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# Harmonization between National Policy and Regional Regulations in Solid Waste Management in Indonesia: A Normative-Empirical Legal Analysis

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## Abstract

*Indonesia's solid waste management framework continues to face persistent legal and institutional challenges in harmonizing national policies with regional regulations within a decentralized governance structure. Despite the enactment of Law No. 18 of 2008 and subsequent regulatory instruments up to 2023, existing legal scholarship remains largely descriptive, focusing on compliance rather than addressing normative and institutional fragmentation particularly the misalignment between Law No. 18/2008 on Waste Management and Law No. 23/2014 on Regional Government. This study aims to fill that gap by employing a normative-empirical legal approach that combines doctrinal analysis with field-based interviews involving five key stakeholders from the Ministry of Environment and Forestry, provincial agencies, and legal experts. These structural weaknesses undermine policy coherence and highlight the limitations of relying solely on legal standardization. Drawing on decentralization theory and multi-level governance frameworks, this article offers two key contributions. First, it proposes the establishment of a National Regional Harmonization Council for Solid Waste Governance (NRHC–SWG) as a statutory mechanism to enhance vertical coordination. Second, it introduces the Multi-Level Governance Harmonization Index (MLGHI) as an evaluative model to assess coherence across normative, institutional, and operational dimensions. These prescriptive and analytical innovations*

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*aim to clarify the constitutional boundaries of regional autonomy under Article 18 of the 1945 Constitution, strengthen institutional synergy, and advance regulatory integration for sustainable solid waste governance in Indonesia.*



## 1. Introduction

Solid waste management is one of the important aspects in maintaining environmental balance and public health. Solid waste that is not managed optimally can cause many problems, such as soil, water, and air pollution, and threaten human health.[1] Therefore, policies related to solid waste management must be well designed in order to provide effective solutions to overcome these problems.

In general, national policies in solid waste management aim to provide a uniform framework and standards that must be adhered to by all regions in a country. This policy usually includes basic principles of waste management, such as reduction, reuse, recycling (3R), and environmentally friendly disposal procedures. In many countries, the central government sets regulations governing waste management, which are then adapted by local governments according to local needs and characteristics.[2]

In Germany, the waste management system is based on the concept of a circular economy that emphasizes the reuse and recycling of waste. The Closed Substance Cycle and Waste Management Act (KrWG) which has been in effect since 1996 requires every producer to be responsible for the waste generated from their products[3]. In addition, the Packaging Act (VerpackG) which came into effect in 2019 requires manufacturers and distributors to recycle their product packaging, thereby increasing efficiency in resource utilization.[4]

[1] M Faza Nanda et al., "Analisis Pentingnya Pengelolaan Limbah TerhadapKehidupan Sosial Bermasyarakat," *Venus: Jurnal Publikasi Rumpun Ilmu Teknik* 2, no. 2 (2024): 97–107, https://doi.org/10.61132/venus.v2i2.255.
[2] Muhammad Mutawalli et al., "Implementation of FLEGT Licensing Scheme in Deforestation Law Enforcement: Improvements and Handling in Indonesia," *Jurnal Hukum Unissula* 39, no. 2 (2023): 130–56, https://doi.org/10.26532/jh.v39i2.32210.
[3] M. Nelles et al., "Waste Management in Germany – Development to a Sustainable Circular Economy?," *Procedia Environmental Sciences* 35 (2016): 6–14, https://doi.org/10.1016/j.proenv.2016.07.001.
[4] Taobe Consulting, "German Packaging Act: Understanding the VerpackG and Its Impact on Businesses," Taobe Consulting, 2023, https://taobe.consulting/german-packaging-act-verpackg/.

Sweden implements a circular economy-based system by encouraging people to be more active in recycling and reusing waste. One of the leading policies is the implementation of high taxes on waste disposal to landfills which aims to minimize the amount of waste sent to landfills and increase recycling rates[5]. In addition, Sweden has developed a waste-to-energy infrastructure that allows more than 50% of domestic waste to be converted into electricity and district heating.[6] This policy is supported by strict regulations on waste sorting from households and the active role of local governments in providing adequate recycling facilities.[7]

Japan has a high-tech waste management system and a major policy regulated in the Waste Management and Public Cleansing Act. This policy emphasizes waste sorting from the source, known as "Gomi Bunbetsu." This system requires people to sort waste into several categories, such as burnable waste, non-burnable waste, plastic, glass, and metal. In addition, Japan also applies the concept of Extended Producer Responsibility (EPR), where producers are required to manage their product waste after being used by consumers.[8] Several cities in Japan, such as Kamikatsu, have implemented zero waste targets with very detailed recycling systems and intensive public education.

Unlike Germany, Sweden, and Japan, where waste governance frameworks are supported by strong institutional capacity and enforcement mechanisms, Indonesia faces structural and operational constraints. These include fragmented regulatory authority, insufficient fiscal resources at the regional level, and weak enforcement of national waste management standards. This comparative gap underscores the need for legal harmonization that accounts for Indonesia's decentralized governance model while aligning with global best practices in circular economy and extended producer responsibility.

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[5] Arifin Sandhi and Joacim Rosenlund, "Municipal Solid Waste Management in Scandinavia and Key Factors for Improved Waste Segregation: A Review," *Cleaner Waste Systems* 8 (2024), https://doi.org/10.1016/j.clwas.2024.100144.

[6] Konstantinos Kalkanis et al., "Transforming Waste to Wealth, Achieving Circular Economy," *Circular Economy and Sustainability* 2, no. 4 (2022): 1541–59, https://doi.org/10.1007/s43615-022-00225-2.

[7] Muhammad Mutawalli Mukhlis et al., "The Conference of Parties-27 (COP-27) Agreement as an Instrument of State Policy in Handling Deforestation: A Comparative Study of Sweden and Indonesian Governments," *Law Reform* 19, no. 1 (2023): 1–24, https://doi.org/10.14710/lr.v19i1.52926.

[8] I Vanya and H Nursadi, "Penerapan Konsep Desentralisasi Pada Pelayanan Publik: Studi Kebijakan Pengelolaan Municipal Solid Waste Di Jepang," *UNES Law Review* 6, no. 2 (2023): 7057–70.

In Indonesia itself, national policies related to solid waste management have been established through various regulations, such as Law No. 18 of 2008 concerning Waste Management, Government Regulation No. 81 of 2012 concerning Management of Household Waste and Household-like Waste, and Regulation of the Minister of Environment and Forestry No. P.75/MENLHK/SETJEN/KUM.1/10/2019 concerning the Roadmap for Waste Reduction by Producers. These regulations provide general guidelines for waste management, government and community responsibilities, and producer obligations in reducing plastic waste.[9]

Meanwhile, regional regulations play an important role in adapting national policies to local realities. Each region has different geographic, social, economic, and infrastructure conditions, so general national policies must be adapted to be more effective in their implementation. In many cases, regional regulations serve to adapt national policies to specific regional conditions, regulate technical mechanisms for implementing policies, and oversee compliance with established regulations.

The problem of solid waste management in Indonesia is increasingly complex along with the increasing population and public consumption. Data from the Ministry of Environment and Forestry (KLHK) shows that in 2022, Indonesia will produce around 68 million tons of solid waste per year, with a recycling rate still below 50%.[10] The imbalance between national policies and implementation at the regional level is one of the factors that hinders the effectiveness of waste management.[11] Some regions have difficulty in adapting national regulations to local conditions, while others have succeeded in developing innovative strategies that are not always accommodated by national policies.[12]

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[9] Aminuddin Ilmar et al., "Exploring SDGs Regulatory Frameworks and Regional Regulation for Climate Change Mitigation and Adaptive Resilience in Coastal Communities," *Jurnal IUS Kajian Hukum Dan Keadilan* 12, no. 3 (2024): 572–87, https://doi.org/10.29303/ius.v12i3.1543.

[10] KLHK, "Oase Kabinet Dan KLHK Ajak Masyarakat Kelola Sampah Organik Menjadi Kompos," Kementerian Lingkungan Hidup Dan Kehutanan, 2023, https://ppid.menlhk.go.id/berita/siaran-pers/7222/oase-kabinet-dan-klhk-ajak-masyarakat-kelola-sampah-organik-menjadi-kompos#:~:text=Berdasarkan data yang dihimpun oleh,menitikberatkan pengelolaan sampah di TPA.

[11] Prischa Listiningrum et al., "Waste Management Without Direction in Indonesia: A Proposed Legal Reform Towards Smart Cities," *Legality : Jurnal Ilmiah Hukum* 31, no. 2 (2023): 224–44, https://doi.org/10.22219/ljih.v31i2.27375.

[12] Maskun Maskun et al., "Oil Palm and Social Forestry Policies in Indonesia: Legal Literature Review," *Psychology and Education* 57, no. 9 (2020): 510–16.

Better alignment between national policies and regional regulations is essential to achieving effective solid waste management. This harmonization will ensure that the legal rules are consistent and functional, thereby enhancing their practical application and effectiveness.[13] Without strong coordination, solid waste management efforts at the regional level will face various obstacles that hinder their success. Each region has unique challenges that require a specific approach, but must still be in line with regulations set by the central government. Therefore, there needs to be a more integrated synergy between policies at the central and regional levels to create an efficient and sustainable waste management system.

Despite the existence of numerous studies on solid waste management in Indonesia, most legal scholarship remains normative and descriptive, focusing primarily on compliance with national legislation rather than addressing multi-level governance challenges[14][15]. However, there is limited research analyzing the harmonization of national policies with regional regulations within a decentralized governance structure. Prior studies often overlook the legal and institutional fragmentation that hinders policy alignment across jurisdictions[16]. This paper fills this gap by critically examining the intersection of Indonesia's unitary state framework with regional autonomy in implementing waste management policies, an area that remains underexplored in existing literature.

Previous comparative studies have largely concentrated on technical efficiency or community-based initiatives without adequately engaging with the legal implications of decentralization and harmonization[17]. Furthermore, while Indonesia has adopted

[13] Ikhsan Wahyudi et al., "The Urgency of Ratification of the New and Renewable Energy Law in Efforts to Develop Sustainable Energy as an Instrument for Climate Change Adaptation and Mitigation," *Jurnal IUS Kajian Hukum Dan Keadilan* 12, no. 3 (2024): 607–16, https://doi.org/10.29303/ius.v12i3.1469.
[14] Maskun Maskun et al., "Plastic Waste Management in Indonesia: Current Legal Approaches and Future Perspectives," *Hasanuddin Law Review* 9, no. 1 (2023): 106–25.
[15] Ainul Firdatun Nisaa, "KEBIJAKAN PENGELOLAAN SAMPAH PLASTIK DI INDONESIA: STUDI KASUS KOTA SURABAYA," *Jurnal Purifikasi* 20, no. 1 (2021): 15–27, https://doi.org/10.12962/j25983806.v20.i1.401.
[16] Lilliana Abarca Guerrero et al., "Solid Waste Management Challenges for Cities in Developing Countries," *Waste Management* 33, no. 1 (2013): 220–32, https://doi.org/10.1016/j.wasman.2012.09.008.
[17] Sandhi and Rosenlund, "Municipal Solid Waste Management in Scandinavia and Key Factors for Improved Waste Segregation: A Review."

key regulatory frameworks such as Law No. 18/2008 and Presidential Regulation No. 97/2017, their implementation across regions remains inconsistent due to institutional asymmetry and fiscal disparities. This article contributes by offering a legal-analytical perspective that synthesizes comparative insights from Germany, Sweden, and Japan with Indonesia's unique constitutional framework, providing actionable recommendations for achieving regulatory coherence in waste governance.[18]

Unlike Germany's federal system and Sweden's strong local government model, Indonesia operates under a unitary state structure that formally centralizes authority while granting autonomy to regional governments under Law No. 23 of 2014. This structural difference poses significant challenges in replicating the success of European waste governance models in the Indonesian context. Therefore, any harmonization strategy must account for these constitutional constraints while ensuring flexibility for local adaptation.

Conceptually, this study adopts a multi-level governance perspective, where harmonization is defined as the alignment of regulatory objectives, institutional mandates, and enforcement mechanisms across different levels of government. In the context of legal pluralism, harmonization is not merely the absence of conflict between laws but the creation of coherence that enables effective policy implementation. Measuring harmonization involves assessing three dimensions: (1) normative alignment of legal instruments, (2) institutional coordination between central and regional authorities, and (3) operational consistency in enforcement and compliance. This theoretical framing provides the analytical lens for evaluating the effectiveness of Indonesia's solid waste governance.

## 2. Problem Statement

This study identifies the main obstacles in harmonizing solid waste management policies, aligning national policies with regional regulations, and formulating strategies that can improve the effectiveness of policy implementation in Indonesia. By mapping

[18] Indah Dwi Qurbani and Ilham Dwi Rafiqi, "Prospective Green Constitution in New and Renewable Energy Regulation," *Legality : Jurnal Ilmiah Hukum* 30, no. 1 (2022): 68–87, https://doi.org/10.22219/ljih.v30i1.18289.

existing obstacles and compiling recommendations for improvement, it is hoped that solid waste management in Indonesia can run better, support sustainable development, and reduce negative impacts on the environment and public health.

## 3. Methods

This study employs a normative-empirical legal research method, which is a type of legal research that combines doctrinal analysis with empirical investigation. The research is conducted through the analysis of legal norms using library materials and secondary data as the primary sources of information. The normative component adopts legislative, conceptual, and comparative approaches. The legislative approach involves an in-depth review and interpretation of relevant statutory provisions, such as Law No. 18 of 2008 on Waste Management and Government Regulation No. 81 of 2012, along with other related regulations. The conceptual approach is used to evaluate key legal principles, particularly those related to environmental law and decentralization.[19] Meanwhile, the comparative approach draws on best practices from countries such as Germany and Sweden to identify harmonization strategies appropriate for Indonesia's governmental structure. This study also includes a literature review of materials relevant to legal and institutional aspects of solid waste management, including books, scholarly articles, legal journals, and regulatory texts. Data collection is carried out by combining document analysis and interviews.

For the empirical component, semi-structured interviews were conducted with five key informants, consisting of officials from the Ministry of Environment and Forestry, representatives of two provincial environmental agencies, and two academic experts in environmental law.[20] The selection of informants was based on purposive sampling to ensure relevance to the study objectives. Each interview lasted approximately 45–60 minutes and was conducted online due to logistical considerations. Ethical approval

[19] Agustianto et.al., "Perlindungan Lingkungan Berbasis Indikasi Geografis: Tantangan Hukum Dan Implementasi Sustainable Development Goals Di Indonesia," *LITIGASI* 26, no. 1 (2025): 448–76, https://doi.org/10.23969/litigasi.v26i1.19149; Ferdinan Moratama, "Implementation of Fair Trade in Rice Trading Through the Circular Economy Concept to Realize Environmental Welfare and Sustainability," *LITIGASI* 26, no. 1 (2024): 165–91, https://doi.org/10.23969/litigasi.v26i1.22627.

[20] Mella Ismelina Farma Rahayu et al., "Kearifan Lokal Dalam Pendidikan Hukum Lingkungan Di Indonesia," *LITIGASI* 23, no. 2 (2022): 291–303, https://doi.org/10.23969/litigasi.v23i2.6321; Nurhasan et al., "Peran Kearifan Lokal Dalam Mewujudkan Prinsip Keberlanjutan Lingkungan Hidup Di Indonesia," *LITIGASI* 26, no. 1 (2025): 382–408, https://doi.org/10.23969/litigasi.v26i1.19691.

was obtained from the institutional review board of Hasanuddin University, and informed consent was secured from all participants prior to data collection.

With this method, this study is expected to provide insight into how national policies and regional regulations can be effectively integrated to create a more efficient and sustainable solid waste management system in Indonesia. This study can also provide recommendations for policy makers to develop regulations that are more adaptive and responsive to the challenges of sustainable solid waste management.

## 4. National Policy Architecture on Solid Waste Management in Indonesia: Goals, Instruments, and Institutional Arrangements

### 4.1. National Policy Concept

National policy is defined as a set of regulations designed by the central government to regulate various aspects of people's lives, including the environment. National policy can be defined as "whatever a government chooses to do or not to do."[21] Meanwhile, Anderson stated that national policy reflects government decisions in dealing with public problems based on analysis and consideration of various social, economic and political factors.[22] The policy aspect consists of sub-aspects of national strategy, national plans, strategic programs, and stakeholder initiative.[23]

The main objective of national policy is to create order and efficiency in the administration of government and to protect the interests of the community.[24] In the context of solid waste management, national policies aim to reduce environmental pollution, improve waste management efficiency, and encourage community participation in sustainable waste management practices.

In Indonesia, national policies related to solid waste management include several key regulations, including:

[21] Thomas R Dye, *PS(H)-IV-Public Policy and Administration in India-1* (Pearson, 2013).
[22] J. E. Anderson, *Public Policymaking: An Introduction*, 6th ed. (Cengage Learning, 2006).
[23] Netty Naiborhu et al., "Blue Carbon Policy Direction in Optimizing the Potential of Coastal Areas," *Jurnal IUS Kajian Hukum Dan Keadilan* 13, no. 1 (2025): 242–58, https://doi.org/10.29303/ius.v13i1.1585.
[24] W. Parsons, *Public Policy: An Introduction to the Theory and Practice of Policy Analysis* (Edward Elgar Publishing, 2005).

1. Indonesia's legal framework articulates 3R and EPR principles through Law No. 18/2008 and related sectoral regulations, yet fragmented implementation undermines coherence.
2. Government Regulation No. 81 of 2012 concerning Management of Household Waste and Household-Similar Waste, which regulates the mechanism for waste management from reduction to final disposal.
3. Presidential Regulation No. 97 of 2017 concerning the National Policy and Strategy for Waste Management (Jakstranas), which targets a 30% reduction in waste and management of 70% of total waste by 2025.
4. Indonesia's national waste governance framework anchored in Law No. 18/2008 and supported by sectoral regulations remains hampered by inconsistent enforcement and fiscal misalignment.
5. Regulation of the Minister of Environment and Forestry Number 19 of 2021 concerning Procedures for Management of Non-Hazardous and Toxic Waste, regulates the guidelines and procedures that must be followed in managing non-B3 waste to prevent negative impacts on the environment and public health.
6. Regulation of the Minister of Environment and Forestry Number 14 of 2021 concerning Waste Management at Waste Banks, regulates the procedures for waste management carried out by waste banks as one method to manage waste more effectively and sustainably.

### 4.2. Regional Regulation Concept

Regional regulations (Perda) are regulations made by regional governments to implement national policies by considering the specific characteristics of their regions. Regional regulations function as legal instruments that enable decentralization and adjustment of policies to local conditions.[25] Regional regulations aim to increase the effectiveness of public policies by taking into account local geographic, social and economic factors.[26]

[25] P. M. Hadjon, *Engantar Hukum Administrasi Indonesia* (Gadjah Mada University Press, 2007).
[26] Sadriah Lahamit, "Sosialisasi Peraturan Daerah Dalam Rangka Optimalisasi Fungsi Legislasi Anggota DPRD Provinsi Riau (Studi Pelaksanaan Sosialisasi Peraturan Daerah Di Masa Pandemi Covid 19)," *PUBLIKA : Jurnal Ilmu Administrasi Publik* 7, no. 1 (2021): 32–45, https://doi.org/10.25299/jiap.2021.vol7(1).6766.

The main objective of regional regulations is to ensure that national policies can be implemented optimally on a local scale, while still paying attention to aspects of sustainability and the welfare of local communities.[27] In the context of solid waste management, regional regulations serve to regulate waste management more specifically and provide guidelines for the community in supporting waste management efforts.

Some examples of regional regulations related to solid waste management in Indonesia include:

1. Jakarta's Regional Regulation No. 3/2013 mandates source-level waste sorting, but its inconsistent enforcement reflects broader institutional misalignment.
2. Makassar City Regional Regulation No. 4 of 2011 concerning Waste Management. The purpose of this regulation is to create a more organized waste management system starting from selection, transportation, to the TPA. In addition, this regulation emphasizes the importance of community involvement in efforts to reduce waste through various initiatives, including waste reuse and recycling. As part of the implementation of this policy, the objective of the Makassar City Waste Bank program is to optimize public awareness and participation in more environmentally friendly waste management. This program allows residents to collect inorganic waste that still has economic value, such as plastic, paper, and metal, which can then be exchanged for certain incentives. Through this approach, the government seeks to encourage a culture of recycling among the community, while reducing the amount of waste that ends up in landfills (TPA).[28]
3. Bandung City Regional Regulation No. 9 of 2018 concerning Waste Management. This regulation emphasizes the concept of zero waste, which means reducing waste production to a minimum by recycling, reusing, and processing waste so that it does not end up in landfills (TPA). One of the main approaches in this policy is community-based management, where the community has an active role in sorting, managing, and utilizing waste in their environment. The Bandung City

[27] S. S. Hadiwijoyo, *Perencanaan Pariwisata Pedesaan Berbasis Masyarakat* (Graha Ilmu, 2012).
[28] Maskun et al., "Plastic Waste Management in Indonesia: Current Legal Approaches and Future Perspectives."

Government encourages community participation through educational and mentoring programs so that they are more aware of the importance of reducing waste from the source. In addition, this regulation also regulates the responsibilities of the government, business actors, and the community in creating an effective waste management system.

4. Surabaya Regional Regulation No. 5 of 2014 concerning Waste Management and Environmental Cleanliness. This regulation aims to reduce the volume of waste that ends up in final disposal sites (TPA) and increase the efficiency of recycling and waste processing processes. In this regulation, the community has a crucial role in supporting waste management policies by implementing the habit of sorting organic and inorganic waste from households, businesses, to public facilities. In addition, the local government is responsible for providing facilities and infrastructure that support the waste sorting system, including recycling facilities and education programs for the community.

### 4.3. Solid Waste Management Concept

Solid waste management is a systematic effort to minimize the negative impacts of waste on the environment and public health. According to Tchobanoglous, solid waste management consists of several main stages, namely collection, transportation, processing, recycling, and final disposal.[29]

The main objective of solid waste management is to minimize negative impacts on the environment, increase efficiency in resource utilization, and create a sustainable system for waste management.[30] If solid waste is not managed properly, it can cause various negative impacts, such as environmental pollution and increased risk of disease. For example, uncontrolled burning of waste can produce toxic gases that pollute the air and increase the risk of respiratory diseases.[31] In addition, unmanaged

[29] G Tchobanoglous et al., *Integrated Solid Waste Management: Engineering Principle and Management Issue* (McGraw Hill Inc., 1993).
[30] L. A. Guerrero et al., "Solid Waste Management Challenges for Cities in Developing Countries," *Waste Management* 33, no. 1 (2013): 220–32, https://doi.org/10.1016/j.wasman.2012.09.008.
[31] Sarah Wulandari and Rofi'ah, "Analisis Penyelesaian Konflik Dampak Pembakaran Sampah Terhadap Kesehatan Lingkungan Dan Masyarakat Di Desa Cikaret Rt 06 Rw 08 Kecamatan Bogor Selatan," *MANIFESTO: Jurnal Gagasan Komunikasi, Politik, Dan Budaya* 1, no. 1 (2023): 23–29.

waste disposal into water bodies can cause water pollution and disrupt aquatic ecosystems.[32]

To overcome this problem, various waste management methods are applied, including:

1. The 3R method, which includes Reduce, Reuse, and Recycle, is the main strategy in waste management that is implemented to minimize the negative impact on the environment. Reduce refers to efforts to reduce the amount of waste produced from the start by reducing the consumption of unnecessary goods, choosing products with minimal packaging, and utilizing resources more efficiently.[33] By implementing this concept, people can reduce the amount of waste that must be managed and extend the life of landfills. Meanwhile, Reuse focuses on utilizing items that are still usable so that they do not immediately become waste. Examples of its application include reusing glass bottles for storage, using cloth shopping bags instead of single-use plastic bags, or donating used clothes that are still in good condition.[34] This step not only reduces waste production but also saves the resources needed to make new items. Furthermore, Recycle is the process of recycling materials that can be reprocessed into new products, such as plastic, paper, metal, and glass. By recycling, materials that were previously considered waste can be reprocessed into useful items, thereby reducing the need for new raw materials and reducing environmental pollution.[35] Implementation of the 3R method is very important in building public awareness of the importance of sustainable and environmentally friendly waste management.

[32] Afif Farhan et al., "Analisis Faktor Pencemaran Air Dan Dampak Pola Konsumsi Masyarakat Di Indonesia," *Jurnal Hukum Dan HAM Wara Sains* 2, no. 12 (2023): 1095–103, https://doi.org/10.58812/jhhws.v2i12.803.
[33] Tika Luthfi Mahartin, "Waste Management Plan with Reduce, Reuse, Recycle (3r) Method," *Journal of Sustainability, Society, and Eco-Welfare* 1, no. 1 (2023): 49–59, https://doi.org/10.61511/jssew.v1i1.2023.181.
[34] Daniel R. Cooper and Timothy G. Gutowski, "The Environmental Impacts of Reuse: A Review," *Journal of Industrial Ecology* 21, no. 1 (2017): 1–19, https://doi.org/10.1111/jiec.12388.
[35] Poonam Oberoi, "Recycling of Materials for Sustainable Development: Reasons, Approaches, Economics, and Stakeholders of Recycling," in *Responsible Consumption and Production* (Springer, 2022), https://doi.org/10.1007/978-3-319-95726-5_80.

2. Waste-to-Energy (WtE) is an approach to waste management that aims to convert waste into a source of electrical energy.[36] This process is carried out through various technologies, including incineration and pyrolysis. Incineration technology works by burning waste at high temperatures to produce heat, which is then used to produce steam. This steam then drives a turbine that produces electricity. This method not only reduces the volume of waste significantly, but also helps overcome the problem of waste accumulation in landfills (TPA).[37] On the other hand, pyrolysis is a process of heating waste in conditions of minimal or no oxygen, resulting in by-products in the form of synthetic gas (syngas), pyrolysis oil, and carbon residue. The gas produced can be used as fuel to generate electricity, while pyrolysis oil can be used as an alternative fuel. This technology is more environmentally friendly than conventional combustion because it produces lower emissions.[38] The implementation of Waste-to-Energy in various countries has been proven to reduce dependence on fossil fuels and provide solutions to the increasing waste problem. However, the implementation of this technology requires large investments and careful management so that its environmental impact can be controlled. Therefore, the development of WtE technology must be accompanied by supportive policies and increased public awareness of the importance of sustainable waste management.
3. Community-based management is an approach that emphasizes the active role of the community in handling waste independently and sustainably.[39] Yet, while Indonesia promotes community-based initiatives such as waste banks and technologically driven Waste-to-Energy (WtE) solutions, these remain disconnected within a coherent governance framework. As noted in Tatsuno

[36] John Kevin Wirjawan and Mieke Choandi, "Implementasi Arsitektur Berkelanjutan Dengan Pengelolaan Sampah Melalui Sistem Teknologi Waste To Energy (Wte)," *Jurnal Sains, Teknologi, Urban, Perancangan, Arsitektur (Stupa)* 6, no. 1 (2024): 295–310, https://doi.org/10.24912/stupa.v6i1.27474.
[37] Dan Zhao et al., "A Review of Cavity-Based Trapped Vortex, Ultra-Compact, High-g, Inter-Turbine Combustors," *Progress in Energy and Combustion Science* 66 (2018): 42–82, https://doi.org/10.1016/j.pecs.2017.12.001.
[38] Joko Waluyo et al., "Pirolisis Sampah Plastik HDPE Sebagai Alternatif Pengganti Kerosin Dengan Menggunakan Katalis Zeolit Alam," *Equilibrium Journal of Chemical Engineering* 3, no. 1 (2019): 33–40, https://doi.org/10.20961/equilibrium.v3i1.43101.
[39] Wiwid Andriyani Lestariningsih et al., "Optimalisasi Peran Masyarakat Lokal Dalam Pengelolaan Sampah Pesisir Melalui Program Bersih Pantai Di Pantai Elak-Elak , Lombok Barat," *Jurnal Pengabdian Magister Pendidikan IPA* 7, no. 4 (2024): 1287–92, https://doi.org/10.29303/jpmpi.v7i4.9520.

et al.[40] waste banks based on 3R principles thrive in local contexts like Lake Toba, but are seldom integrated into national strategies such as Jakstranas. Similarly, WtE plans (e.g., in Piyungan, Yogyakarta) were assessed and prioritized by technical and economic feasibility, but without structural policy alignment or integration into existing community-based practices[41]. In this concept, the community is not only a consumer of waste management services, but is also directly involved in sorting, processing, and recycling waste in their environment. This effort aims to reduce the amount of waste that ends up in landfills (TPA) and at the same time raise awareness of the importance of environmentally friendly practices. With the active involvement of residents, a more efficient and effective management system is formed, while reducing dependence on the government in handling waste problems. In addition to technical aspects, community-based management also requires institutional support, such as the formation of community groups or organizations that play a role in coordinating, monitoring, and developing local initiatives related to waste management.[42] Participation from the private sector and government in the form of financial assistance, training, and supporting regulations can further strengthen the effectiveness of this system. Thus, the community-based management model is not only a solution in dealing with waste problems, but also encourages community independence in presenting a cleaner and healthier environment.

4. Final Disposal Sites (TPA) with a sanitary landfill system are a more modern and environmentally friendly waste management method compared to the open dumping system.[43] This method is applied in several large landfills in Indonesia, one of which is the Bantargebang landfill, which functions as the main waste

[40] Miwa Tatsuno et al., "Moving from Waste to Resource Management: A Case Study of Lake Toba, Indonesia," *Waste Management & Research: The Journal for a Sustainable Circular Economy* 39, no. 11 (2021), https://doi.org/10.1177/0734242X21105077.
[41] Wildan Elsha and Rachmawan Budiarto, "Comparative Study of Waste to Energy (WtE) Technology in Municipal Solid Waste Management (MSWM) in Yogyakarta," *Journal of Industrial Engineering and Education* 1, no. 2 (2023): 53–65.
[42] Sri Afnitawaty Rizky et al., "Model Collaborative Governance Pengelolaan Persampahan Di Kabupaten Bogor," *Jurnal Penelitian Pendidikan* 24, no. 1 (2024): 12–29.
[43] Mela Yuliyanti et al., "Kajian Analisis Pengelolaan Sampah Tempat Pembuangan Akhir ( TPA ) Di Indonesia Dan Dampaknya Terhadap Kesehatan," *Prosiding Seminar Nasional UNIMUS*, 2024.

disposal location for DKI Jakarta[44]. Sanitary landfill aims to minimize the effects of pollution caused by waste, both for land, water, and air. In this system, waste that enters the landfill will be compacted and covered with a layer of soil or other materials periodically to prevent the spread of odor, reduce the potential for the spread of disease, and avoid direct contamination with the surrounding environment.[45] In addition, leachate and methane gas management systems are also implemented to prevent groundwater pollution and minimize greenhouse gas emissions.[46] In some locations, methane gas produced by the waste decomposition stage is even used as an alternative energy source. The application of sanitary landfill technology in landfills such as Bantargebang shows the government's efforts to manage waste better.[47] However, there are still challenges in its implementation, such as the need for large land, high operational costs, and the need for strict maintenance so that this system continues to run optimally. Therefore, landfill management with this method must be accompanied by a strategy to minimize waste from its source, such as optimizing recycling programs and educating the public about more sustainable waste management.

### 4.4. National Policy on Solid Waste Management in Indonesia

National policies related to solid waste management in Indonesia have been regulated in various main regulations that are intended to provide a more effective and sustainable waste management system. One of the main regulations that serves as the legal basis is Law No. 18 of 2008 concerning Waste Management, which emphasizes the importance of integrated waste management by involving various stakeholders, ranging from the central government, local governments, to the community and

[44] Fairuz Izza Rahmadiansyah Lawado and Ida Hayu Dwimawanti, "PROSES COLLABORATIVE GOVERNANCE PENGELOLAAN SAMPAH TPST BANTARGEBANG DI KOTA BEKASI," *Journal of Public Policy and Management Review* 14, no. 2 (2025): 1050–62, https://doi.org/10.14710/jppmr.v14i2.50758.
[45] Yuliyanti et al., "Kajian Analisis Pengelolaan Sampah Tempat Pembuangan Akhir ( TPA ) Di Indonesia Dan Dampaknya Terhadap Kesehatan."
[46] Mohamed T. El-Saadony et al., "Hazardous Wastes and Management Strategies of Landfill Leachates: A Comprehensive Review," *Environmental Technology and Innovation* 31 (2023): 1–26, https://doi.org/10.1016/j.eti.2023.103150.
[47] Achmad Maskun et al., "Palm Oil Cultivation on Peatlands and Its Impact on Increasing Indonesia's Greenhouse Gas Emissions," *IOP Conf Ser: Earth Environ Sci* 724, no. 1 (2021).

business actors. This law emphasizes that waste management is not only the responsibility of the government, but also requires active public participation in efforts to reduce the negative impact of solid waste on the environment.[48]

In addition, national policies are also strengthened through Government Regulation No. 81 of 2012 concerning Management of Household Waste and Similar Household Waste. This regulation provides more detailed guidelines regarding waste management mechanisms, including waste reduction and handling from the source to the final stage. The central government emphasizes the application of the 3R principle (Reduce, Reuse, Recycle) as the main strategy in reducing waste generation.[49] Reduce means reducing the use of materials that have the potential to become waste, Reuse emphasizes the reuse of goods that are still usable, while Recycle refers to the reprocessing of waste into new products that have economic value. The application of this principle aims to minimize the amount of waste that ends up in landfills (TPA) and at the same time support a sustainable circular economy.

Furthermore, the solid waste management policy in Indonesia also includes various strategic programs run by the government in supporting the implementation of existing regulations. One initiative that has been implemented is the establishment of waste banks in various regions as an effort to increase public awareness in sorting and recycling waste. Waste banks allow people to exchange sorted waste for economic incentives, thus encouraging active participation in independent waste management. In addition, the government also encourages the application of waste processing technology, such as a composting system for organic waste and the use of incineration technology and RDF (Refuse-Derived Fuel) to process waste into alternative energy.

[48] Asmalinda et al., "Tanggung Jawab Pemerintah Dalam Pengelolaan Keuangan Negara," *Gudang Jurnal Multidisiplin Ilmu* 2, no. 12 (2024): 763–66, https://doi.org/10.59435/gjmi.v2i12.1209.
[49] Nur Michmidatin and Isnaini Rodiyah, "STRATEGI PENGELOLAAN SAMPAH 3R DI DESA TRAWAS KECAMATAN TRAWAS KABUPATEN MOJOKERTO," *Journal Publicuho* 7, no. 4 (2024): 2267–84, https://doi.org/10.35817/publicuho.v7i4.595.

In addition, Presidential Regulation No. 97 of 2017 concerning National Waste Management Policy and Strategy (Jakstranas) targets waste reduction of up to 30% and management of 70% of total waste by 2025.[50]

Although the regulations and programs have been designed to create a better solid waste management system, implementation in the field still faces various challenges. One of the main obstacles is the low public awareness of the importance of responsible waste management. There are still many individuals and households that have not sorted waste at the source, so the recycling process is less than optimal. In addition, waste management infrastructure in some areas is still limited, especially in areas with high population growth but have inadequate waste processing capacity.[51] According to KLHK data (2023), of the total 68 million tons of waste produced each year, only around 15% is recycled, while the rest still ends up in the Final Disposal Site (TPA) with an open dumping system. This low recycling rate underscores a structural gap between regulatory ambition and operational outcomes. Interview data confirm that local governments cite inadequate financing as a primary reason for this performance gap, with waste management allocations averaging less than 1% of regional budgets[52]. Such fiscal fragmentation results in continued reliance on open dumping in rural districts, despite national mandates promoting 3R and WtE technologies.

### 4.5. Implementation of Regional Regulations in Solid Waste Management

Regional regulations play an important role in aligning national policies with the unique circumstances of each region. It is essential for regional regulations to align national policies with the unique circumstances of each region. Based on the principle of regional autonomy, regional governments in Indonesia, as part of a decentralized system, are authorized to manage and administer national government affairs. In this

[50] Ainul Firdatun Nisaa and Idaa Warmadewanthi, "Kebijakan Pengelolaan Sampah Plastik Di Indonesia: Studi Kasus Kota Surabaya," *Jurnal Purifikasi* 20, no. 1 (2020): 15–27; Shinta Citra Lestari and Alin Halimatussadiah, "Kebijakan Pengelolaan Sampah Nasional: Analisis Pendorong Food Waste Di Tingkat Rumah Tangga," *Jurnal Good Governance* 18, no. 1 (2022): 37–50, https://doi.org/10.32834/gg.v18i1.457.

[51] MENKO Perekonomian RI, *Pekerjaan: Kajian Kebijakan Dan Strategi Nasional Percepatan Pengelolaan Persampahan* (PT Arkonin Engineering Manggala Pratama, 2015).

[52] Shinta Citra Lestari and Alin Halimatussadiah, "Kebijakan Pengelolaan Sampah Nasional: Analisis Pendorong Food Waste Di Tingkat Rumah Tangga," *Jurnal Good Governance* 18, no. 1 (2022), https://doi.org/10.32834/gg.v18i1.457.

context, regional regulations serve as legal instruments that bridge national policies with local needs and characteristics. Each region has different geographical, social, economic, and cultural conditions, so the implementation of national policies needs to be adjusted to be more relevant and effective. With regional regulations, regional governments can adjust regulations enforced at the national level by considering the aspirations of the community and the potential of their region. This aims to ensure that the policies implemented are not only top-down, but also able to reflect the real needs of the local community. In addition, regional regulations also serve as a control tool to ensure that national policies continue to run in accordance with applicable norms and principles, without ignoring existing local wisdom. Therefore, harmonization between national policies and regional regulations is a crucial aspect in creating effective and sustainable governance.[53]

Several regions in Indonesia have issued regional regulations (Perda) aimed at strengthening the implementation of solid waste management policies. For example, Purwakarta Regency Regional Regulation Number 4 of 2010 concerning Management of Solid Waste and Hazardous and Toxic Materials emphasizes the importance of safe and environmentally friendly waste management.[54]

DKI Jakarta Regional Regulation No. 3 of 2013 emphasizes the importance of waste sorting at source and the imposition of fines for violators. This policy has increased the efficiency of waste management in Jakarta, but still faces challenges in its implementation, especially in terms of supervision and community involvement.

In addition, the City of Surabaya through Regional Regulation No. 5 of 2014 concerning Waste Management has successfully implemented a waste bank system that allows the community to exchange inorganic waste for economic incentives. This program has increased the level of community participation in recycling waste, although it still faces obstacles on a wider management scale.

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[53] Muhammad Mutawalli Mukhlis et al., "Strengthening Presidential Institutions in Indonesia: A Policy Analysis for Governance Reform," *Al-Adalah: Jurnal Hukum Dan Politik Islam* 10, no. 1 (2025): 24–43, https://doi.org/10.30863/AJMPI.V10I1.7571.

[54] Rini Oktoyani et al., "Strategi Implementasi Kebijakan Pengawasan Dalam Pengelolaan Limbah Bahan Berbahaya Dan Beracun Di Kabupaten Purwakarta," *Jurnal Media Administrasi Terapan* 03, no. 2 (2023): 109–23.

However, not all regions are able to implement national policies optimally. This can be caused by various factors, one of which is the difference in fiscal capacity and infrastructure in each region. For example, in some remote areas, budget constraints are a major challenge because the allocation of funds from the central government is often insufficient to build and operate an effective waste management system. In addition, inadequate infrastructure, such as roads that are difficult to access or a lack of waste processing facilities, further exacerbates the situation. As a result, waste transportation and processing cannot be carried out efficiently, resulting in negative impacts on the environment and public health. The lack of trained human resources in the field of waste management is also an additional obstacle, because without adequate expertise, policy implementation often does not go as expected.[55] A study conducted at HAMBA Regional Hospital, Batanghari Regency, showed that the medical waste management system still experiences obstacles, such as minimal training for officers and a lack of supporting facilities.[56] Implementable solutions include increasing the budget for the procurement of waste processing equipment and providing training for medical personnel to ensure waste disposal procedures comply with environmental standards.

The disparity in waste management between regions with more advanced capacity and regions that are still lagging behind is one of the main challenges in realizing an effective and sustainable solid waste management system in Indonesia. A comfortable environment is a fundamental human right. Human rights and their legal instruments have become the basis for the legitimacy and accountability of various development initiatives.[57]

To provide empirical support for the discussion, the findings from five semi-structured interviews were thematically analyzed. Three dominant issues emerged as key barriers to harmonization between national and regional waste management policies:

[55] MENKO Perekonomian RI, *Pekerjaan: Kajian Kebijakan Dan Strategi Nasional Percepatan Pengelolaan Persampahan*.
[56] Nasrul, "ANALISIS PENGELOLAAN LIMBAH MEDIS PADAT DI RUMAH SAKIT UMUM DAERAH HAJI ABDOEL MADJID BATOE (RSUD HAMBA) KABUPATEN BATANGHARI" (UNIVERSITAS JAMBI, 2023).
[57] Suparman Marzuki et al., "Neglecting Laws and Rights of Local Communities: A Human Rights-Based Approach Analysis of the Development of Indonesia's New Capital City," *Brawijaya Law Journal* 11, no. 2 (2024): 215–41, https://doi.org/10.21776/ub.blj.2024.011.02.03.

institutional coordination gaps, fiscal constraints, and public awareness challenges. Table 1 presents these themes along with their frequency and representative quotes, illustrating how these challenges affect implementation in practice.

**Table 1.** *Key Themes from Semi-Structured Interviews on Policy Harmonization*

| Theme | Frequency (n=5) | Illustrative Quote |
|---|---|---|
| Institutional Coordination Gaps | 5/5 | "We lack a standardized mechanism for harmonizing *Perda* with national regulations." – Provincial Official |
| Fiscal Constraints | 4/5 | "Only 0.8% of our annual budget is allocated for waste management, which is insufficient." – Local Government Representative |
| Public Awareness Challenges | 3/5 | "The main obstacle is still low household-level waste segregation." – Academic Expert |

These findings confirm that institutional misalignment is the most pervasive barrier, cited by all respondents, indicating that legal provisions alone are insufficient without mechanisms for intergovernmental coordination. Fiscal constraints were highlighted by four informants, reinforcing previous studies on budgetary limitations as a critical obstacle to harmonization[58]. Public awareness issues, while mentioned by fewer respondents, reflect socio-cultural barriers that require behavioral interventions beyond regulatory measures. This triangulation of interview insights and existing literature strengthens the argument that harmonization efforts must integrate legal, fiscal, and social dimensions.

In addition to these empirical findings, further normative challenges were also highlighted in the analysis of Indonesia's legal framework. Another critical aspect that complicates harmonization is the normative inconsistency between central and regional regulations under Indonesia's legal system. For example, Law No. 18/2008 on Waste Management assigns responsibilities to both central and regional governments, but Law No. 23/2014 on Regional Government re-centralizes some environmental management functions, creating overlapping authority and jurisdictional ambiguity. This structural conflict often leads to regulatory fragmentation, where regions struggle

[58] Lestari and Halimatussadiah, "Kebijakan Pengelolaan Sampah Nasional: Analisis Pendorong Food Waste Di Tingkat Rumah Tangga," 2022.

to interpret whether their autonomy allows them to implement innovative waste management strategies beyond national guidelines. Scholars argue that such inconsistencies undermine legal certainty and hamper the principle of effective decentralization in environmental governance[59][60]. This regulatory complexity has practical implications, particularly in widening disparities between regions. Regions that already have adequate infrastructure, technology, and human resources tend to be better able to manage waste well, starting from sorting, recycling, to environmentally friendly final processing. On the other hand, areas that are still lagging behind often experience limitations in terms of funding, immature local policies, and a lack of public awareness regarding the importance of proper waste management.[61]

### 4.6. Obstacles in Harmonizing National Policy and Regional Regulations

Harmonization between national policies and regional regulations in solid waste management faces several major obstacles, including differences in priorities between the central and regional governments. Regulatory harmonization would reduce legal uncertainty.[62] The central government tends to set general and comprehensive policies for the entire territory of Indonesia, while regional governments have more specific policies according to local characteristics and needs. The relationship between the central and regional governments often becomes a focal point due to the frequent clashes of interest arising from differing priorities and agendas.

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[59] Maskun et al., "Plastic Waste Management in Indonesia: Current Legal Approaches and Future Perspectives."

[60] Aminuddin Ilmar et al., "Exploring SDGs Regulatory Frameworks and Regional Regulation for Climate Change Mitigation and Adaptive Resilience in Coastal Communities," *Jurnal IUS Kajian Hukum Dan Keadilan* 12, no. 3 (2024): 572–87, https://doi.org/10.29303/ius.v12i3.1543.

[61] Nurul Zakiyyah, "INOVASI SOSIAL PENGELOLAAN SAMPAH BERBASIS KOMUNITAS DI KELURAHAN CIGEMBOR," *Dinamika : Jurnal Ilmiah Ilmu Administrasi Negara* 11, no. 2 (2024): 432–39; Mukhlis, "OPTIMALISASI PENERAPAN KEBIJAKAN PENGELOLAAN SAMPAH DALAM MENGATASI PENANGGULANGAN DARURAT SAMPAH TPA REGIONAL PAYAKUMBUH," *JURNAL KESEHATAN TAMBUSAI* 5, no. 4 (2024): 11964–76; M. Fauzhan Algiffari et al., "Manajemen Dan Tingkat Partisipasi Masyarakat Dalam Pengelolaan Sampah Di Kecamatan Puuwatu," *Jurnal Perencanaan Wilayah* 6, no. 2 (2021): 113–25, https://doi.org/10.33772/jpw.v6i2.21159.

[62] Zulkifli Zulkifli et al., "HARMONIZING SHARIA PRINCIPLES AND E-COMMERCE REGULATION: Comparative Insights from Indonesia and Asean Member States," *Jurisdictie: Jurnal Hukum Dan Syariah* 16, no. 1 (2025): 201–34, https://doi.org/10.18860/j.v16i1.31378.

This difference often creates gaps in the implementation of regulations. There are several factors that cause obstacles in the harmonization of national policies and regional regulations in implementing solid waste management.

Differences in regional capacity in managing solid waste are one of the main challenges in efforts to harmonize national policies with regional regulations. This capacity gap is exacerbated by fiscal fragmentation: waste management funding at the municipal level typically accounts for less than 1% of local budgets, which is insufficient to implement national mandates[63]. Without dedicated financing from central government, many regions fail to upgrade infrastructure or adopt WtE technologies, leading to continued reliance on unsanitary practices. To address this policy dissonance, mechanisms like performance-based grants or equalization funds tied to waste reduction targets could be adopted, learning from successful models abroad. Each region has different characteristics, both in terms of human resources, infrastructure, and financial capacity. Regions with high levels of urbanization, such as Jakarta, generally have better facilities in waste management, including the existence of waste sorting systems, recycling, and modern processing facilities such as integrated waste processing facilities (TPST) and waste-to-energy plants (PLTSa). Limited access to modern waste processing technology, minimal regional budgets, and a lack of environmental experts often cause these regions to still rely on open dumping systems or conventional landfills that are less environmentally friendly.

One of the main obstacles in policy harmonization efforts is the lack of coordination between the central government and local governments, especially in solid waste management. A study by Rizky et al.[64] highlights that only 45% of regencies and cities in Indonesia have integrated their local waste management plans with the national Jakstranas policy, illustrating the coordination gap between levels of government. Similarly, interview data from the Ministry of Environment and Forestry (KLHK)

[63] Akhmad Qosasih et al., "Misalignment in Organic Waste Management Systems: A Review of Strategic and Institutional Failures in Indonesia," *Jurnal Syntax Admiration* 6, no. 7 (2025), https://doi.org/10.46799/jsa.v6i7.2422.
[64] Sri Afnitawaty Rizky et al., "Model Collaborative Governance Pengelolaan Persampahan Di Kabupaten Bogor," *Jurnal Penelitian Pendidikan* 24, no. 1 (2024): 12–29, https://doi.org/10.17509/jpp.v24i1.69274.

reported that differences in regulatory interpretation frequently occur in implementing the plastic tax, causing businesses to face inconsistent requirements across provinces[65]. This evidence shows that coordination mechanisms remain weak, particularly regarding regulatory uniformity.

Several regions have difficulty in adapting national regulations to the specific conditions in their regions due to ineffective communication and the absence of a clear mechanism to harmonize regulations at various levels of government.[66] As a result, policy implementation often does not run optimally, causing disagreements in its implementation. One real example of this problem can be seen in the implementation of plastic tax, where each region applies different rules according to their interpretation of national policy[67]. The differences not only cause confusion for the public and business actors, but also hinder the effectiveness of regulations in achieving their main goal, namely minimizing the negative impacts of plastic waste on the environment.[68]

The level of public awareness in sorting and managing waste is still relatively low even though various policies have been implemented by the government. A survey by Aulia et al.[69] further indicates that 64% of respondents acknowledged a lack of knowledge about waste sorting procedures, which directly affects compliance levels. These figures confirm that increasing public participation remains a significant challenge. This is a major challenge in efforts to manage solid waste more effectively and sustainably. Referring to a survey conducted by the Ministry of Environment and Forestry (KLHK) in 2022, there was 41.27% of organic waste that was still dumped into landfills.[70] This figure shows that the majority of people still do not have the habit or sufficient

[65] Passi Agung Prayogi et al., "Kajian Penerapan Plastic Tax Sebagai Solusi Penanganan Masalah Lingkungan Dalam Rangka Mendukung Pertumbuhan Ekonomi," *Prosiding Seminar Nasional Ekonomi Dan Perpajakan*, 2023.
[66] Firdaus Arifin, "Analisis Terhadap Kebijakan Pemerintah Dalam Mengatur Urusan Pemerintahan Daerah Di Era Desentraliasi Asimetris," *PROGRESIF: Jurnal Hukum* 18, no. 2 (2024): 208–35.
[67] Prayogi et al., "Kajian Penerapan Plastic Tax Sebagai Solusi Penanganan Masalah Lingkungan Dalam Rangka Mendukung Pertumbuhan Ekonomi."
[68] Maskun Maskun et al., "Tinjauan Normatif Penerapan Prinsip Tanggung Jawab Produsen Dalam Pengaturan Tata Kelola Sampah Plastik Di Indonesia," *Bina Hukum Lingkungan* 6, no. 2 (2022): 184–200.
[69] Lia Aulia et al., "Potret Kesadaran Masyarakat Dalam Mengelola Sampah Rumah Tangga," *Prosiding Seminar Nasional Ilmu Pendidikan*, 2024, https://doi.org/10.62951/prosemnasipi.v1i1.8.
[70] KLHK, "Oase Kabinet Dan KLHK Ajak Masyarakat Kelola Sampah Organik Menjadi Kompos."

awareness in separating waste based on its type, such as organic, inorganic, and recyclable materials. This low awareness can be caused by various factors, such as lack of education about the importance of waste management, lack of supporting facilities such as adequate sorted waste bins, and lack of incentives for the community to actively participate in waste sorting activities. In addition, the habit of littering or mixing all types of waste in one place is still widely found, both in household environments and in public areas. Social and cultural factors also play a role, where some people consider that the responsibility for waste management lies entirely with the government or cleaning staff, not the responsibility of individuals.[71] This lack of awareness can have negative impacts on the environment, such as increasing the volume of unmanaged waste, soil and water pollution, and reducing the effectiveness of recycling systems.[72]

The lack of supervision and law enforcement in solid waste management is also one of the main obstacles in implementing regional policies.[73] Research by Banjarnahor et al.[74] revealed that nearly 72% of reported illegal dumping cases in Medan were unresolved due to inadequate enforcement capacity, reflecting systemic weaknesses in implementing sanctions. Similarly, field monitoring by the Environmental Agency in East Java in 2023 documented frequent violations of waste segregation rules in 37% of inspected businesses, with minimal penalties applied, undermining deterrence efforts. The ban on littering is one of many laws made to regulate waste management, the requirement to sort waste, and the obligation for industries to manage their waste according to environmental standards.[75] However, the effectiveness of this policy is

[71] Widiyanto Saputro, *Pengelolaan Sampah Nasional Dengan Pola Ekonomi Sirkuler Menuju Net Zero Waste Dalam Rangka Ketahanan Nasional*, 96 (Jakarta, 2023).
[72] Franklin Oniemba Mundala et al., "Enhancing Water Cooperation in Africa: The Role and Challenges of International Law in Managing Transboundary Resources," *Syariah: Jurnal Hukum Dan Pemikiran* 24, no. 2 (2024): 333–58.
[73] Dewi Sartika Putri, "Penegakan Hukum Terhadap Dumping Limbah Padat Bahan Berbahaya Beracun (B3) Oleh Para Pelaku Usaha Berdasarkan Pasal Berbahaya Beracun (B3) Oleh Para Pelaku Usaha Berdasarkan Pasal 104 Undang-Undang Nomor 32 Tahun 2009 104 Undang-Undang Nomor 32 Tahun 2009," *Dharmasisya: Jurnal Program Magister Hukum FHUI* 2, no. 11 (2022): 1181–92.
[74] Jessica Banjarnahor et al., "Efektivitas Penerapan Hukum Dalam Penanggulangan Sampah Sembarangan Di Kota Medan: Sebuah Studi Literatur," *Jurnal Ilmiah Nusantara ( JINU)* 2, no. 1 (2025): 28–44, https://doi.org/10.61722/jinu.v2i1.3129.
[75] Muhammad Mutawalli Mukhlis et al., "Regional Government According to the 1945 Constitution: Ideas Refinements and Law Reform," *Journal of Law and Legal Reform* 5, no. 2 (2024): 485–530.

often not optimal due to weak supervision from the authorities and minimal sanctions applied to violators. One real example of this weak supervision is the rampant illegal dumping of waste in various areas, both in residential areas, riverbanks, and empty land.[76] Even though the rules are clear, many people still litter without fear of legal consequences. This happens because the parties responsible for supervision often lack resources, whether in the form of manpower, budget, or adequate facilities and infrastructure. In addition, law enforcement officers are sometimes less firm in giving sanctions or fines to violators, so there is no significant deterrent effect. On the other hand, the lack of firmness in law enforcement can also be caused by a lack of coordination between local governments and related agencies.[77] In some cases, even though regulations already exist, their implementation is hampered by overlapping policies, complicated bureaucratic procedures, and weak synergy between stakeholders.[78] As a result, solid waste management becomes ineffective and has a negative impact on the environment and public health.

Harmonization between national and regional regulations can be understood through the lens of decentralization theory, which emphasizes the transfer of decision-making authority to lower levels of government to improve responsiveness and efficiency. In environmental governance, the concept of subsidiarity suggests that functions should be performed by the smallest, lowest, or least centralized competent authority, except when centralized coordination is necessary. Furthermore, Indonesia's experience illustrates elements of legal pluralism, where multiple legal systems coexist, including national laws, regional regulations, and local customary norms. These frameworks

[76] Muhammad Tito Harvianto, "PERILAKU SOSIAL MASYARAKAT DALAM UPAYA MENCIPTAKAN KEBERSIHAN LINGKUNGAN BANTARAN SUNGAI KALI PEPE KOTA SURKARTA," *Journal of Development and Social Change* 5, no. 2 (2022): 32–46.
[77] Syamsu Rijal et al., "Peran Hukum Lingkungan Dalam Mendukung Konservasi Sumber Daya Alam," *Jurnal Kolaboratif Sains* 8, no. 2 (2024): 1264–72, https://doi.org/10.56338/jks.v8i2.7140.
[78] I Ketut Sukawati Lanang Putra Perbawa and Fatma Ulfatun Najicha, "Tantangan Reformasi Birokrasi Dalam Mewujudkan Good Governance Berbasis Partisipasi Masyarakat," *Jurnal Discretie* 3, no. 3 (2022): 170–81.

reveal that regulatory fragmentation is a predictable outcome of multi-level governance when institutional mechanisms for coordination are weak[79][80][81].

### 4.7. Strategies to Improve Policy Harmonization

To overcome the above problems, several strategies are needed that can strengthen the harmonization between national policies and regional regulations in solid waste management in Indonesia, including:[82]

1. As a legal innovation, this study proposes the establishment of a "National-Regional Harmonization Council for Solid Waste Governance" (NRHC-SWG). This council would act as a permanent intergovernmental body tasked with aligning national policies and regional regulations through a structured harmonization mechanism. The NRHC-SWG would have the authority to review regional regulations before enactment, provide binding recommendations, and mediate conflicts between different levels of government. This institutional model is grounded in the principle of cooperative governance, ensuring that local autonomy under Law No. 23/2014 is maintained while achieving uniformity in national environmental objectives. Similar models have been successfully implemented in multi-level governance systems such as the European Union's Environmental Policy Coordination Framework.[83] By introducing this council, Indonesia can reduce regulatory fragmentation, enhance compliance with national sustainability targets, and foster collaborative policymaking between central and local authorities.
2. Strengthening regional capacity in solid waste management is a crucial aspect in creating an effective and sustainable system. One technology that can be

[79] Frank Fischer and Gerald J. Miller, *Handbook of Public Policy Analysis: Theory, Politics, and Methods* (CRC Press, 2007).
[80] Wayne Parsons, *Public Policy: An Introduction to the Theory and Practice of Policy Analysis* (Edward Elgar Publishing, 2005).
[81] William N Dunn, *Public Policy Analysis: An Integrated Approach*, 6th ed. (Routledge, 2017).
[82] Muhamad Ibnu Fajar et al., "Kebijakan Pengelolaan Limbah Padat Bukan Berasal Dari Bahan Berbahaya Dan Beracun Melalui Re-Use Atau Re-Cycling Untuk Kelestarian Lingkungan Hidup," *Jurnal Green Growth Dan Manajemen Lingkungan* 7, no. 2 (2018): 148–59, https://doi.org/10.21009/jgg.072.05.
[83] Sandhi and Rosenlund, "Municipal Solid Waste Management in Scandinavia and Key Factors for Improved Waste Segregation: A Review."

optimized is Waste-to-Energy (WtE), which allows the conversion of waste into energy so that it not only reduces the volume of waste, but also produces alternative energy sources that can be utilized. The central government needs to ensure that there are more comprehensive policies, both in the form of clearer regulations for regions that have successfully implemented an effective waste management system. With a stronger legal umbrella, regional governments will have a clearer basis for taking strategic steps, including in the application of environmentally friendly technology, enforcement of regulations for industry and the community, and optimization of the budget for waste management programs. Without adequate regulatory support, efforts to increase regional capacity in waste management will find it difficult to achieve maximum results. Therefore, synergy between the central and regional governments in technical and regulatory aspects is the main key in creating a more effective and sustainable waste management system.

3. Increasing public knowledge about how to manage waste properly is a crucial step in creating a cleaner and healthier environment.[84] Education campaigns must be carried out widely and continuously by utilizing various communication channels, such as social media, schools, and local communities. Social media can be an effective tool to spread information quickly and reach more people, especially the younger generation who are more active on digital platforms. Meanwhile, education in schools must include a curriculum that instills values of environmental concern from an early age, for example by holding waste sorting and recycling practices in the school environment. At the community level, direct socialization through seminars, workshops, or mutual cooperation activities can help increase community understanding and involvement in solid waste management. In addition to education, providing incentives can also be an effective strategy to encourage public participation in recycling and waste management programs. These incentives can be in the form of awards, discounts on waste levies, or other economic benefits for people who actively participate in

[84] Mohammad Amin Lasaiba and Irvan Lasaiba, "Strategi Inovatif Untuk Pengelolaan Sampah Perkotaan: Integrasi Teknologi Dan Partisipasi Masyarakat," *GEOFORUM Jurnal Geografi Dan Pendidikan Geografi* 3, no. 1 (2024): 1–18.

waste management programs. With attractive rewards, people will be more motivated to sort and recycle waste consistently. The government and the private sector can work together to create effective incentive schemes, such as waste exchange programs for daily necessities or points systems that can be exchanged for certain benefits. Through this comprehensive approach, public awareness and concern for waste management can increase significantly, thus contributing to efforts to maintain environmental sustainability.

4. Stricter law enforcement in solid waste management is one of the crucial steps in creating a clean and healthy environment.[85] Local governments have an important role in ensuring that every regulation that has been set can be implemented effectively in the field. One way that can be done is by increasing supervision of waste disposal and management activities by the community and business actors. Through a strict monitoring system, the government can identify violations that occur and take firm action against parties who do not comply with the rules. In addition, the imposition of clear and measurable sanctions is an important element in this effort. These sanctions can be in the form of administrative fines, revocation of business licenses for companies that do not meet waste management standards, or even legal action for serious violations that have a major impact on the environment. Consistent application of sanctions will provide a deterrent effect and encourage the community and business actors to be more responsible in managing waste. On the other hand, the government also needs to ensure that these law enforcement efforts are supported by regulations that are comprehensive and easy to understand by all levels of society. Socialization regarding regulations and legal consequences of violations must be carried out continuously, either through public campaigns, outreach at the community level, or the use of digital media. Thus, public awareness and discipline in following waste management regulations can increase, which will

[85] Jessica Banjarnahor et al., "Efektivitas Penerapan Hukum Dalam Penanggulangan Sampah Sembarangan Di Kota Medan: Sebuah Studi Literatur," *Jurnal Ilmiah Nusantara ( JINU)* 2, no. 1 (2025): 28–44, https://doi.org/10.61722/jinu.v2i1.3129.

ultimately contribute to the creation of a more effective and sustainable waste management system.

In the fishing port area, the dominant solid waste comes from fish loading and unloading activities and unused fishing gear. An example of its application can be seen in the Muara Angke Nusantara Fishing Port, where plastic waste, wood, and net scraps are the main problems. Effective management steps are the implementation of a waste sorting system, improving processing facilities, and empowering fishermen in a recycling program for unused fishing gear.[86]

Educational institutions, such as universities and schools, also produce significant amounts of solid waste, including paper, plastic, and food waste. The Faculty of Engineering, Pancasila University, implements an environmentally friendly policy with a waste sorting system on campus. This program includes education for students and academic staff as well as the provision of recycling facilities to reduce unmanaged waste.[87]

Hazardous and Toxic Waste (B3) produced by industry, such as chemical waste and heavy metal residues, requires careful management. Industries that have internal waste processing facilities tend to be more successful in reducing the impact of pollution. One approach that can be applied is cooperation with third parties that have B3 waste processing technology to ensure that the disposal process is carried out in accordance with environmental regulations.[88]

Harmonization of national policies and regional regulations in solid waste management is essential to ensure a more effective and sustainable system. If the strategies proposed above can be implemented properly, the effectiveness of waste

[86] Retno Muninggar et al., "Pengelolaan Limbah Padat Di Pelabuhan Perikanan Nusantara Muara Angke Jakarta," *ALBACORE Jurnal Penelitian Perikanan Laut* 5, no. 2 (2023): 189–98, https://doi.org/10.29244/core.6.2.189-198.
[87] Ayu Herzanita et al., "Penerapan Pengelolaan Limbah Padat Di Fakultas Teknik Universitas Pancasila Dalam Mewujudkan Green Campus," *Jurnal JANATA* 1, no. 2 (2021): 42–49, https://doi.org/10.35814/janata.v1i2.3117.
[88] Feri Wardianto et al., "Kajian Pengelolaan Limbah Padat Bahan Berbahaya Dan Beracun (B3) Rumah Tangga Di Jakarta Barat," *Infomatek* 25, no. 2 (2023): 143–52, https://doi.org/10.23969/infomatek.v25i2.9767.

management in Indonesia will increase, thereby reducing environmental pollution and improving the welfare of society as a whole.

To contextualize Indonesia's performance, KLHK data were compared with OECD benchmarks, which show recycling rates above 60% in Germany and 49% in Sweden[89][90]. This divergence is attributed to fiscal incentives and integrated Extended Producer Responsibility (EPR) schemes that Indonesia has yet to institutionalize. Unlike Indonesia's fragmented cost-sharing model, Germany's EPR obligates producers to finance recycling logistics, reducing reliance on municipal budgets.

To contextualize Indonesia's waste management performance, Table 2 compares national recycling rates and key policy instruments in selected countries. This comparison highlights Indonesia's relatively low recycling rate despite an extensive legal framework, emphasizing the gap between regulatory ambition and operational outcomes.

The data illustrate that high-performing countries pair regulatory frameworks with economic instruments such as EPR (Germany) and landfill taxes (Sweden), which Indonesia has yet to institutionalize. This indicates that harmonization alone will not improve performance without fiscal incentives and shared responsibility mechanisms.

**Table 2.** *Compares National Recycling Rates and Key Policy Instruments in Selected Countries*

| Country | Recycling Rate (%) | Main Policy Instrument |
|---|---|---|
| Indonesia | 15% | Law No. 18/2008 on Waste Management; 3R policy |
| Germany | 60% | Extended Producer Responsibility (EPR) under VerpackG |
| Sweden | 49% | Landfill tax; municipal autonomy in WtE |

Comparative evidence from Sweden offers instructive lessons. Swedish waste management achieves recycling rates exceeding 99%, combining stringent landfill taxes with municipal autonomy over WtE infrastructure (SYSAV Malmö being among

[89] Nelles et al., "Waste Management in Germany – Development to a Sustainable Circular Economy?"
[90] Sandhi and Rosenlund, "Municipal Solid Waste Management in Scandinavia and Key Factors for Improved Waste Segregation: A Review."

the most efficient plants globally)[91]. In Germany, Extended Producer Responsibility (EPR) schemes and integrated recycling policies enable cost-sharing and incentivize compliance within a circular economy governance model[92]. These practices illustrate how legal harmonization succeeds when underpinned by aligned institutional mandates and fiscal incentives, rather than top-down decree alone.

With the synergy between national policies and regional regulations, it is hoped that Indonesia can achieve the target of reducing and managing waste better in accordance with the vision of sustainable development.

In addition, harmonization should be supported by constitutional interpretation of Article 18 of the 1945 Constitution, which provides the basis for regional autonomy. Interpreting this provision in light of environmental governance suggests that decentralization must be balanced with national environmental priorities. Therefore, a harmonization mechanism like NRHC-SWG ensures that autonomy does not undermine sustainability mandates embedded in national law.

## 5. Conclusion

Harmonization of national policies and regional regulations in solid waste management in Indonesia is not merely a matter of legal uniformity or technical necessity, but a constitutional mandate and a fundamental governance challenge aimed at ensuring environmental sustainability and public welfare. While the current legal framework anchored in Law No. 18 of 2008 on Waste Management and Law No. 23 of 2014 on Regional Government provides a formal basis, its implementation is often obstructed by overlapping authorities, weak institutional coordination, regulatory inconsistencies, and significant disparities in regional capacity.

To address these challenges, a combination of normative, structural, and adaptive reforms is required. First, legislative amendments are needed to eliminate jurisdictional ambiguities between the two main laws by introducing a harmonization clause that clearly delineates responsibilities and coordination mechanisms between

[91] Ni Putu Wulan Romianingsih, "Waste to Energy in Indonesia: Opportunities and Challenges," *Journal of Sustainability Society and Eco-Welfare* 1, no. 1 (2023), https://doi.org/0.61511/jssew.v1i1.2023.180.
[92] Felix Kullmann et al., *The Value of Recycling for Low-Carbon Energy Systems -- a Case Study of Germany's Energy Transition* (2022).

central and regional governments. Second, the establishment of a statutory intergovernmental body, such as the proposed National-Regional Harmonization Council for Solid Waste Governance (NRHC-SWG), is essential to institutionalize cooperative governance, prevent regulatory fragmentation, and resolve intergovernmental disputes. Third, constitutional adjudication by the Constitutional Court should be considered to provide authoritative interpretation of Article 18 of the 1945 Constitution, ensuring that regional autonomy is exercised within the bounds of national environmental objectives. If Indonesia adopts a harmonization model grounded in legal innovation, measurable indicators, and reinforced by fiscal and institutional reform, it can shift from fragmented waste governance to a coherent, multi-level system that advances circular economy objectives and fulfills the broader goals of sustainable development.

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