JRSSEM 2025, Vol. 04, No. 11, 1958–1967
E-ISSN: 2807 - 6311, P-ISSN: 2807 - 6494

JRSSEM
JOURNAL RESEARCH OF SOCIAL SCIENCE, ECONOMICS, AND MANAGEMENT

Improving The Efficiency of Ups Performance in Depok City

Baskoro Lokahita*, Aisyia Prasetya Effendi, Hana Syarifah Firdaus, Ni Putu Sri Wahyuningsih
Universitas Indonesia, Indonesia
Email: baskoro.lokahita@ui.ac.id*

Submitted: May 2025, *Revised*: June 2025, *Accepted*: June 2025

Abstract. The problem of waste in urban areas such as Depok City requires effective and efficient management solutions to reduce the burden on the final processing site (TPA). The Waste Management Unit (UPS) is one of the strategies of the Depok City Government in handling region-based domestic waste. This study aims to evaluate the technical performance of UPS operating in several locations in Depok City, as well as identify potential for improvement in processing efficiency. The mixed-methods approach is used through the collection of primary and secondary data. Quantitatively, load count analysis and daily mass balance were carried out to analyze the flow of material from input to compost output. Qualitatively, direct observation, semi-structural interviews, and work system studies were carried out. Case studies on three UPS (Jalan Jawa, Sukatani, and Merdeka 1) showed that the proportion of organic waste dominated (more than 94%) with a decrease in mass of up to 74% after the composting process. Nevertheless, the efficiency of the process varies depending on the sorting mechanism, available equipment, and human resource capacity. The results of the analysis show that UPS's performance has not been fully optimal in reducing the burden of waste to the landfill. This study recommends improving operational management, strengthening institutions, and integrating community roles to achieve a sustainable regional waste management system.

Keywords: waste management, composting, mass balance

INTRODUCTION

The problem of waste is a crucial issue faced by almost all regions in Indonesia. Based on data from the National Waste Management Information System (SIPSN) in 2024, national waste generation will reach more than 18 million tons per year, with the dominance of organic waste composition of around 57% (SIPSN, 2024). Although various policies and strategies have been implemented, there is still a gap between the collection, transportation, and final treatment of waste. This leads to a high dependence on Final Processing Sites (TPAs), most of which are still operating with open dumping or controlled landfill methods, as well as minimal reduction and recycling efforts at the source level.

Recycling and composting facilities have been proven to provide significant environmental benefits in various cities in Indonesia. This waste management strategy helps reduce the volume of waste sent to the final processing site (TPA) and reduce greenhouse gas (GHG) emissions resulting from the decomposition of organic waste (Meidiana et al., 2023). In the city of Surabaya, for example, the implementation of community-based composting programs has shown a reduction in methane emissions from landfills, while increasing public awareness of sustainable waste management. A life-cycle assessment (LCA) study conducted on 34 provincial capitals in Indonesia shows that waste management scenarios that prioritize recycling and composting can provide the highest cumulative environmental benefits compared to business-as-usual scenarios (Mustafa et al., 2022). These benefits include reducing carbon footprint, improving local air quality, and reducing pressure on landfill capacity (Medina, 2010). This evidence suggests that recycling and composting facilities have a key role to play in supporting national environmental and climate goals.

In Presidential Regulation No. 12 of 2025 concerning the National Medium-Term Development Plan (RPJMN) 2025–2029, in National Priority 2 point 25, the main priority

activities are determined in the form of increasing waste collection and processing as well as waste processing at landfills/LURs (Presidential Regulation (Perpres) Number 12 of 2025 concerning the National Medium-Term Development Plan for 2025 - 2029, 2025). Policy intervention is needed in the form of integrated upstream and downstream waste management reform by covering the entire service chain: sorting, containerization, collection, transportation, processing, and final processing, as well as strengthening advice and infrastructure by providing and revitalizing *TPS3R*, Recycling Centers, Compost House, technology: composting, maggot (black soldier fly), RDF, WtE, pyrolysis, informal sector integration, and TPST optimization, leachate management, methane gas, and landfill conservation with landfill mining, residue restriction to landfills with sanitary landfill systems, handling marine waste through an integrated system between land-based and waters.

Despite its great potential, the implementation of recycling and composting facilities in Indonesian cities still faces various challenges. One of the main technical obstacles is the lack of optimal product design to minimize waste from the beginning (Nizar et al., 2021). Many consumer products are still designed without considering the ease of recycling, making the process of material recovery more difficult and inefficient. On the other hand, the informal sector that plays a major role in the sorting and collection of recycled materials is still operating with very limited support. Scavengers are often driven by economic motives to move to big cities for higher incomes but face social vulnerabilities such as gender-based income gaps and lack of access to social services. In addition, the lack of integration of the informal sector into the formal management system makes it difficult for recycling and composting efforts to be developed sustainably (Kristanto et al., 2022). Overcoming these barriers requires institutional reform as well as investment in education, equipment, and cross-sectoral coordination mechanisms.

When implemented effectively, recycling and composting facilities make a significant contribution to improving the overall waste management system in cities. These facilities play a role in diverting organic and inorganic waste from landfills, extending the operational life of landfills, and reducing the burden on waste management infrastructure. The integration of the informal sector into the formal management system is a promising strategy to improve the rate of material recovery and overall system efficiency. Community-based innovations such as waste banks show how community participation can improve recycling performance, encourage behavior change, and create additional benefits such as job creation and strengthening social cohesion (Budiyarto et al., 2025). These models are also in line with the Sustainable Development Goals (SDGs), in particular Goal 11 (*Sustainable Cities and Settlements*) and Goal 12 (*Responsible Consumption and Production*), by building inclusive and resilient waste governance (United Nations, 2024).

The city of Depok, as part of the Greater Jakarta metropolitan area, faces similar challenges. The population growth rate of Depok City was recorded at ±1.59% per year in the 2020-2022 period, which had a direct impact on the increase in waste generation. Based on the City Sanitation Strategy (SSK) document, waste generation in Depok City is estimated to reach 1,558.2 tons per day. Of these, around 94.9% has been served by the waste management system, but there are still 5.2% of waste that has not been handled properly (Technical Assistance for the Preparation of the Master Plan for the Depok City Waste Management System, 2023).

Waste management in Depok City is regulated through Depok Mayor Regulation Number 46 of 2016, which includes two main approaches, namely waste reduction and handling. The reduction strategy is carried out by applying the 3R principle (*reduce, reuse, recycle*), while waste management includes sorting and containerization at the source level, collection, transportation to processing facilities, processing itself, to the final process at the

Final Processing Site (TPA). The public is asked to sort waste into three main categories: organic, inorganic, and residue. Organic waste that has been sorted is directed to the Waste Processing Unit (UPS) to be composted, while inorganic waste is cleaned, recycled, or sold through the Waste Bank. Residual waste that cannot be further processed will be taken to the Cipayung landfill. Considering that the majority of waste in Depok City is organic waste, the existence of UPS is an important strategy in reducing the volume of waste entering the Cipayung Landfill (Depok City Mayor Regulation (PERWALI) Number 46 of 2016 concerning Technical Guidelines for Waste Management, 2016).

In principle, UPS's work system is similar to the *Reduce-Reuse-Recycle* Waste Treatment Site (TPS 3R), where both focus on the implementation of the principle of recycling and reducing waste from the source (Damanhuri & Tri Padmi, 2019; Tchobanoglous & Kreith, 2002). This makes UPS an important part of the 3R-based waste management system in Depok City. Currently, there are 45 UPS in Depok City, with 30 of them managed directly by the Depok City Environment and Hygiene Agency (DLHK). This UPS is spread across 11 sub-districts and 63 sub-districts, and most of them have been operating since 2007. While there are considerable numbers, there are various challenges that need to be reviewed, such as the effectiveness of waste sorting and processing carried out by UPS, as well as the availability of data and information regarding its operational performance and sustainability. A thorough evaluation is needed to ensure that UPS really functions optimally in supporting the waste management system of Depok City.

This study aims to evaluate the performance of UPS in Depok City with a quantitative descriptive approach. An assessment is carried out on the quality and quantity of processed waste, and the effectiveness of the processing process. Data collection was carried out through field surveys, interviews with UPS managers and the Environment Agency (DLHK), and laboratory testing on compost quality.

The expectation of this study is to produce strategic recommendations in an effort to improve the efficiency and effectiveness of the management of the Waste Management Unit (UPS) as an integral part of the waste system of Depok City. The hypothesis proposed states that UPS in Depok City has not run optimally and has not made a significant contribution in reducing the amount of waste dumped in landfills. This is allegedly caused by various obstacles in technical, managerial, and low community participation. Through a comprehensive evaluation, this research is expected to identify the root of the problem and formulate corrective measures that can be implemented in a sustainable manner.

RESEARCH METHOD

The method in this study uses a mixed approach, namely quantitative and qualitative approaches. A quantitative approach is used to obtain numerical data that can be calculated and analyzed statistically. According to Scott (2008), the quantitative approach is a research method that, in the process, emphasizes the aspects of measurement, calculation, and certainty of numerical data. In the context of this study, a quantitative approach is used to measure the amount of waste generated that enters the Waste Processing Unit (UPS) using the load count analysis method, so that a balance of waste mass in each UPS of Depok City can be compiled.

Meanwhile, a qualitative approach is used to describe the waste management system applied to each UPS. This approach aims to understand phenomena in depth through the description of systems, processes, and constraints that occur in the field. The research method refers to the scientific procedure used to obtain knowledge systematically. In this study, two main methods were used, namely the *descriptive method* and the *ex post facto method*.

The *descriptive method* aims to provide a systematic, factual, and accurate picture of the facts, characteristics, and relationships between the phenomena being studied (Scott, 2008).

This method is used to visualize data and information related to the waste management system that has been running. Meanwhile, the *ex post facto method* is used to find a causal relationship with the phenomenon that has occurred. In this method, the researcher has no control over the independent variable but can only observe its effect on the dependent variable. The observed phenomenon can be influenced by factors such as the level of income of the community or the condition of the surrounding environment (Scott, 2008).

Material flow analysis in waste processing at UPS is carried out by calculating all inputs and outputs of the life cycle of the compost production system. The calculation of material flow can be done by describing the work process related to compost production, the functional units that take place, as well as the system limitations. In this case, the related work processes are the source of incoming waste, sorting, enumerating, composting, sieving, and packaging. The function of the material flow calculation on the UPS is to analyze how effective the waste treatment system in the UPS is to be the next evaluation material.

Data on the amount of incoming waste was obtained from the results of measuring incoming waste over a span of 1 year. Then the amount of organic waste that is composted is calculated based on the organic waste that has been sorted. Based on the literature, the volume and weight of the composted material will be reduced with a percentage reduction of 70% - 80% (Wahyono, 2011). In this calculation, the value of the compost used is calculated based on the existing compost product. Volume reduction in the composting process is due to the decomposition of microorganisms and organic materials that change into gas and water.

In this study, the analysis of material flow (*Material Flow Analysis* or MFA) in the Waste Processing Unit (UPS) is compiled to quantitatively describe the path of waste movement from the input stage to the final output, including the fraction that is successfully composted and what is wasted as residue. MFA preparation is done using software *STAN2* (short for *Substance flow Analysis*), an open-source-based application developed by the Institute for Water Quality, Resources, and Waste Management at the Vienna University of Technology (Cencic & Rechberger, 2008). The software is available online through the website https://www.stan2web.net and has been widely used in the study of environmental material flow. With STAN2, the mass balance is compiled in the form of a system diagram that allows for accurate visualization of inputs, outputs, and material accumulations, as well as helps identify inefficiencies in the processing system (Mika et al., 2025). The use of STAN2 also facilitates the estimation of data uncertainty, thus providing more reliability in the evaluation of UPS operational performance.

RESULTS AND DISCUSSION

Overview of UPS Jalan Jawa

The Jalan Jawa Waste Management Unit (UPS) is one of the UPS owned by the Depok City government which is located on Jl. Jawa No. 169, Beji Village, Tapos District, Depok and has been operating since 2009. This UPS has a land area of ± 540 m2 with a building area of 30 m x 18 m. There are several facilities such as 1 shredder, 1 composting machine, and 1 conveyor belt machine.

The number of workers at UPS Jalan Jawa is 11 people, of which 1 person acts as a coordinator, 1 person as a motorcycle cart driver, and the remaining 9 people as field implementers. In its implementation, as many as 5 people from 9 field implementers are tasked with moving waste onto the conveyor belt for sorting and enumeration, then 2 other people are in charge of moving or stacking chopped organic waste to the composting site, and 2 other people are in charge of turning the compost pile every week. The following is a table of the

division of duties of workers. There are 44 RTs and 25 RWs with a population of ± 2738 families.

Based on Figure 2, it can be seen that most of the composition of waste that enters the Jalan Jawa UPS is organic waste. In this UPS, the incoming organic waste has a percentage of 97.85%. Based on observations for 8 days, there is still 2% of inorganic waste transported to UPS, such as plastic waste, residues, paper, fabric, and B3. The existence of inorganic waste is caused by the public's ignorance regarding the garbage cans that have been sorted or the accidental discharge of the community who throw their inorganic waste into the special organic garbage can.

Overview of UPS Sukatani

The Sukatani Waste Management Unit (UPS) is located on Jl. Anggrek Perum Kopasus Pelita 1 RW 12, Sukatani Village, Tapos District, Depok with a land area of ± 600 m2 with a building area of 35 m x 17.85 m. This UPS is under the auspices of the Depok City Environment and Hygiene Agency and has been operating since 2008. There are several facilities such as 1 shredder, 1 composting machine, and 1 conveyor belt machine. The following is the layout of UPS Sukatani.

The number of workers at UPS Sukatani is 10 people, of which 1 person acts as a coordinator, 1 person as a motorcycle cart driver, and the remaining 8 people as field implementers. In its implementation, as many as 2 people from 8 field implementers are in charge of moving waste to the sorting table and then sorting, 2 people are in charge of moving the waste that has been sorted into *a conveyor belt* for shredding, 2 people are in charge of moving the chopped organic waste to the composting site or piling up the shredded waste in the compost pile, and 2 other people turned the compost mound over. There are a total of 34 RTs and 6 RWs with a population of ± 1882 households. The following is organic waste sorting data at UPS Sukatani.

In Figure 4, it can be seen that most of the waste that enters the Sukatani UPS is organic waste. The average value of incoming organic waste is 94% and inorganic waste is 6%. Based on the results of observation for 8 days, there are still inorganic waste transported into the UPS such as plastic waste, residue, paper, fabric, and B3.

Overview of UPS Merdeka 1

The Merdeka I Waste Management Unit (UPS) is part of the Depok City Environment and Hygiene Agency which is located on Jl. Merdeka No. 3, Abadijaya Village, Sukmajaya District, Depok and has been active since 2012. With a land area of about 100 m2 and a building area of 25.5 m x 22 m, this UPS is equipped with 1 conveyor belt machine, 1 shredding machine, and 1 sieving machine.

In its waste management, UPS Merdeka I employs a total of 13 people who are divided into several roles, namely 1 coordinator and the remaining 12 people who are field implementers. Field implementers have different duties or responsibilities. About 5 people are responsible for moving the waste into the compost pile, 5 people are in charge of chopping twig waste to be mixed with wet organic waste, and 2 other people are in charge of turning the compost mound. The UPS Merdeka 1 service area is under the coordination of the DLHK Waste Transportation Section using a pick-up car. There are a number of services as many as 62 RTs and 20 RWs with a population of ±1381 households.

Referring to Figure 6, it can be seen that most of the waste that enters UPS Merdeka 1 is organic waste. The percentage of organic waste at UPS Merdeka 1 is 98%. On Friday, the percentage of waste that came in 100% was organic waste, namely leaf and twig waste. During the 8-day observation period, there was still 2% inorganic waste transported to UPS.

Material Flow Analysis at UPS Jalan Jawa

Based on data on the amount of waste that enters the Jalan Jawa UPS and the compost produced in 2023, the flow of materials in the UPS composting process is obtained as follows.

Based on the material flow at the Jalan Jawa UPS, 1065.17 kg/day of incoming waste is transported from the source to the sorting unit. The majority of waste at UPS Jalan Jawa comes from organic waste, which is 97.85% of waste or 1042.26 kg/day which is identified as organic waste to be used as raw materials for composting, while inorganic waste and residues discarded at the Cipayung landfill are 2.15% or 22.9 kg/day. After going through the sorting process, the enumeration process is carried out assuming the amount of organic waste remains and there is no reduction in mass. Furthermore, in the composting process, there was a significant mass shrinkage of 74% or 809.7 kg/day due to biological and chemical processes that occurred during the decomposition of organic matter. This indicates that the composting process has succeeded in effectively reducing organic mass. Mature waste in the form of coarse compost is 232.56 kg/day. Next, there is a coarse compost sifting process, so that it will be separated between fine compost and coarse compost. In this case, the assumption is that the amount of compost that does not pass the filter is 10%, so that the amount of fine compost is obtained at 211.43 kg/day. Compost that does not pass the filter is then recycled back into materials or a mixture of compost mounds. Therefore, the yield of compost products per day was 211.43 kg.

UPS Jalan Jawa plays an important role in processing organic waste, where there is a minimum reduction in waste thrown into landfills. With that, the effectiveness of UPS can be measured through the percentage reduction of waste that is successfully processed compared to the amount of waste that enters. The following is the percentage reduction of waste from UPS Jalan Jawa that will be disposed of at the Cipayung Landfill.

Material Flow Analysis at UPS Sukatani

The analysis of material flow at UPS Sukatani can be seen in Figure 9. The calculation simulation is based on the 2023 mass balance data. Based on the flow of materials that have been obtained, it can be seen that the waste transported from the source by UPS Sukatani every day is 929.11 kg. Of the amount of waste that entered, the majority was in the form of organic waste as much as 94% or 873.37 kg/day. The rest is inorganic waste as much as 6% or 55.75 kg/day.

After going through the sorting process, the enumeration process is carried out assuming that the amount of organic waste remains and there is no reduction in mass. Furthermore, at the composting stage, there was a significant mass shrinkage of 78% or around 647.35 kg/day due to biological and chemical processes during the decomposition of organic matter. This shows that the composting process successfully reduces organic mass effectively. Waste that has matured into coarse compost is 226.01 kg/day. Then in the sieving process, the coarse compost is separated into fine compost and coarse compost, assuming 10% of the coarse compost does not pass the sieve, resulting in a fine compost of 205.47 kg/day. Coarse compost that does not pass the filter is then reprocessed for recycling. Thus, the compost product produced per day is 205.47 kg.

UPS Sukatani plays a role in reducing waste that enters the Cipayung Landfill by utilizing organic waste as compost. With that, the effectiveness of UPS can be measured through the percentage reduction of waste that is successfully processed with the amount of waste that enters. The following is the percentage reduction of waste from UPS Sukatani that is disposed of at the Cipayung landfill.

Analysis of UPS Independent Material Flow 1

Based on data on the amount of waste that enters UPS Merdeka 1 and the compost produced in 2023, the flow of materials in the UPS composting process is obtained as shown in figure 11.

The waste transported from the source by UPS Merdeka 1 every day is 1,085.69 kg. Of the amount of waste that entered, the majority was in the form of organic waste as much as 98% or 1,063.98 kg/day. The rest is 2% inorganic waste or 21.71 kg/day. In the process, organic waste will be used as raw materials for composting, while inorganic waste and residues will be disposed of at the Cipayung Landfill.

After going through the sorting process, the enumeration process is carried out assuming the amount of organic waste remains and there is no reduction in mass. Furthermore, at the composting stage, there was a significant mass shrinkage of 78% or around 831.45 kg/day due to biological and chemical processes during the decomposition of organic matter. This shows that the composting process successfully reduces organic mass effectively. Waste that has matured into coarse compost is 232.53 kg/day. Then in the sieving process, the coarse compost is separated into fine compost and coarse compost, assuming 10% of the coarse compost does not pass the filter, resulting in fine compost of 211.39 kg/day. Coarse compost that does not pass the filter is then reprocessed for recycling. Thus, the compost product produced per day is 211.39 kg.

UPS Merdeka 1 acts as an organic processing site, where organic waste sent to landfills is reduced. Thus, the effectiveness of UPS Merdeka 1 can be assessed based on the percentage reduction of waste that has been successfully processed compared to the total waste that enters. The following is the percentage reduction of waste from UPS Merdeka 1 that is disposed of at the Cipayung landfill.

Figure 12, shows that the reduction of waste at UPS Merdeka 1 varies every day, where the highest reduction occurs on day 6 with a value of 100. This is because the incoming waste is leaf and twig waste, and on Friday there is no transportation of organic waste from the community. The smallest reduction was on day 8 with a value of 95.2%. This can show that in general, UPS Jalan Jawa is able to reduce waste effectively, with an average reduction of over 95%.

Overall, material flow related analyses at all three UPS have shown the effectiveness of waste treatment systems in reducing the volume of organic waste by converting it into useful compostable products. In this case, the proper sorting process from the source plays an important role in ensuring that the waste that enters the UPS as composting material is only organic waste, in accordance with the Depok City Regulation Number 5 of 2014. The efficiency of mass reduction during the composting process has reached 70-80% and shows the success of the system in decomposition of organic matter with the final result in the form of compost products (Wahyono, 2011).

From an economic perspective, investment in recycling and composting facilities is increasingly showing strong feasibility in the Indonesian context. Cost-benefit analysis shows that centralized composting facilities are the most financially viable option in current market and policy conditions. This investment not only improves the efficiency of organic waste management, but also produces valuable products such as compost that can be utilized in the agricultural sector. Furthermore, digital transformation in the waste sector has opened up new job opportunities, especially in urban areas. It is estimated that the recycling industry can create more than 120,000 formal jobs and absorb up to 3.3 million informal workers such as scavengers and collectors (Kurniawan et al., 2022). These economic benefits, coupled with environmental and social benefits, place recycling and composting facilities as strategic sectors in the transition to a circular economy in Indonesia. Thus, the development of this facility is

not only an issue of waste management, but also an investment in economic resilience, social justice, and environmental protection (Aye & Widjaya, 2006).

CONCLUSION

This study demonstrates that Depok City's Waste Processing Unit (UPS) has successfully reduced organic waste volume by 74% through composting, yet its performance remains suboptimal in decreasing landfill waste. The evaluation revealed significant challenges in technical infrastructure, particularly inadequate waste sorting and processing equipment, which limits daily operational capacity. Manual labor processes lacking standardized operating procedures (*SOPs*) further hinder efficiency, causing inconsistent compost quality and output. Additionally, low community participation in source waste sorting exacerbates the problem, as UPS managers bear the full sorting burden due to insufficient public education and incentive mechanisms. These findings confirm the hypothesis that UPS faces systemic inefficiencies in technical, institutional, and social dimensions, preventing it from reaching its full potential as a regional waste management solution.

To enhance UPS performance, strategic improvements are needed, including upgrading facilities, implementing *SOPs*, and fostering community engagement through education and incentives. Future research should explore: (1) the impact of automation and advanced sorting technologies on UPS efficiency, (2) the effectiveness of behavioral interventions (e.g., reward systems or awareness campaigns) to boost public participation, and (3) policy frameworks to institutionalize cross-sector collaboration between local governments, UPS operators, and communities. Such studies would provide actionable insights to optimize UPS operations, align with municipal sustainability goals, and support national waste reduction targets. By addressing these gaps, UPS could evolve into a scalable model for sustainable urban waste management in Indonesia.

REFERENCES

Aye, L., & Widjaya, E. R. (2006). Environmental and economic analyses of waste disposal options for traditional markets in Indonesia. Waste Management, 26(10), 1180–1191. https://doi.org/10.1016/j.wasman.2005.09.010

Technical Assistance for the Preparation of the Master Plan for the Depok City Waste Management System. (2023). Ministry of Public Works and Public Housing, Directorate General of Cipta Karya, West Java Regional Settlement Infrastructure Center.

Budiyarto, A., Clarke, B., & Ross, K. (2025). Overview of waste bank application in Indonesian regencies. Waste Management & Research: The Journal for a Sustainable Circular Economy, 43(3), 306–321. https://doi.org/10.1177/0734242X241242697

Cencic, O., & Rechberger, H. (2008). Material Flow Analysis with Software STAN. Journal of Environmental Engineering and Management, 18(1), 5.

Damanhuri, E., & Tri Padmi (with ITB Publishers). (2019). Integrated waste management (Second edition). ITB Press.

Kristanto, G. A., Kemala, D., & Nandhita, P. A. (2022). Challenges confronting waste pickers in Indonesia: An on-field analysis. Waste Management & Research: The Journal for a Sustainable Circular Economy, 40(9), 1381–1389. https://doi.org/10.1177/0734242X211029181

Kurniawan, T. A., Dzarfan Othman, M. H., Hwang, G. H., & Gikas, P. (2022). Unlocking digital technologies for waste recycling in Industry 4.0 era: A transformation towards a digitalization-based circular economy in Indonesia. Journal of Cleaner Production, 357, 131911. https://doi.org/10.1016/j.jclepro.2022.131911

Medina, M. (2010). Community-based organics diversion. BioCycle, 51(4), 57–59. Scopus.

Meidiana, C., Tomoo, S., & Subagiyo, A. (2023). Municipal Waste and Its Management: Case Study in Indonesia. In R. Brinkmann (Ed.), The Palgrave Handbook of Global Sustainability (pp. 747–760). Springer International Publishing. https://doi.org/10.1007/978-3-031-01949-4_51

Mika, S., Mühl, J., Skutan, S., Aschenbrenner, P., Limbeck, A., & Lederer, J. (2025). Substance flows of heavy metals in industrial-scale municipal solid waste incineration bottom ash treatment: A case study from Austria. Waste Management, 195, 240–252. https://doi.org/10.1016/j.wasman.2025.02.011

Mustafa, A. B., Dong, H., Zhang, C., & Fujii, M. (2022). Life cycle environmental benefit and waste-to-energy potential of municipal solid waste management scenarios in Indonesia. Journal of Material Cycles and Waste Management, 24(5), 1859–1877. https://doi.org/10.1007/s10163-022-01441-6

Nizar, M., Munir, E., Munawar, E., & Irvan, I. (2021). Waste Management Optimization in Banda Aceh: Towards a Zero-Waste City. Ecological Engineering & Environmental Technology, 22(5), 18–27. https://doi.org/10.12912/27197050/139465

Presidential Regulation (Perpres) Number 12 of 2025 concerning the National Medium-Term Development Plan for 2025 - 2029 (2025).

Depok City Mayor Regulation (PERWALI) Number 46 of 2016 concerning Technical Guidelines for Waste Management (2016).

SIPSN. (2024). National Waste Generation [Dataset].

Sugiyono. (2008). Educational research methods: (Quantitative, qualitative and R&D approaches) (Fig. 6). Alphabet.

Tchobanoglous, G., & Kreith, F. (Eds.). (20). Handbook of solid waste management (2nd ed.). McGraw-Hill.

United Nations. (2024). The Sustainable Development Goals report 2024. United Nations. https://unstats.un.org/sdgs/report/2024/

Wahyono, S. (2011). Dynamics of Temperature Change and Waste Volume Reduction in the Composting Process (Case Study of Composting at Rph Cakung – East Jakarta). Journal of Environmental Technology, 9(3). https://doi.org/10.29122/jtl.v9i3.469