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Original Article

Achieving Sustainable and Responsible Consumption Production Policy through Integrated Waste Management in Residential Areas

Resti Dian Luthviati [1,*]

[1] Universitas Sebelas Maret, Surakarta, Indonesia.

*Corresponding Author: restidianl@staff.uns.ac.id

Abstract

Effective and sustainable waste management constitutes a central component of environmental governance and public health protection, particularly in residential areas located along the administrative borders of Surakarta City. Border settlements frequently experience disparities in infrastructure provision, limited supervisory control, and uneven public service delivery, which collectively weaken the effectiveness of integrated waste governance. This study analyzes the implementation of the regional regulatory framework on integrated waste management in these peripheral residential areas and evaluates the institutional, regulatory, and socio legal constraints that affect its practical operation. The research applies a qualitative design grounded in empirical fieldwork. The study collects primary data through structured interviews with relevant stakeholders and analyzes the data using a normative and comparative approach. It compares Indonesia's waste governance practices with selected international models implemented in Germany, Japan, and Singapore to identify transferable principles and institutional mechanisms that may strengthen local implementation. The findings demonstrate that the regulatory framework provides a systematic structure for integrated waste management; however, implementation gaps persist. Limited public awareness, inadequate waste processing facilities, and weak inter institutional coordination significantly hinder policy effectiveness, particularly in border residential zones. The study concludes that the government must intensify community engagement strategies, strengthen environmental education programs, and enhance cross sectoral collaboration to ensure the realization of sustainable and responsible waste management in border areas.

Keywords: Consumption; Sustainable; Policy; Waste;

Introduction

Contemporary socio-economic transformation directly influences patterns of human activity, including the expansion of infrastructure designed to sustain public welfare. Urban development reflects measurable population growth, which compels governments to intensify land utilization and strengthen public service facilities.[1] Municipal authorities prioritize the provision of infrastructure to meet increasing societal needs, including the establishment of integrated waste management systems in residential areas. Population growth increases consumption rates and consequently amplifies the volume and diversity of waste generation. Therefore, urban governance must systematically integrate environmental management into spatial and infrastructural planning to ensure sustainability.[2]

Urban development continues to encounter structural constraints, particularly the limited availability of adequate waste management facilities and supporting infrastructure. Low public awareness regarding responsible waste practices further exacerbates this condition. Waste originates from human activity and directly corresponds to behavioral and socio-economic patterns within society. In Indonesia, waste management has evolved into a critical

[1] Febrina Heryanti et al., "Tinjauan Hukum Undang-Undang Pengelolaan Sampah Terhadap Pencemaran Lingkungan," *Sang Pencerah: Jurnal Ilmiah Universitas Muhammadiyah Buton* 9, no. 2 (2023): 433–44, https://doi.org/10.35326/pencerah.v9i2.3243.

[2] Ferry Lismanto Syaiful and Isra Hayati, "Inovasi Pengolahan Sampah Plastik Menjadi Produk Dan Jasa Kreatif Di Kenagarian Kinali Kabupaten Pasaman Barat," *Jurnal Hilirisasi IPTEKS* 4, no. 4 (2021): 233–40, https://doi.org/10.25077/jhi.v4i2.542.

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environmental issue at both national and global levels. The increasing complexity of waste composition, including organic, inorganic, and hazardous materials, demands comprehensive regulatory frameworks, technological innovation, and institutional coordination.[3]

Inadequate waste management practices produce serious environmental and public health consequences. Leachate from unmanaged waste contaminates rivers and groundwater systems, while methane emissions from decomposing organic matter contribute to air pollution and climate change. Accumulated waste also creates breeding grounds for pathogenic microorganisms, thereby increasing the risk of disease transmission. Furthermore, unmanaged waste degrades environmental aesthetics and reduces the overall quality of life in urban communities. Historically, rapid increases in urban waste generation began during the Industrial Revolution, when large scale migration from rural to urban areas intensified population density. This demographic shift expanded both the quantity and composition of municipal waste. Contemporary cities continue to face similar pressures, although within more complex regulatory and governance contexts.[4]

In Surakarta City, population growth intensifies the demand for infrastructure development, including integrated waste management systems. Recent demographic data demonstrate measurable population increases, which correlate with higher waste generation rates. Border residential areas present additional governance challenges because they involve overlapping administrative jurisdictions that often weaken coordination and service delivery. Limited municipal capacity to accommodate rising waste volumes, combined with insufficient public knowledge regarding organic and inorganic waste management, undermines policy effectiveness. Strengthening community participation and institutional coordination therefore constitutes a strategic necessity to achieve sustainable and integrated waste governance in urban areas.[5]

Empirical data indicate that waste management in Surakarta City remains suboptimal, particularly in relation to disposal practices at the Putri Cempo Landfill. The landfill continues to apply an open dumping method, which prevents systematic waste segregation and undermines environmentally sound processing standards. The municipal authority maintains this approach due to the continuous annual increase in waste generation. Of the total 17 hectares allocated for the landfill site, approximately 13 hectares function as active dumping zones that accommodate waste transported from all districts and sub districts within the city. This spatial limitation intensifies operational pressure and reduces the feasibility of implementing more advanced waste treatment systems.[6]

Waste management challenges in Surakarta extend beyond disposal techniques. The system faces behavioral and structural constraints, including persistent public practices of indiscriminate dumping and resistance to the establishment of temporary waste collection points perceived as disruptive. The imbalance between the availability of temporary disposal facilities and the volume of waste generated has created logistical inefficiencies. Although many temporary collection sites are located near residential areas, waste collection from

[3] Muhlis Madani, "Agenda Setting Pengelolaan Sampah Pasar Di Kota Makassar," *Otoritas : Jurnal Ilmu Pemerintahan* 1, no. 1 (2011): 11–24, https://doi.org/10.26618/ojip.v1i1.12.
[4] David C. Wilson, "Development Drivers for Waste Management," *Waste Management and Research* 25, no. 3 (2007): 198–207, https://doi.org/10.1177/0734242X07079149.
[5] (Williams dan Tchobanoglous dalam Amasuomo & Baird, 2016)
[6] Muchammad Zamzami Elamin et al., "Analysis of Waste Management in The Village of Disanah, District of Sreseh Sampang, Madura," *Jurnal Kesehatan Lingkungan* 10, no. 4 (2018): 368, https://doi.org/10.20473/jkl.v10i4.2018.368-375.

households does not consistently occur on a daily basis, thereby increasing the risk of accumulation and environmental degradation.[7]

In response to the escalating waste volume, the municipal government enacted a regional regulation on integrated waste management to strengthen environmental protection and safeguard public health. The regulation seeks to establish an effective and structured waste governance system capable of addressing pollution risks and promoting urban sustainability for present and future generations. It also aligns local policy with the mandate of Law Number 18 of 2008 concerning Waste Management, which obliges regional governments to implement comprehensive and integrated waste management policies. Through this regulatory framework, the government intends to enhance institutional coordination and encourage active community participation in waste sorting and responsible disposal practices.[8]

Despite this normative framework, implementation in border residential areas encounters persistent obstacles. Internal factors such as age, educational background, and environmental knowledge significantly influence levels of community participation. Adults with greater environmental awareness tend to demonstrate higher responsiveness to waste related risks. Conversely, limited awareness and individual indifference continue to weaken collective engagement. External factors also shape participation, including insufficient governmental outreach regarding household waste management and the physical distance between residential areas and waste banks. Increased distance correlates with declining public involvement, thereby reducing the overall effectiveness of integrated waste management initiatives in peripheral urban zones.[9]

Although the Government of Surakarta City has enacted a regional regulation on integrated waste management to strengthen supervision and law enforcement mechanisms, significant implementation challenges persist, particularly in border residential areas. The Environmental Agency of Surakarta bears formal responsibility for monitoring compliance; however, low public awareness and limited community discipline continue to obstruct effective enforcement. Bureaucratic complexity further delays administrative action, while insufficient environmental education and the absence of adequate incentives weaken community participation in sustainable waste practices.[10]

The regulatory framework encounters structural obstacles in its operationalization. Limited land availability for Integrated Waste Processing Facilities constrains expansion capacity, while low rates of waste segregation and retribution payment reduce financial sustainability. Inadequate infrastructure, restricted human resources, weak inter agency coordination, and budgetary limitations collectively slow policy implementation. At the societal level, persistent practices of indiscriminate dumping and limited environmental concern contribute to the continuous increase in waste volume. These conditions demonstrate that the existence of a regulatory instrument alone does not guarantee effective governance without institutional capacity and social compliance. To address these gaps, the

[7] Ni Made Nia Bunga Surya Dewi, "Kajian Partisipasi Masyarakat Dusun Bone Puteh Dalam Pengelolaan Sampah," *Sosial Sains Dan Teknologi* 1, no. 1 (2021): 32–40.
[8] Samudra Ivan Supratikno, Lina Warlina, and Sri Listyarini, "Model Pengelolaan Sampah Terpadu Di Kota Surakarta," *Gema Wiralodra* 14, no. 1 (2023): 118–29, https://doi.org/10.31943/gw.v14i1.361.
[9] Norsita Agustina, Hilda Irianty, and Nova Tri Wahyudi, "Hubungan Karakteristik Petugas Kebersihan Dengan Pengelolaan Sampah Di Puskesmas Kota Banjarbaru," *Jurnal Publikasi Kesehatan Masyarakat Indonesia* 4, no. 2 (2017): 66–74, https://doi.org/10.20527/jpkmi.v4i2.3843.
[10] E. Antriyandarti et al., "Climate Change Mitigation through Strengthening of Waste Bank Role and 3R (Reduce, Reuse, Recycle) Application in Urban Area," *IOP Conference Series: Earth and Environmental Science* 1253, no. 1 (2023), https://doi.org/10.1088/1755-1315/1253/1/012097.

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municipal government has introduced participatory governance mechanisms. The regulation obliges authorities to provide accessible information regarding waste management policies and budget allocation, thereby promoting transparency and public trust. Waste management operators must also report performance outcomes to the public through accountable monitoring systems. The regulation encourages community involvement across all stages of policy implementation, including planning, execution, and supervision. Through discussion forums, public campaigns, and educational initiatives, the government seeks to position citizens as collaborative partners rather than passive beneficiaries.[11]

Rising waste volumes between 2021 until 2025 prompted the municipal authority to reinforce preventive and corrective measures, including the promotion of the 3R principle of reduce, reuse, and recycle. Waste handling at the source constitutes a strategic priority because segregation, reuse, and recycling significantly decrease the volume transported to final disposal sites. Effective source-based management enhances downstream efficiency and reduces environmental burden. The Putri Cempo Landfill remains central to Surakarta's waste system. The government has attempted to convert waste into electrical energy through a waste to energy power plant facility located at the landfill site. While this initiative aims to reduce accumulation and generate renewable energy, surrounding communities report environmental disturbances, including air and water pollution risks. These concerns intensify in border settlements such as Jatirejo in Mojosongo, Jebres District, which lies near the administrative boundary between Surakarta City and Karanganyar Regency. Residents in this area experience the direct environmental impact of landfill operations and cross jurisdictional governance complexities.[12]

Despite the national and local prioritization of the 3R model, implementation in border communities remains limited. Insufficient waste banks, inadequate technical training, and the absence of economic incentives reduce public engagement. Moreover, the proximity of dual administrative authorities complicates regulatory harmonization and enforcement consistency. [13] Comparative experience demonstrates that effective integrated waste governance requires coherent policy alignment and strong civic participation. In Germany, strict segregation systems, comprehensive recycling infrastructure, and sustained public education campaigns have institutionalized waste reduction as a societal norm. Such models illustrate that regulatory clarity, infrastructural readiness, and community awareness must operate synergistically to achieve sustainable waste management, particularly in border regions where administrative coordination becomes indispensable. [14]

Integrated waste management infrastructure in Germany significantly enhances operational efficiency and environmental performance. Modern waste treatment facilities support systematic recycling and recovery processes while simultaneously functioning as instruments of public education. Empirical studies demonstrate that the availability of accessible and technologically advanced facilities increases community participation in waste segregation and recycling activities. German municipalities actively involve residents through

[11] Rosita Candrakirana, "Penegakan Hukum Lingkungan Dalam Bidang Pengelolaan Sampah Sebagai Perwujudan Prinsip Good Environmental Governance Di Kota Surakarta," *Yustisia Jurnal Hukum* 93, no. 3 (2015): 581–601, https://doi.org/10.20961/yustisia.v93i0.3686.

[12] Endang Sawitri et al., "Pelatihan Penggunaan Tensimeter Manual Bagi Kader Posyandu Di Wilayah Desa Bawak Cawas, Klaten," *WASATHON Jurnal Pengabdian Masyarakat* 2, no. 1 (2024): 1–4.

[13] AHMAD ARIDHO, "Pengelolaan Sampah Di Kabupaten Deli Serdang Di Tinjau Dari Perda Nomor 4 Tahun 2021," *Civics Education and Social Science Journal (CESSJ)* 6, no. 1 (2024): 37–54, https://doi.org/10.32585/cessj.v6i1.5168.

[14] M. Nelles, J. Grünes, and G. Morscheck, "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.

structured initiatives, including community-based recycling programs and environmental clean-up campaigns. This participatory framework strengthens environmental awareness and fosters collective responsibility. In border regions, cooperation between communities across adjacent jurisdictions further reinforces cross boundary waste governance and minimizes regulatory fragmentation.[15]

Although Germany establishes waste management policy at the national level, local authorities retain discretion to adapt implementation mechanisms according to contextual needs. This flexible regulatory architecture enables municipalities, including those in border areas, to tailor programs without deviating from overarching sustainability principles. Responsive local adaptation enhances policy effectiveness and ensures that environmental protection measures address specific ecological risks. The integration of environmentally friendly technologies and sustainable operational standards prevents ecosystem degradation and supports long term resilience. Consequently, Germany's integrated approach demonstrates that coherent policy design, adequate infrastructure, and active civic engagement must operate in synergy to achieve sustainable waste governance. [16]

Integrated waste management in Japan similarly relies on a holistic and disciplined system that prioritizes waste reduction, meticulous segregation, structured collection, and high recycling rates. Japanese municipalities implement rigorous sorting standards supported by extensive public education campaigns. High levels of environmental awareness directly influence household compliance and reduce overall waste generation. However, border areas between adjacent cities face additional challenges when local regulations differ, particularly regarding classification standards and collection schedules. Policy misalignment can create public confusion and reduce compliance. Therefore, harmonizing municipal regulations across neigh-boring jurisdictions becomes essential for maintaining efficiency and legal clarity. Japan also integrates information technology into waste governance systems to monitor waste streams, evaluate program effectiveness, and inform adaptive policymaking.[17]

In Singapore, waste governance reflects a highly organized and centralized environmental management model grounded in the 3R principle of reduce, reuse, and recycle. The government promotes public awareness through structured campaigns such as the "Say Yes to Waste Less" initiative, which disseminates practical guidance on waste minimization and recycling practices. Singapore incorporates advanced technological systems to optimize collection logistics and monitor environmental impact. Importantly, policy design also considers social equity dimensions, particularly for communities residing near disposal facilities, to prevent disproportionate environmental burdens. [18]

These comparative experiences illustrate that effective waste governance in border residential areas requires regulatory coherence, infrastructural adequacy, technological integration, and sustained community engagement. Inspired by these models, this research

[15] Ali Akbar Babaei et al., "Household Recycling Knowledge, Attitudes and Practices towards Solid Waste Management," *Resources, Conservation and Recycling* 102 (2015): 94–100, https://doi.org/10.1016/j.resconrec.2015.06.014.

[16] Suzan Bernadetha Stephani, Harefan Arief, and Niken Sulistyowati, "Pembentukan Dan Pendampingan Bank Sampah Menggunakan Sistem Manajemen Pendukung Keberlanjutan Di Meruya Selatan, Jakarta Barat," *Batara Wisnu : Indonesian Journal of Community Services* 2, no. 1 (2022): 97–104, https://doi.org/10.53363/bw.v2i1.75.

[17] Zrimurti Mappau and Fahrul Islam, "Pelatihan Pengelolaan Sampah Rumah Tangga Dengan Metode Komposting Takakura," *Poltekita: Jurnal Pengabdian Masyarakat* 3, no. 2 (2022): 258–67, https://doi.org/10.33860/pjpm.v3i2.1077.

[18] M. Uhaib et al., "Policy for the Development and Education Management of Entikong Border Area on Political Economic Perspective," *Khazanah Sosial* 4, no. 4 (2022): 745–56, https://doi.org/10.15575/ks.v4i4.18689.

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examines how residents of RT 03/RW 39 Kampung Jatirejo in Surakarta City respond to the regional regulatory framework on waste management. The study evaluates governmental roles in strengthening integrated waste governance in border settlements and formulates strategic recommendations to enhance policy effectiveness. By conducting this legal and empirical analysis, the research seeks to contribute to the development of a more structured, participatory, and sustainable waste management model at both local and regional levels.

Method

This research applies an empirical legal methodology that examines the interaction between normative legal provisions and their implementation in society. The study adopts a descriptive research design to systematically portray the operation of waste management regulation and its practical implications within the community. The descriptive character of the research enables the author to identify factual conditions, institutional practices, community responses, and regulatory gaps related to the implementation of waste governance in border residential areas of Surakarta City.[19] The research employs two principal approaches, namely a qualitative approach and a comparative approach. The qualitative approach facilitates an in depth understanding of legal behavior, institutional performance, and social perception through direct engagement with relevant actors. The comparative approach examines integrated waste management practices in Indonesia and contrasts them with regulatory and institutional frameworks in Germany, Japan, and Singapore in order to identify similarities, differences, and potential best practices.

The study utilizes both primary and secondary data sources. Primary data derive from structured interviews conducted with officials of the Environmental Agency of Surakarta and residents of RT 03/RW 39 Kampung Jatirejo who experience the direct impact of waste management policies. Secondary data consist of statutory regulations, including regional regulations, scholarly books, and peer reviewed journal articles relevant to environmental law and public administration. The author analyzes the collected data using qualitative legal analysis. The analysis process involves data reduction, categorization, interpretation, and systematic synthesis to identify patterns, normative inconsistencies, and implementation barriers. Through this mechanism, the research formulates objective conclusions and provides structured legal arguments to address the identified regulatory and practical challenges. [20]

Results and Discussions

Green Budget and Green Regulation to Achieving Integrated Waste Management

The Regional Regulation of Surakarta City No. 4 of 2022 on Waste Management was enacted in response to increasingly complex waste management issues in the city, driven by population growth, economic activity, and industrial development. Unmanaged or poorly managed waste poses significant environmental, public health, and urban aesthetic challenges. The regulation derives its legal foundation from Article 28H paragraph (1) of the 1945 Constitution of the Republic of Indonesia, which guarantees the right to a healthy and adequate living environment, supporting the local government's mandate to protect public health and environmental quality. The regulation aims to establish a structured, efficient, and sustainable waste management system by promoting public awareness, applying circular economy principles, and mitigating negative environmental and health impacts. Adequate

[19] Madina Moshkal, Yerlan Akhapov, and Atsushi Ogihara, "Sustainable Waste Management in Japan: Challenges, Achievements, and Future Prospects: A Review," *Sustainability* 16, no. 17 (2024): 7347, https://doi.org/10.3390/su16177347.

[20] N. A.A. Abus et al., "Waste Bank Management as an Alternative Community-Based Waste Management Strategy in Langsa City, Aceh Province," *IOP Conference Series: Earth and Environmental Science* 1375, no. 1 (2024), https://doi.org/10.1088/1755-1315/1375/1/012007.

infrastructure is therefore critical to creating a cleaner, healthier, and more environmentally friendly city.[21]

Perda No. 4 of 2022 categorizes waste into Household Waste, Similar Household Waste, and Specific Waste, facilitating targeted management according to the source. Complementing this, Perda No. 7 of 2023 mandates that waste management infrastructure within residential areas meets technical standards, including household-level waste separation, neighborhood-scale collection fleets, and integrated processing facilities employing the 3R principles (reduce, reuse, recycle). These provisions align with Law No. 18 of 2008 on Waste Management, which obligates local governments to implement waste reduction, treatment, and utilization measures, and sets targets for environmental-friendly technology adoption, recycled material use, and public engagement in waste minimization. Perda No. 4 of 2022 also introduces compliance mechanisms, including administrative sanctions such as written warnings, activity restrictions, or license revocation, and criminal sanctions of up to three months' imprisonment or fines up to IDR 50,000,000 for violations. Conflict resolution provisions encourage both judicial and extrajudicial approaches, emphasizing consensus-building.[22]

Implementation in border neigh-borhoods, such as Kelurahan Mojosongo, demonstrates the need for coordinated governance between municipal and district authorities. The regulation emphasizes community participation through household waste separation, recycling programs, and educational campaigns. Integrating technology, such as digital reporting applications, and public-private partnerships for circular economy solutions, further enhances efficiency. By applying 3R principles, reducing waste to landfills like TPA Putri Cempo, and promoting recycling, the regulation simultaneously mitigates environmental pollution, reduces greenhouse gas emissions, and generates economic opportunities for residents. Effective enforcement and public engagement are therefore essential to achieving sustainable, efficient, and environmentally responsible waste management in Surakarta City.[23]

The Regional Regulation of Surakarta City No. 4 of 2022 emphasizes the necessity of comprehensive and integrated waste management to ensure every citizen's right to a prosperous life, healthy living environment, and adequate housing, as stipulated in Article 28H paragraph (1) of the 1945 Constitution. The regulation responds to increasing population growth and changes in consumption patterns that elevate the volume, type, and complexity of waste. These challenges demand a structured management approach from waste generation to final disposal, ensuring environmental safety, public health, and potential economic benefits. The regulation also updates previous provisions, such as Perda No. 3 of 2010, to align with evolving legal and societal conditions.[24]

The success of integrated waste management in Surakarta relies on active community participation through initiatives such as waste banks, composting, and neighborhood-based collection programs. Community engagement fosters environmental awareness, encourages proper waste segregation, and promotes adoption of circular economy practices. Programs like 3R (Reduce, Reuse, Recycle) enable the transformation of household waste into economically valuable products, generating supplemental income for residents while

[21] David C. Wilson and Anne Scheinberg, "What Is Good Practice in Solid Waste Management?," *Waste Management and Research* 28, no. 12 (2010): 1055–56, https://doi.org/10.1177/0734242X10392106.

[22] Nima Karimi, "Assessing Global Waste Management: Alternatives to Landfilling in Different Waste Streams—A Scoping Review," *Sustainability (Switzerland)* 15, no. 18 (2023), https://doi.org/10.3390/su151813290.

[23] Hari Bhakta Sharma et al., "Challenges, Opportunities, and Innovations for Effective Solid Waste Management during and Post COVID-19 Pandemic," *Resources, Conservation and Recycling* 162, no. July (2020): 105052, https://doi.org/10.1016/j.resconrec.2020.105052.

[24] Sintha Prima Widowati, "Evaluating The Integrated Environmental Management Of Municipal Solid Waste In Osaka City, Japan," *Indonesian Journal of Geography* 46, no. 2 (2014): 187, https://doi.org/10.22146/ijg.5788.

reducing landfill volumes and environmental impact. Social mobilization activities, such as gotong royong, strengthen communal bonds and support collaborative waste management efforts. Educational campaigns and continuous awareness-building enhance ecological consciousness, motivating individuals to adopt sustainable behaviors and reduce the tendency to prioritize short-term convenience over long-term environmental sustainability.[25]

The regulation integrates administrative and legal mechanisms to ensure compliance, including structured sanctions and enforcement measures. Simultaneously, governance requires coordinated efforts among local authorities, communities, and private stakeholders. Policy implementation frameworks, such as Soerjono Soekanto's Theory of Legal Effectiveness and Grindle's Policy Implementation Theory, highlight the importance of policy clarity, resource allocation, social context, and active stakeholder engagement in achieving desired outcomes. Compliance is further reinforced through legal awareness, public education, and responsive enforcement measures that create a deterrent effect. Perda No. 4 of 2022 provides a legal and institutional framework for sustainable, efficient, and community-oriented waste management in Surakarta. Its effectiveness depends on the synergistic interaction of policy clarity, community participation, education, technological support, and consistent enforcement. By integrating these elements, the regulation promotes environmental preservation, public health, and economic opportunities, ensuring that waste management contributes to a cleaner, healthier, and more sustainable urban environment. [26]

Green budgeting, as constitutes a budgeting paradigm that prioritizes environmental sustainability at every stage of public finance management, encompassing planning, execution, monitoring, and evaluation of government expenditures. This paradigm directs governments to ensure that all programs and operations funded by the state budget not only support ecological sustainability but also align with ecosystem preservation principles. Its primary objectives include reducing waste production, minimizing resource consumption, promoting efficiency and sustainability in government operations, lowering greenhouse gas emissions, and addressing social challenges such as environmental vulnerability and inequality. [27]

Green regulation complements this framework by establishing a legal and operational policy structure aimed at guiding the transition toward sustainable economic practices. It emphasizes efficient resource management, pollution control through stringent environmental standards, energy efficiency, and the adoption of environmentally friendly technologies. At local, national, and international levels, green regulations facilitate renewable energy adoption, waste management, critical land rehabilitation, and climate cooperation, fostering economic innovation and social well-being while reducing environmental harm. The implementation of Surakarta City Regional Regulation No. 4 of 2022 integrates green budgeting and green regulation into comprehensive waste management. The regulation allocates financial resources for waste processing facilities, recycling programs, and community-based initiatives such as waste banks, ensuring both environmental preservation and public awareness. Active community participation in planning, execution, and evaluation strengthens compliance, reinforces collective responsibility, and fosters a culture of sustainability. Consequently, this integrated approach

[25] Brian Dyson and Ni Bin Chang, "Forecasting Municipal Solid Waste Generation in a Fast-Growing Urban Region with System Dynamics Modeling," *Waste Management* 25, no. 7 (2005): 669–79, https://doi.org/10.1016/j.wasman.2004.10.005.
[26] Kornelius Benuf, Siti Mahmudah, and Ery Agus Priyono, "Perlindungan Hukum Terhadap Keamanan Data Konsumen Financial Technology Di Indonesia," *Refleksi Hukum: Jurnal Ilmu Hukum* 3, no. 2 (2019): 145–60, https://doi.org/10.24246/jrh.2019.v3.i2.p145-160.
[27] Benuf, Mahmudah, and Priyono.

enhances environmental quality, supports intergenerational ecological justice, and promotes sustainable socio-economic development. [28]

The reduction of waste constitutes a primary objective aligned with Goal 12 of the Sustainable Development Goals (SDGs), which emphasizes sustainable consumption and production. Human activities inherently generate waste, making it a persistent challenge that must be strategically addressed to prevent further environmental and social issues. The implementation of Regional Regulation on integrated waste management plays a crucial role in advancing the SDGs by mitigating environmental impacts, enhancing public health, and promoting local economic empowerment. Effective waste management not only ensures environmental cleanliness but also contributes to SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production). A key aspect of Perda implementation involves raising public awareness about proper waste management. Outreach and educational programs enhance household-level waste utilization and facilitate responsible disposal at final waste disposal sites (Rauf et al., 2022). By promoting waste segregation and processing, the regulation encourages circular economy practices, transforming waste into valuable resources and generating new economic opportunities for communities.[29] Integrated waste management regulated under Perda further protects the environment by minimizing negative impacts from poorly managed waste through compliance with established standards (Dermawan et al., 2018). Additionally, it supports public health by providing adequate waste facilities and promoting hygienic practices. Grounded in ecological justice principles, the regulation ensures intergenerational equity by safeguarding access to a clean, healthy environment while empowering communities economically through programs such as waste banks and recycling initiatives. [30]

Integrated Waste Management in Border Settlement Areas in Several Countries

Integrated waste management in border residential areas in Germany requires a comprehensive and systematic approach that actively combines policy, infrastructure, and community engagement to achieve effective and sustainable outcomes. The national strategy prioritizes reducing, segregating, and recycling waste, emphasizing public participation as a key factor in the success of waste management programs. Residents actively separate waste into categories such as organic, plastic, and hazardous materials, which minimizes environmental impact and supports sustainable resource use. Authorities implement modern waste processing facilities equipped with advanced recycling technologies, enabling efficient treatment of materials while simultaneously educating the community on responsible waste practices. [31]

Local governance ensures that policy frameworks remain adaptable to the unique conditions of border settlements, facilitating consistent implementation across regions and preventing operational discrepancies. Community involvement extends to initiatives such as waste banks, composting programs, and organized environmental cleanups, fostering a sense of responsibility, ownership, and collective action in maintaining environmental quality. The integration of environmentally friendly practices, including technologies that reduce emissions and optimize resource utilization, further strengthens the ecological sustainability

[28] Zulfatun Ruscitasari et al., "Implementasi Timbangan Sampah Cerdas Terintegrasi Dalam Pengelolaan Sampah Di Taman Benteng Mataram, Pleret," *J-ABDI: Jurnal Pengabdian Kepada Masyarakat* 3, no. 5 (2023): 837–42, https://doi.org/10.53625/jabdi.v3i5.6479.

[29] Tiwi Okhtafianny and Ria Ariani, "Analisis Implementasi Kebijakan Pengelolaan Sampah Di Kota Payakumbuh," *Jurnal Ekonomi Bisnis, Manajemen Dan Akuntansi (JEBMA)* 3, no. 2 (2023): 537–50, https://doi.org/10.47709/jebma.v3i2.2837.

[30] Lidia Br Tarigan, Yuanita C. Rogaleli, and Ferry W.F. Waangsir, "Community Participation in Waste Management," *International Journal of Public Health Science* 9, no. 2 (2020): 115–20, https://doi.org/10.11591/ijphs.v9i2.20380.

[31] Achmad Husen and Samadi Samadi, "Community-Based Waste Management Model in DKI Jakarta," *Linguistics and Culture Review* 5, no. S3 (2021): 1377–83, https://doi.org/10.21744/lingcure.v5ns3.1839.

of the waste management system. Overall, effective integrated waste management in these border areas depends on coordinated governance, infrastructure adequacy, active public engagement, and continuous attention to environmental preservation, ensuring that waste management practices contribute positively to both societal well-being and ecological sustainability. [32]

Integrated waste management in cross-municipal border residential areas in Japan represents a complex issue that requires a holistic and systematic approach. Japan has established an efficient and integrated waste management system that encompasses waste reduction, segregation, collection, and recycling. In border areas, challenges intensify due to variations in municipal policies, infrastructure, and public awareness. Community participation plays a critical role in this system, as residents actively engage in sorting waste and following local recycling programs, supported by extensive educational initiatives aimed at increasing understanding of proper waste handling. Collaborative efforts between local governments, non-governmental organizations, and community groups foster cleaner and healthier environments while promoting shared responsibility. [33]

Policy alignment between adjacent municipalities is essential to avoid public confusion and enhance program effectiveness, particularly when differing local standards exist for waste segregation, collection, and recycling. Infrastructure, including modern treatment facilities and efficient transport systems, ensures the effective handling of waste, while information technology enables real-time monitoring of waste flows and program outcomes. Environmentally sustainable practices, such as low-emission technologies and comprehensive recycling programs, mitigate ecological impact and protect public health. Economically, community involvement generates employment opportunities and supports local income through recycling initiatives. Overall, successful integrated waste management in these border areas depends on coordinated governance, robust infrastructure, active public engagement, and sustainable environmental practices, ensuring both social and ecological benefits.[34]

Integrated waste management in cross-border residential areas in Singapore represents a complex challenge that requires a holistic and systematic approach. Singapore has developed a highly organized and efficient waste management system that encompasses waste reduction, segregation, collection, and recycling. In border areas, the complexity increases due to dynamic social and economic interactions among residents. Community participation constitutes a central element, as residents actively engage in waste reduction and recycling initiatives, supported by government-led educational programs that enhance awareness of sustainable waste management practices. Programs such as "Say Yes to Waste Less" demonstrate how public campaigns, workshops, and training sessions can promote responsible waste handling. Alignment of policies and practices across neighboring jurisdictions is critical to avoid confusion and enhance system effectiveness, particularly in multi-jurisdictional border zones.[35]

Waste banks serve as both operational and economic incentives, encouraging active public engagement while supporting resource recovery. Socioeconomic factors also influence management outcomes, as marginalized populations often reside near disposal

[32] Despa Wildawati and Evi Hasnita, "Faktor Yang Berhubungan Dengan Pengelolaan Sampah Rumah Tangga Berbasis Masyarakat Di Kawasan Bank Sampah Hanasty," *Jurnal Human Care* 4, no. 3 (2019): 149–58.
[33] Lin Shen et al., "Factors Influencing Young People's Intention toward Municipal Solid Waste Sorting," *International Journal of Environmental Research and Public Health* 16, no. 10 (2019), https://doi.org/10.3390/ijerph16101708.
[34] Christos Vlachokostas, "Closing the Loop between Energy Production and Waste Management: A Conceptual Approach towards Sustainable Development," *Sustainability (Switzerland)* 12, no. 15 (2020): 1–15, https://doi.org/10.3390/su12155995.
[35] Imam Santosa and Enro Sujito, "Potensi Ekonomi Dan Pengelolaan Sampah Pasar Di Kota Bandar Lampung," *Ruwa Jurai: Jurnal Kesehatan Lingkungan* 14, no. 2 (2021): 64, https://doi.org/10.26630/rj.v14i2.2189.

sites, necessitating inclusive strategies and supportive infrastructure to mitigate environmental and health risks. The consistent application of 3R principles—reduce, reuse, recycle—combined with robust policy frameworks and modern technology, including dynamic modeling for waste prediction and monitoring, ensures efficiency and environmental sustainability. Ultimately, Singapore's integrated approach emphasizes collaboration among government, communities, and the private sector, creating a resilient, inclusive, and sustainable waste management system that benefits both local residents and the broader environment. [36]

Government Strategies for Achieving Effective Integrated Waste Management Policies

Normative hurdles in integrated waste management stem from insufficient community awareness and minimal participation in fostering environmental sustainability. Residents often discard rubbish improperly, disregarding established restrictions and public awareness initiatives. Numerous individuals regard garbage sorting as cumbersome and yielding negligible immediate advantages, thereby obstructing behavioral modification in the absence of incentives or comprehensive training initiatives. The collection of waste fees is frequently overlooked or postponed owing to inadequate information, apathy, or poor oversight, so affecting municipal waste management processes. As a result, the availability of consistent waste collection services and sufficient processing facilities is limited. Governments must implement deliberate and comprehensive actions to tackle these concerns. Ongoing educational initiatives can improve community awareness of effective waste management and promote adherence to trash segregation protocols.[37]

Collaboration with community leaders, environmental organizations, and local media enhances citizen participation and promotes compliance with normative norms. The integration of teaching campaigns with explicit enforcement measures and incentives for compliance behavior enhances the efficacy of waste management systems. Establishing community-based programs, including recycling centers and waste banks, fosters active engagement, diminishes waste volume, and advances cleaner and more sustainable living conditions. In peripheral residential regions, insufficient community engagement markedly undermines the efficacy of integrated waste management execution. A deficiency in comprehension of sustainable waste practices compromises regulation adherence, while the belief that waste management is exclusively the government's obligation diminishes engagement.[38]

Inadequate monitoring and enforcement methods intensify these problems, while ingrained societal practices render the assimilation of new waste management norms a slow process. Ongoing, captivating, and contextually relevant instruction is crucial for fostering behavioral change and enhancing normative compliance. To surmount normative obstacles, authorities must adopt a comprehensive strategy that include ongoing education, uniform enforcement, transparency in resource allocation, and proactive community engagement. Utilizing principles from participation theory and legal efficacy, policymakers can create measures that improve citizen involvement and guarantee adherence to waste management legislation. The integration of these measures allows border residential communities to fulfill

[36] Bagus Andika Fitroh et al., "Pemberdayaan Warga Desa Bakipandeyan Kecamatan Baki Kabupaten Sukoharjo Jawa Tengah Dalam Pengelolaan Pemilahan Sampah Organik Dan Anorganik Sebagai Upaya Menciptakan Masyarakat Yang Bersih Terhadap Lingkungan," *Inovasi Jurnal Pengabdian Masyarakat* 2, no. 1 (2024): 19–24, https://doi.org/10.54082/ijpm.363.

[37] Moch Lukmanul Hakim et al., "Pengaruh Pengetahuan Teknis, Komitmen Manajemen, Dan Sumber Daya Terhadap Kualitas Pengukuran Kinerja Pemerintah Daerah," *JURISMA : Jurnal Riset Bisnis & Manajemen* 11, no. 1 (2021): 78–96, https://doi.org/10.34010/jurisma.v11i1.4302.

[38] Jade Megan Chisholm et al., "Sustainable Waste Management of Medical Waste in African Developing Countries: A Narrative Review," *Waste Management and Research* 39, no. 9 (2021): 1149–63, https://doi.org/10.1177/0734242X211029175.

the goals of integrated waste management, fostering settings that are clean, healthy, and sustainable for both present and future generations.[39] Sociological obstacles in integrated waste management inside the border residential zones of Surakarta predominantly stem from insufficient public understanding of the significance of sustainable waste management. Interviews with representatives from the Surakarta Environmental Agency reveal that citizens often lack awareness of the detrimental effects of incorrect trash disposal on health and the environment. This disparity indicates inadequate and erratic educational outreach, especially in densely populated regions and communities with restricted access to information.[40]

In numerous peripheral communities, inhabitants persist in viewing waste management as exclusively a governmental obligation, which hinders active engagement in garbage segregation and disposal procedures. Field officers indicate that a considerable percentage of residents are still unaware of the tenets of 3R (Reduce, Reuse, Recycle). Despite the government's implementation of socialization initiatives, such as waste sorting training and the establishment of waste banks, the coverage of these programs remains inconsistent. The lack of active involvement from local community leaders, who could serve as catalysts for behavioral change, intensifies these issues. Community leaders have observed that changing deep-seated beliefs that view waste as a technical issue instead of a shared obligation constitutes a significant obstacle in advancing sustainable practices. [41]

Economic limitations also add to sociocultural obstacles. Low-income families sometimes prioritize immediate survival needs over sustainable waste practices, hence reducing their participation in trash management projects. The socioeconomic conditions provide considerable obstacles for local administrations in establishing comprehensive and sustainable waste management systems. Participants advocate for the augmentation of socialization initiatives via community-oriented strategies, the engagement of local media, and the proactive participation of community leaders, educational entities, and environmental organizations to bolster collective knowledge and accountability.[42]

Theoretical frameworks, such as ecological justice and legal compliance theories, offer analytical instruments to comprehend these sociocultural obstacles. Ecological justice underscores the fair allocation of environmental resources and responsibilities. Inhabitants of border regions often encounter environmental disparities owing to insufficient access to appropriate waste management services, including temporary disposal sites and garbage collection systems. This unequal allocation exacerbates environmental pressures and diminishes community engagement in integrated waste management initiatives. To resolve this issue, authorities must provide fair access to facilities and information while promoting active community engagement during program planning, implementation, and assessment to encourage ownership and communal accountability.
Theory of legal compliance emphasizes that citizens' conformity to regulations is contingent upon their comprehension of the laws, sense of their equity, and the efficacy of enforcement. In border regions, inadequate adherence to waste management requirements arises from a lack of awareness of obligations, insufficient dissemination of local ordinance No. 4 of 2022, and beliefs that the restrictions are inequitable or unworkable. Inadequate oversight and

[39] Elin Slätmo, Kjell Nilsson, and Eeva Turunen, "Implementing Green Infrastructure in Spatial Planning in Europe," *Land* 8, no. 4 (2019), https://doi.org/10.3390/land8040062.
[40] B. Faisal et al., "Analysis of Green Infrastructure Development Policy in Indonesia: An Adaptive Strategy for Sustainable Landscape Development," *IOP Conference Series: Earth and Environmental Science* 1092, no. 1 (2022), https://doi.org/10.1088/1755-1315/1092/1/012013.
[41] Feng Li et al., "Urban Ecological Infrastructure: An Integrated Network for Ecosystem Services and Sustainable Urban Systems," *Journal of Cleaner Production* 163 (2017): S12–18, https://doi.org/10.1016/j.jclepro.2016.02.079.
[42] Hasan Hasan Takbiran Takbiran, "Bank Sampah Sebagai Alternatif Strategi Pengelolaan Sampah Menuju Sentul City Zero Emission Waste Kabupaten Bogor," *IJEEM - Indonesian Journal of Environmental Education and Management* 5, no. 2 (2020): 165–72, https://doi.org/10.21009/ijeem.052.05.

constrained governmental resources diminish the perceived repercussions for noncompliance, hence weakening people' commitment to appropriate waste management procedures. [43]

Addressing sociocultural barriers necessitates a comprehensive approach that include ongoing education, equal access to waste management resources, transparent and inclusive policies, and constant enforcement alongside educational support. Policymakers can boost community engagement, improve normative adherence, and accomplish sustainable integrated waste management in the border residential neighborhoods of Surakarta by amalgamating the ideas of ecological justice and legal compliance. Structural impediments in integrated waste management in Surakarta include interconnected variables, from regulatory deficiencies to insufficient supporting infrastructure. Interviews with representatives from the Surakarta Environmental Agency indicate that a significant challenge is the erratic enforcement of waste management standards [44]

Authorities often overlook to impose punishments on residents who inappropriately dispose of rubbish or fail to pay waste fees punctually. The absence of constant enforcement undermines deterrent, permitting disorderly waste management practices to continue. Collaboration among institutions engaged in waste management is a considerable difficulty. Communication among governmental agencies, business companies, and community groups frequently lacks coordination, hindering the execution of programs intended to facilitate integrated waste management. For example, inadequate coordination in the procurement and administration of trash sorting facilities at the sub-district level has led to underutilization and diminished efficacy of these resources. Interviews with municipal officials reveal that the inadequate availability of waste processing facilities, such as sorting stations, integrated waste processing centers, and collection trucks, represents a significant limitation from an infrastructure standpoint. Current sorting facilities are inadequate to handle the ever rising volume of waste, and limited staffing diminishes the efficiency of collection and cleaning operations. The infrastructure shortcomings impede the overall efficacy of garbage management in the city. [45]

Structural impediments in border residential zones in Surakarta can be examined through the frameworks of community participation theory and legal compliance theory. Insufficient facilities, including temporary disposal sites and trash transportation systems, hinder citizens' compliance with waste management requirements. Policies lacking adequate infrastructure diminish the practical efficacy of these restrictions. Theory of community participation underscores the significance of active public involvement in environmental initiatives; nonetheless, participation rates in border regions are low due to restricted access to information and insufficient inclusion in policy formulation and assessment. Residents who perceive limited access to facilities frequently disregard obligations such garbage separation or fee payment, suggesting that public participation is significantly influenced by trust in the system and comprehension of sustainable waste management. Structural hurdles in integrated waste management reveal a dynamic interplay between infrastructural constraints and insufficient community engagement, which directly impacts policy efficacy. By synthesizing insights from community engagement and legal compliance theories, policymakers can formulate targeted policies to address these structural constraints and

[43] I Gusti Ayu Ketut Rachmi Handayani, "Pembentukan Peraturan Daerah Berbasis Lingkungan Dalam Rangka Mewujudkan Praktik-Praktik Good Governance Di Daerah," *Yustisia Jurnal Hukum* 2, no. 1 (2013): 66–73, https://doi.org/10.20961/yustisia.v2i1.11072.

[44] Yosmina Waliki, Ihwan Tjolli, and Hugo Warami, "Perilaku Masyarakat Dalam Mengelola Sampah Rumah Tangga Di Distrik Manokwari Timur Kabupaten Manokwari," *Cassowary* 3, no. 2 (2020): 127–40, https://doi.org/10.30862/casssowary.cs.v3.i2.59.

[45] Hamsiah and Sugeng Nuradji, "Edukasi Pemilahan Sampah Berbasis Masyarakat Sebagai Media Reduce Sampah Ke TPA Di Kelurahan Talise," *Jurnal Kolaboratif Sains* 6, no. 4 (2023): 371–79, https://doi.org/10.56338/jks.v6i4.3473.

attain sustainable waste management results in the border residential neighborhoods of Surakarta. [46]

Conclusion

The Regional Regulation on Integrated Waste Management in border residential areas of Surakarta demonstrates significant potential in achieving more structured, sustainable, and efficient waste management. The regulation addresses not only technical aspects, such as waste separation and infrastructure provision, but also emphasizes the critical role of community participation through education, socialization, and community-based programs, including waste banks and recycling initiatives. Effective implementation requires cross-sector coordination among government institutions, communities, and private stakeholders to address local challenges, such as policy variations across neighboring areas. Adopting the principles of Reduce, Reuse, and Recycle, alongside modern technological applications, plays a central role in minimizing the negative environmental and health impacts of waste. Active community involvement combined with consistent regulatory enforcement enables the framework to foster cleaner environments while supporting local economic empowerment through circular economy practices. Comparative analysis of integrated waste management in border residential areas in Germany, Japan, and Singapore highlights the effectiveness of a holistic approach that integrates policy, infrastructure, and public participation. Germany emphasizes rigorous waste separation and modern processing facilities to support recycling, Japan prioritizes inter-city collaboration and the application of technological innovations in waste management, and Singapore demonstrates the success of implementing the 3R principles and public awareness campaigns, such as "Say Yes to Waste Less," to enhance citizen engagement. Collectively, these cases illustrate that effective waste management requires coordinated policy frameworks, robust infrastructure development, and active community support to establish sustainable and efficient systems, even in border areas facing cross-jurisdictional challenges.

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