for assessing the contribution of the zero waste program to the achievement of SDGs in the city of Surabaya.

FINDINGS AND DISCUSSION

The implementation of the zero waste program in Surabaya City relies on a series of interrelated interventions, starting from waste reduction at the source, sorting, processing, and public education. The Environmental Agency (I-1) explained that the program is carried out "through waste reduction at the source, sorting, processing, waste banks, 3R TPS, compost houses, and public education," with the biggest challenge being the effort to "change people's habits to sort waste at home." This statement is in line with the zero waste hierarchy that places prevention and reduction at the top of the priority (Zaman & Lehmann, 2013). Institutional support is reflected in the availability of quite massive infrastructure, namely 3 main waste banks, 670 unit waste banks, 120 zero waste villages, 191 TPS, 12 TPS 3R, 27 compost houses, and 29,453

environmental cadres. The distribution of these facilities indicates that the city has the structural capital to implement a circular-based waste management system, as proposed by Wikurendra et al. (2024).

In 2024, Surabaya City's waste generation was recorded at 660,946.82 tons/year, or an average of 1,810.81 tons/day. Of this amount, 49,090.68 tons (7.43%) were successfully reduced at source and 606,171.07 tons (91.71%) were managed, leaving only 5,685.07 tons (0.86%) unmanaged (Table 1). The total management achievement of nearly 99% places Surabaya far above the national average, which still leaves around 35.7% of waste unmanaged (SIPSN, 2024).

Table 1. Waste Generation and Achievements of Surabaya City Waste Management in 2024

Indicator	Amount (tons/year)	Percentage
Waste generation	660,946.82	100%
Reduction from source	49,090.68	7.43%
Garbage handled	606,171.07	91.71%
Unmanaged waste	5,685.07	0.86%

However, these aggregate figures need to be read critically. The 7.43% reduction from source indicates that Surabaya's success is largely driven by downstream management, such as transportation and processing, rather than upstream prevention. Within a zero-waste framework, this is less than ideal, as the management hierarchy prioritizes reduction at source (Zaman & Lehmann, 2013). In terms of composition, food waste or organic waste dominates at 55.5%, followed by plastic at 22% (Table 2). This compositional structure is consistent with findings from other cities in Indonesia (Zahrah et al., 2024) and confirms that organic processing through composting and compost houses should be the backbone of the strategy. Households also dominate the source of waste (85.2%), making behavioral interventions at the household level the most crucial lever.

Table 2. Composition of Surabaya City Waste in 2024

Types of Waste	Persentase
Food waste/organic	55.5%
Plastic	22%
Other	9.4%
Cloth	5.8%
Paperboard	3%
Wood/leaves	2.2%
Rubber/leather	1.3%
Glass	0.5%
Metal	0.2%

The low reduction at source is closely related to the issue of sorting. Field officers (I-2) stated that "some areas have sorted, but there is still a lot of mixed waste," while the manager of the 3R Waste Management Site (I-3) emphasized that "if sorting is done at home, the processing process will be more effective and residue can be reduced." This complaint is reflected in the performance of the 3R Waste Management Site, namely, of the 48.71 tons/day of incoming waste, only 25.83 tons (53%) are processed into compost and recycled materials, while 22.88 tons (47%) become residue. The high residue, which is almost half of the input, is quantitative evidence that weak sorting upstream reduces the efficiency of the downstream system. Triangulation between secondary data and interview results strengthens the conclusion that waste reduction at source remains a major challenge for the program.

In terms of utilization, waste banks play a dual role: reducing waste disposal while generating economic value. A waste bank administrator (I-4) stated that waste banks "help reduce waste disposal while providing economic benefits through the sale of materials that still have value," while a collection partner (I-9) emphasized that "the cleanliness and quality of the materials significantly determine the selling price of recycled waste." Both statements confirm the logic of a circular economy, where maintaining the value of materials for as long as possible is at the heart of the business model (Puntillo, 2023). These findings also align with previous research that positions waste banks as an effective instrument for achieving sustainable cities (Marlina, 2024; Meylanisa et al., 2025). However, I-9's emphasis on material quality implies that economic value is only optimal if sorting is carried out properly, reaffirming the importance of upstream behavior.

The entire series of findings ultimately boils down to one determining factor: community participation. An environmental cadre (I-5) assessed that the program is "easier to implement if supported by neighborhood administrators and residents" through regular education and concrete examples. An active resident (I-6) said they are motivated because "the environment is cleaner and there is less household waste being thrown away," while an inactive resident (I-7) stated that "it is not routine due to limited time and habits." The contrast between I-6 and I-7 shows that the main obstacle is not a lack of knowledge, but rather habit formation. A culinary entrepreneur (I-8) added an economic dimension, stating that waste reduction is "still hampered by the cost of alternative packaging." With 29,453 environmental cadres, Surabaya has significant social capital, but its effectiveness depends on the sustainability of education and incentives that can transform habits into permanent behavior.

From the SDGs framework, Surabaya City's zero waste program contributes to three goals. In Goal 11 on sustainable cities and human settlements, reducing the impact of urban waste, reflected in the low proportion of unmanaged waste (0.86%), supports Target 11.6 on reducing environmental impacts per capita in urban areas (Marlina, 2024). In Goal 12 on responsible consumption and production, the practice of reducing, reusing, and recycling

through waste banks and 3R waste disposal sites (TPS 3R) aligns with Target 12.5 on substantially reducing waste generation (Puntillo, 2023). In Goal 13 on climate change mitigation, processing organic waste, which dominates the composition (55.5%), has the potential to reduce methane emissions from landfills (UNEP, 2024). However, in line with the academic view (I-10) that success "is not only seen from the waste collected, but from the amount of waste that is successfully prevented, reused, and recycled," the contribution to the SDGs will be more optimal if the success indicator is shifted from the volume of handling to the volume of prevention, in line with the idea of the Zero Waste Index (Zaman & Lehmann, 2013).

CONCLUSION

Based on the research results, it can be concluded that the zero waste program in Surabaya City has been supported by relatively adequate policies, infrastructure, and community participation, thus reducing unhandled waste to only 0.86% and placing the city's management achievements far above the national average. However, this success is supported more by downstream handling than upstream prevention, as indicated by the low waste reduction from sources which has only reached 7.43% and the high residue at the 3R TPS at 47%. The dominance of organic waste at 55.5% also confirms that strengthening organic processing and sorting from the household level is key to increasing the program's effectiveness.

From a sustainable development perspective, Surabaya City's zero waste program contributes to the achievement of the SDGs, particularly Goals 11, 12, and 13, by reducing the impact of urban waste, implementing responsible consumption and production principles, and processing organic waste that has the potential to reduce greenhouse gas emissions. Therefore, the program's future sustainability requires strengthening source sorting, ongoing public education, strengthening waste bank institutions and 3R waste disposal sites, and implementing an SDGs-based evaluation system. Thus, the program's success is no longer measured solely by the volume of waste collected, but rather by the amount of waste that is successfully prevented, reused, and recycled (Zaman & Lehmann, 2013).

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