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Strengthening Household Solid Waste Management in Sierra Leone: Lessons from South Korea and Indonesia

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Abstract

Household solid waste (HSW) generation and its illegal disposal pose significant challenges to Sierra Leone, leading to public health and environmental harm. While municipal by-laws are implemented to deal with HSW in Sierra Leone, existing literature shows significant inadequacies in these laws. This paper employs normative legal research to examine the relevant laws in Sierra Leone and their adequacy and discusses related laws in South Korea and Indonesia. The findings reveal significant areas for improvement in Sierra Leone's laws, regulations, and policies pertaining to HSW, such as the absence of specific provisions to address HSW and the non-binding nature of existing provisions. Observing the relevant laws and measures in South Korea and Indonesia could significantly improve Sierra Leone's waste laws, leading to better HSW minimization. The proposed measures include establishing clear and specific laws and regulations for HSW management, implementing stricter penalties for

HSW violations, promoting public awareness and education on waste reduction and recycling, and providing incentives for waste reduction and recycling. By doing so, Sierra Leone can improve public health, protect the environment, and promote sustainable development.

KEYWORDS *Household solid waste, Legislation, Sierra Leone, South Korea, Indonesia*

Introduction

As the world continues to urbanize at an unprecedented pace, HSW, a significant by-product of urban lifestyles, is increasing even faster.[1] Decades ago, the 2.9 billion urban residents generated approximately 0.64 kg of municipal solid waste per person per day, equivalent to 0.68 billion tonnes per year. However, this figure is expected to surge significantly, especially in Asia and Africa. By 2025, there will be 1.42 kg of municipal solid waste per capita daily, translating to 2.2 billion metric tonnes annually.[2] The high magnitude of unregulated and uncollected HSW is a crucial indicator of rapid urban concentration and planning challenges, particularly in developing countries, which affect sustainable development.[3] According to Hettiarachchi et al., these problems and difficulties indicate a need for more effective institutional, legislative, and participatory approaches.[4] Hanim Kamaruddin et al. stated that a crucial first move in effectively implementing legal strategies for plastic waste governance in both nations is to enhance the governing framework and foster a legal culture of plastic waste management.[5]

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1 Sondh, Sidhartha, et al. "A strategic review on Municipal Solid Waste (living solid waste) management system focusing on policies, selection criteria and techniques for waste-to-value." *Journal of Cleaner Production* 356 (2022): 131908.

2 Hoornweg, Daniel, and Perinaz Bhada-Tata. *What a Waste: A Global Review of Solid Waste Management*. World Bank Publications-Reports 17388 (2012).

3 Loukil, Faten, and Lamia Rouached. "Waste collection criticality index in African cities." *Waste management* 103 (2020): 187-197.

4 Machado, Cristian Rivera, and Hiroshan Hettiarachchi. "Composting as a municipal solid waste management strategy: lessons learned from Cajicá, Colombia." *Organic Waste Composting through Nexus Thinking: Practices, Policies, and Trends* (2020) 17–38.

5 Kamaruddin, Hanim, Farida Patittingi, Hasbi Assidiq, Siti Nurhaliza Bachril, and Nurul Habaib Al Mukarramah. "Legal aspect of plastic waste management in Indonesia and Malaysia: Addressing marine plastic debris." *Sustainability* 14, no. 12 (2022): 6985.

According to Siolpakaza, an urban development specialist at the World Bank, unmanaged waste and improper disposal practices have significant health and environmental consequences. The cost of mitigating these impacts is often far greater than the cost of developing and operating basic, adequate waste management systems. Since 2000, the World Bank has invested more than $4.7 billion in over 340 solid waste management programs worldwide, emphasizing the importance of implementing sound waste management practices to ensure environmental and public health protection.[6] Effective waste management systems and establishing sound solid waste legislation have numerous advantages.[7] For example, a conducive environment promotes public health, enhances economic activities, and creates an aesthetically pleasing atmosphere.[8] Despite the numerous factors (legal and non-legal) affecting HSW in Sierra Leone, a sound legal framework plays a vital role in regulating activities leading to waste generation. According to Aparcana, policy obstacles account for 75% of the mismanagement of solid waste in developing countries.[9]Thus, regulations should encompass comprehensive oversight over waste management (including generation, storage, collection, transportation, and disposal of solid waste).[10]

Going further, the unchecked accumulation of HSW in Sierra Leone has become a significant concern for public health.[11] In 2021, the Freetown capital city generated an estimated 550,000 tonnes of municipal solid waste.[12] This

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6 Onyi-Ogelle, Obioma Helen, And Deborah Nwosu. "Addressing The Menace of Waste Through Environmental Legislation in Nigeria." *International Review of Law and Jurisprudence (IRLJ)* 2, no. 2 (2020).

7 Muheirwe, Florence, Wilbard Kombe, and Jacob M. Kihila. "The paradox of solid waste management: A regulatory discourse from Sub-Saharan Africa." *Habitat International* 119 (2022): 102491.

8 Ike, C. C., et al. "Solid waste management in Nigeria: problems, prospects, and policies." *The Journal of Solid Waste Technology and Management* 44, no. 2 (2018): 163-172.

9 Aparcana, Sandra. "Approaches to formalization of the informal waste sector into municipal solid waste management systems in low-and middle-income countries: Review of barriers and success factors." *Waste Management* 61 (2017): 593–607.

10 Siebel, Maarten Alexander, Vera Susanne Rotter, Agnes Nabende, and Joyeeta Gupta. "Clean Development Mechanism Way to Sustainable Waste Management in Developing Countries." *Österreichische Wasser-und Abfallwirtschaft* 65, no. 1-2 (2013): 42-46.

11 Elamin, Mohamed Osman, Mary Achol William, Hatim Rahamtalla, and Hatim A. Natto. "Assessment of Households' Practices towards Solid Waste Management." *International Journal of Public Health and Health Sciences* 3, no. 2 (2021): 13-23.

12 Komba, Tamba. "Assessment of municipal solid waste management for better-quality public health and environmental sustainability in the Freetown Metropolitan City in Sierra Leone." *Journal of Geoscience and Environment Protection* 9, no. 04 (2021): 33.

figure will increase significantly to over 1,000 tonnes per day by 2030 and 2,000 by 2050.[13] Consequently, local councils must take proper action and practical measures against unmanaged waste; unfortunately, due to limitations and irregularities, many major residential areas do not receive waste services, and most services are carried out at a basic level.[14] Moreover, existing literature indicates that most of these wastes still need to be regulated, and the waste management laws need to be revised.[15]

This paper examines the legal approaches the three countries have taken to address and deal with the issue. The study will also analyze the experience of South Korea and Indonesia in dealing with HSW by examining their relevant waste management legislation. Finally, based on the findings, the paper will provide recommendations to improve the HSW legal framework in Sierra Leone. The first part describes the relevant laws dealing with the problems of HSW in Sierra Leone. The second part explains the legal approaches South Korea and Indonesia have implemented to combat and address HSW. Lastly, the third part will analyze how strengthening the legal system can be a way forward to resolving the issue surrounding HSW in Sierra Leone.

The authors employed a normative-legal approach, utilizing a statutory method to review relevant materials on HSW management in Sierra Leone, South Korea, and Indonesia. This study examined and assessed primary legal materials derived from relevant laws and regulations and secondary legal sources from literature about the three countries. The objective was to unveil the prevailing issues surrounding HSW in Sierra Leone and recommend potential solutions and improvements drawn from the legal frameworks of South Korea and Indonesia. An additional analysis of various secondary legal materials provides a comprehensive understanding of the current state of HSW management in Sierra Leone and its municipal laws. This included examining journal articles and statistical records documenting the extent of HSW generation and the challenges associated with unmanaged waste. These supplementary sources aimed to provide a more robust and detailed description of the HSW situation in Sierra Leone.

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[13] Jalloh, Mohamed Yayah, Wan Siti Adibah Wan Dahalan, and Rasyikah Md Khalid. "Environmental Awareness and Public Participation: A Driving Force for Environmental Protection in Sierra Leone." *Malaysian Journal of Social Sciences and Humanities (MJSSH)* 7, no. 11 (2022): e001989-e001989.

[14] Peters, Krijn. "Sierra Leone." In *Africa Yearbook Volume 18*, pp. 178–184. Brill, 2022.

[15] Jalloh, M. Y. "A Study of the Law and Policy on Abatement and Control of Marine Pollution in Sierra Leone" (Master's thesis, Ahmad Ibrahim Kulliyyah of Laws, International Islamic University Malaysia, 2017).

Sierra Leone Waste Management Laws

Sierra Leone is a country on the West African coast, covering an area of 71,740 square kilometers.[16] Sierra Leone is renowned for its abundant natural resources, including forests, biodiversity, wetlands, extensive fisheries, and mineral deposits like diamonds, gold, iron ore, bauxite, and other valuable resources.[17] The history of Sierra Leone has resulted in a pluralistic legal system consisting of general, customary, and Islamic Law.[18] Despite the country's beautiful and resilient environment, environmental degradation has been an ongoing issue since the 1990s, leading to massive deforestation, animal extension, pollution and more. As a result, it is imperative to examine the legal response to environmental concerns, specifically regarding HSW management.[19] Rodi'c and Wilson argued that a solid and reliable regulatory framework is indispensable for establishing sustainable waste management practices.[20] This may subsume a plethora of written and unwritten norms, including policies, rules, guidelines, by-laws, values, and norms. Considering the discussions surrounding the impact of regulation on behavior, it is assumed that both formal and informal regulations should be capable of promoting improved practices in HSW management in Sierra Leone.[21]

A practical regulatory approach to house solid waste management should include reactive and proactive approaches. Reactive policies may include inspecting practices and issuing commands, while proactive measures prioritize

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16 Environmental Performance Index, Country ranking http://archive.epi.yale.edu/epi/country-rankings, 2014

17 Engwicht, Nina, and Christina Ankenbrand. "Natural resource sector reform and human security in post-conflict societies: Insights from diamond mining in Sierra Leone." *The Extractive Industries and Society* 8, no. 4 (2021): 100988.

18 Joko Smart, H. M. "The place of Islamic law within the Sierra Leone legal system framework." *The Journal of Legal Pluralism and Unofficial Law* 12, no. 18 (1980): 87–102.

19 Das, Shruti, and Deepshikha Routray. "Climate Change and Ecocide in Sierra Leone: Representations in Aminatta Forna's Ancestor Stones and The Memory of Love." *eTropic: Electronic Journal of Studies in the Tropics* 20, no. 2 (2021): 221–239.

20 Rodić, Ljiljana, and David C. Wilson. "Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries." *Sustainability* 9, no. 3 (2017): 404.

21 Rodić and Wilson.

raising awareness to foster compliance.[22] It is widely recognized that waste regulation has been adapting to the global agenda, shifting its focus from waste disposal to waste reduction.

The SDGs share the underlying motivations that have historically propelled the advancement of HSW initiatives. These motivations primarily encompass public health, environmental considerations, and the value of resources. Notably, more recently, climate change and inclusivity have been added as driving forces.[23] Several centuries ago, the primary impetus for early endeavors to establish solid waste collection systems in cities worldwide stemmed from the imperative to safeguard public health.[24] Numerous cities and towns established certain levels of services for their residents in previous years. However, in recent decades, many of these urban areas, particularly in developing countries, have needed help in coping with the increasing volumes of waste generated.[25] As a result, addressing the global waste crisis through sound legislation, the provision of accessible, safe, and affordable solid waste collection services for everyone, and eradicating unregulated dumping and open burning would make a significant contribution to achieving sustainable development as outlined by the SDGs.

Acknowledging this global problem, SDG Target 11.6 provides: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management". Also, Sustainable Development Goal 6, which focuses on water and sanitation, explicitly tackles the problem of waste dumping in its Target 6.3: "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling

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[22] Bhushan, Chandra, Swati Singh Sambyal, D. D. Basu, and Sonia Devi Henam. "Integrated Waste Management Policy and Legislation for African Nations, 2017." *Conservation and Recycling* 47 (2006): 222–244.

[23] Wilson, David C. "Development drivers for waste management." *Waste Management & Research* 25, no. 3 (2007): 198–207.

[24] Barles, S. "History of Waste Management and the Social and Cultural Representations of Waste". In *World Environmental History; Encyclopedia of Life Support Systems* (EOLSS), UNESCO: Paris, France, 2007. Available Online: http://www.eolss.net/sample-chapters/c09/e6-156-16-00.pdf (accessed on December 1, 2016).

[25] Nonor, D. *Shame: Cholera Lurks as Accra Wallows in Filth.* The Chronicle (Ghana). June 2, 2014. Available online: http://thechronicle.com.gh/shame-cholera-lurks-as-accra-wallows-in-filth/ (accessed on February 16, 2017)

and safe reuse globally."[26] This will eventually protect the ecosystem and prevent environmental loss.[27]

The African Union Agenda 2063 places significant emphasis on recycling at least 50% of urban waste and establishing supportive policies for the growth of recycling industries by 2030.[28] Most importantly, these regional goals must align with the SDGs. Despite pertinent legislation in various countries, the practical implementation of waste management measures is insufficient in numerous locations, leading to a lack of accessible waste collection services for all residents. This situation arises for various reasons, including inadequate capacities of responsible authorities, insufficient political commitment and support, reluctance or inability of service users to pay, and, in certain instances, the absence of local legislation enabling engagement with other stakeholders. Nevertheless, most African countries, including Sierra Leone, still need to implement the required and necessary legislation, while the fewer countries that have developed the needed laws (such as South Africa and Senegal) have been challenging.[29] Many factors contribute to this situation, encompassing inadequate capacities of responsible authorities, insufficient political commitment and support, service users' lack of willingness and ability to pay, and, in some instances, the absence of enabling local legislation to engage other stakeholders.[30]

Sierra Leone must improve its efforts to ensure a healthy, habitable and conducive environment for its citizens. According to the Environmental Performance Index (EPI) 2010, Sierra Leone ranked last out of 163 countries, indicating a critical concern for its citizens' environmental and public health due to continuous degradation.[31] Also, in 2020, the Environmental Performance Index (EPI) 2020 ranked 177th out of 180 countries and

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[26] Nonor.

[27] Putro, Widodo Dwi, and Adriaan W. Bedner. "Ecological Sustainability from a Legal Philosophy Perspective." *Journal of Indonesian Legal Studies* 8, no. 2 (2023): 595-632.

[28] Aniche, Ernest Toochi. "African Continental Free Trade Area and African Union Agenda 2063: the roads to Addis Ababa and Kigali." *Journal of Contemporary African Studies* (2020): 1-16.

[29] Bello, Ibrahim Adebayo, Muhamad Norshafiq bin Ismail, and Nassereldeen A. Kabbashi. "Solid Waste Management in Africa: A Review". *International Journal of Waste Resources* 6, no. 2 (2016): 1000216.

[30] Bello, Ismail, and Kabbashi.

[31] Yale Center for Environmental Law & Policy. *Environmental Performance Index 2010*. Yale University. (New Haven: YCELP, 2010).

remained below the regional average.[32] This poor ranking reflects the country's continued struggle with environmental degradation, including HSW management. This underscores the importance of a legal response to these concerns as a significant area of exploration for improving the current situation. This Legal response is driven by the imperative for the government and relevant environmental authorities to adopt legal and financial regulations and instruments to educate society and impose legal penalties for non-compliance. Furthermore, addressing environmental matters necessitates implementing measures that can foster a cultural shift and enhance public interest in preserving the environment for current and future generations, with a primary focus on educational endeavors, among other factors.[33]

To regulate and protect the environment, Sierra Leone demonstrated its international commitment by ratifying several international and regional conventions, including the Stockholm Convention of 2001, the Bamako Convention of 1998, the Basel Convention of 1989, and the United Nations Framework Convention on Climate Change.[34] These international environmental conventions cover various environmental issues, including climate change, deforestation, pollution, and biodiversity.[35] For instance, the Basel Convention of 1989 mandates contracting parties to prohibit dumping waste or matter in any form or condition except as otherwise specified. The convention further stipulates that dumping wastes or other matter listed in Annex I is prohibited while dumping wastes or other matter listed in Annex II requires a prior special permit. The convention also requires member states to adopt sound environmental measures to prevent HSW generation.[36]

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[32] En Annex Republic of Sierra Leone – European Union Multi-Annual Indicative Program 2021-2027

[33] Batista, Marcio, Rodrigo Goyannes Gusmão Caiado, Osvaldo Luiz Gonçalves Quelhas, Gilson Brito Alves Lima, Walter Leal Filho, and Ivany Terezinha Rocha Yparraguirre. "A framework for sustainable and integrated municipal solid waste management: Barriers and critical factors to developing countries." *Journal of Cleaner Production* 312 (2021): 127516.

[34] Coordinated Implementation of the Bamako, Basel, Rotterdam and the Stockholm Conventions in Sierra Leone. December 2016.

[35] Alhendi, Noor. "The Role of International Legislation in Protecting the Environment." *Journal of Environmental Management and Tourism (JEMT)* 13, no. 1 (57) (2022): 174–180.

[36] Borthakur, Anwesha. "Policy approaches on e-waste in the emerging economies: a review of the existing governance with special reference to India and South Africa." *Journal of Cleaner Production* 252 (2020): 119885.

Despite ratifying these crucial instruments, their domestication has been challenging due to financial, technical, and political reasons.[37] At the national level, Sierra Leone has implemented Acts and by-laws to address waste-related matters. The following discussion will explain Sierra Leone's legal approach to HSW management.

A. Environmental Protection Agency Act 2008

The Environmental Protection Agency Act 2008, as amended in 2011, is the principal environmental Law in Sierra Leone.[38] It is a comprehensive statute that covers various environmental matters in Sierra Leone and assigns the responsibility of enforcing environmental laws, regulations, guidelines, and standards to the Environmental Protection Agency (EPA).[39] The Act mandates the EPA to ensure compliance with environmental conventions, treaties, and protocols to which Sierra Leone is a signatory.[40] The Act empowers the Environmental Protection Agency to review and regulate environmental issues such as water and air quality, the control of harmful substances, and effluent limitations. Additionally, the Act prohibits the discharge of pollutants into Sierra Leone's environment.[41]

B. Waste Management By-laws

Local councils worldwide, particularly in developing nations, face a significant and urgent HSW management issue. The escalating urban population, technological advancements, and shifting consumption habits have

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[37] Jalloh, Mohamed Yayah, Wan Siti Adibah Wan Dahalan, and Rasyikah Md Khalid. "Environmental Awareness and Public Participation: A Driving Force for Environmental Protection in Sierra Leone." *Malaysian Journal of Social Sciences and Humanities (MJSSH)* 7, no. 11 (2022): e001989-e001989.

[38] Maconachie, Roy, and Felix Conteh. "Artisanal mining policy reforms, informality and challenges to the Sustainable Development Goals in Sierra Leone." *Environmental Science & Policy* 116 (2021): 38-46.

[39] Wilson, Sigismond A. "Measuring the effectiveness of corporate social responsibility initiatives in diamond mining areas of Sierra Leone." *Resources Policy* 77 (2022): 102651.

[40] Sankoh, Salieu Kabba, Josephus Choe Mamie, Alie Kamara, Zainab Amina Sankoh, and Paul A. Lamin. *Integrated Coastal Zone Management Plan for Sierra Leone 2016-2020.* (Brookfields, Freetown Sierra Leone: Environment Protection Agency–Sierra Leone, 2016).

Jalloh, Mohamed Yayah, Wan Siti Adibah Wan Dahalan, and Rasyikah Md Khalid. "Environmental awareness and public participation: A driving force for environmental protection in Sierra Leone." *Malaysian Journal of Social Sciences and Humanities (MJSSH)* 7, no. 11 (2022): e001989-e001989.

led to a considerable increase in the quantity and composition of HSW, posing a significant challenge for these councils.[42] According to Akinwe and Nwobodo, addressing fundamental concerns related to HSW management in developing countries presents a significant hurdle. Issues such as the safe disposal of waste become particularly challenging due to limited resources, inadequate treatment and disposal technologies, and a lack of necessary regulatory frameworks to enforce proper waste management practices.[43]

There are four contributing factors to the challenges faced in solid waste management. Firstly, suboptimal institutions need help to fulfill their duties and responsibilities in waste management effectively. Secondly, operational techniques need more optimization due to insufficient resources, such as limited budget allocations for waste management programs, inadequate capacity and expertise of human resources, and inadequate quantity and quality of waste infrastructure. Thirdly, enacting and implementing sound environmental laws vis-à-vis- waste laws, particularly those about HSW, remains suboptimal. Lastly, there is a lack of community participation in waste management efforts.[44] Furthermore, it is crucial to implement sustainable management practices for HSW to mitigate the negative consequences on the environment and human well-being. Such practices are pivotal in promoting sustainable development across three key dimensions: *the environment*, *the economy*, and *society*.[45]

A plethora of literature proposes that factors that hinder sustainable HSW management are: "public health; environmental protection; resource value of waste; closing the loop; institutional and responsibility issues, and public awareness."[46] Implementing HSW management policies positively affects

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[42] Dada, Abubakar Dauda, and Pınar Ulucay Righelato. "Assessment of Household Solid Waste Management Techniques in Nassarawa "A" Ward in Minna, Niger State, Nigeria." *European Journal of Sustainable Development* 11, no. 4 (2022): 217-217.

[43] Adamu, Muhammad Salisu, Imrana Bello, Buhari Idris, Malami Usman Muhammad, and Bashar Abdullahi Hadi. "Assessment of Physiochemical Properties and Heavy Metals Concentration of Municipal Solid Compost (MSWC): A Case Study in Sokoto Metropolis, Nigeria." *Open Access Library Journal* 10, no. 3 (2023): 1-12.

[44] Probandari, A. N., W. Setyaningsih, and H. S. Kasjono. "Implementation of environmental policy on solid waste management in Bondowoso Regency-Indonesia." In *Journal of Physics: Conference Series*, vol. 1465, no. 1, p. 012012. IOP Publishing, 2020.

[45] Khan, Intan Nadia Ghulam, Wan Siti Adibah Wan Dahalan, and Zulkifli Mohd Nopiah. "A survey on perceptions of legal and non-legal factors affecting sustainable solid waste management in Malaysia." *Akademika* 89 (2019): 41-51. *See also* Oktarina, Tri Nurmega, and Anisa Yulianti. "The role of women in sustainable development and environmental protection: A discourse of ecofeminisme in Indonesia." *Indonesian Journal of Environmental Law and Sustainable Development* 1, no. 2 (2022): 107-138.

[46] Khan, Dahalan, and Nopiah.

environmental quality and public health, resulting in cleaner, more beautiful, and more comfortable surroundings. The government or relevant authorities must implement sober HSW management regulations to ensure sustainable HSW minimization.[47] Legislation and policy are among the core factors that impact HSW management.[48], which are governmental instruments to improve HSW programs. According to Halvorsen, legislation can reinforce social norms, leading to social sanctions and feelings of guilt when the legislation is not adhered to by society.[49]

Sierra Leone aims to establish sustainable HSW management, as evidenced by passing waste by-laws. Nevertheless, various issues related to HSW management in Sierra Leone indicate that the passing of by-laws and the sustainable achievement of HSW solid waste in Sierra Leone are embryonic. The ineffective management of HSW demonstrates a need for more practical implementation of policies in this area.[50] According to Malaysia's Solid Waste and Public Cleansing Management Corporation, implementing effective, efficient, and advanced management practices is essential to sustainable solid waste management. These practices aim to ensure environmental sustainability, minimize resource usage, and protect the environment during the production and distribution stages. The goal is to minimize waste and increase the production of recycled materials.[51] Adopting the 2030 Agenda for Sustainable Development by United Nations Member States signifies a critical call to action for all nations, both developed and developing, to collaborate in a global partnership to achieve sustainable development.[52] When implementing waste management strategies, it remains crucial to prioritize the key objectives

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[47] Zhu, Huijia, et al. "The interactive influence of personal norm and policy measures on urban resident waste separation behaviour." *Journal of Material Cycles and Waste Management* 25, no. 4 (2023): 2012-2024.

[48] Ali, Hasnah, Dody Dermawan, Noraziah Ali, Maznah Ibrahim, and Sarifah Yaacob. "Masyarakat dan amalan pengurusan sisa pepejal ke arah kelestarian komuniti: Kes isi rumah wanita di Bandar Baru Bangi, Malaysia." *GEOGRAFIA Malaysia Journal of Society and Space* 8, no. 54 (2012): 64-75.

[49] Halvorsen, Bente. "Effects of norms and policy incentives on household recycling: An international comparison." *Resources, Conservation and Recycling* 67 (2012): 18–26.

[50] Abas, Muhamad Azahar, and Seow Ta Wee. "Sustainable solid waste management in Malaysia: The concept of multi-stakeholder governance in solid waste policy implementation." *Public Policy and Administration Research* 4, no. 10 (2014): 26-35.

[51] SW Corp (Written response by the SW Corp through its officer, Mohamed Nur Shafiq bin Mohamed Hanif, Engineer, Domestic Waste and Public Cleansing Division, SW Corp.) February 19, 2016.

[52] Hák, Tomáš, Svatava Janoušková, and Bedřich Moldan. "Sustainable Development Goals: A need for relevant indicators." *Ecological Indicators* 60 (2016): 565-573.

outlined in the SDGs. These objectives include ensuring the quality of infrastructure (Goal 9), promoting sustainable cities and communities (Goal 11), encouraging sustainable consumption and production (Goal 12), and fostering partnerships for achieving the goals (Goal 17).[53] These goals should be central considerations when adopting waste management strategies.

Environmental management and sanitation in Sierra Leone are assigned to the local councils.[54] Assistant Environmental Health Officers are given to the committees to provide expert advice and training to council staff on waste removal and disposal. In addition, the councils have enacted by-laws and waste management strategy plans to regulate municipal solid waste generation and disposal.[55] For example, the Freetown City Council has passed the Prohibited Use of Public Places 2014 by-laws and the Nuisance 2014 by-laws to regulate activities that are harmful to the environment and public health. The Prohibited Use of Public Places 2014 by-laws prohibit the Act of littering in public places, while the Nuisance 2014 by-laws require that all neighborhoods be kept clean. The by-laws also prohibit all companies, businesses, and trading activities from causing an unhealthy stench or producing harmful dust within the Freetown municipality. Violations of any provision under these by-laws carry a sanction of a fine and imprisonment.[56]

The Koidu City Council has taken steps to create a healthy environment for citizens by drafting the 'Koidu New Sembehun City Council (KNSCC) Community By-laws for Waste Management 2020'. The by-laws aim to make Koidu the cleanest city in Sierra Leone and regulate activities that pollute the environment, such as illegal dumping and using premises to accumulate waste. Furthermore, the by-law requires all HSW to be deposited in appropriate containers as the relevant authority prescribes. Additionally, households are encouraged to subscribe to the Klin Koidu East or Klin Koidu West scheme, which the Koidu New Sembehun City Council authorizes to collect HSW for a fee or use skip and collection services provided by the council.[57]

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[53] Dada, Abubakar Dauda, and Pınar Ulucay Righelato. "Assessment of Household Solid Waste Management Techniques in Nassarawa "A" Ward in Minna, Niger State, Nigeria." *European Journal of Sustainable Development* 11, no. 4 (2022): 217-217.

[54] Dada, and Righelato.

[55] Ngegba, Andy Otis, and Akopon J. Bertin. "Assessment of the energy potential of municipal solid waste (MSW) in Freetown, Sierra Leone." *Open Access Library Journal* 7, no. 1 (2020): 1-15.

[56] "FCC - Freetown City Council." Accessed June 2, 2023. https://fcc.gov.sl/bye-laws/.

[57] Draft Koidu New Sembehun City Council (KNSCC) Community By-laws for Waste Management 2020.

C. Integrated National Waste Management Strategic Plan for Bo City 2012-2016

Bo City is the largest city in Sierra Leone after the Freetown capital. According to the research, no enacted or published by-laws exist on HSW management in this part of the country. Nonetheless, the Bo City Council formulated an Integrated National Waste Management Strategic Plan 2012-2016. The Integrated National Waste Management Strategic Plan for Bo City 2012-2016 aims to (i) protect the environment and public health from HSW and (ii) ensure efficient waste management. (iii) to promote waste minimization, reuse, and recycling.[58]

D. Kenema and Makeni Cities Policy Framework

The Kenema and Makeni City Councils need help addressing HSW management in their cities. According to the existing policy framework, both cities are constrained by several factors, such as the lack of effective management of HSW, the absence of a documented waste management plan with clear goals and objectives, and the absence of a policy framework to guide waste management efforts.

South Korea Waste Legislation

The Republic of Korea is on the Korean Peninsula, stretching 1,100 kilometers from north to south. Despite its relatively small land area of 223,343 km2, excluding the Demilitarized Zone (DMZ), the country is home to a significant population estimated to be around 51,378,271 as of December 25, 2022. Thanks to its location and four distinct seasons, Korea has diverse natural habitats and rich biodiversity, and 65.4% of its land is covered with forests and trees.[59] The Republic of Korea's Constitution provides a legal framework for environmental protection. Article 35 of the Constitution stipulates the need to establish the Framework Act on Environmental Policy (FAEP), which provides the foundation for Korean environmental policy and the fundamental principles of Korean environmental Law.[60]

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[58] Strengthening Capacities for an Integral Waste Management System in Bo City, Waste Management Plan 2020.

[59] Lee, Sang-hun. "Policies for sustainable resources management in the Republic of Korea." *Ministry of Environment, Seoul* (2009).

[60] Dull, Paul S. "South Korean Constitution." *Far Eastern Survey* 17, no. 17 (1948): 205-207.

The FAEP sets out the purpose of Korean environmental policy: to preserve a healthy environment for current and future generations and contribute to global environmental protection efforts. The FAEP also provides guidelines for interpreting the environmental rights of citizens and the obligations of the state, as well as relevant legal principles.[61] The Environmental Preservation Act, enacted in 1978, was Korea's first comprehensive environmental protection legislation.[62] It aimed to tackle various environmental issues and established guidelines for the disposal of waste and emissions. The Act also provided for the development of waste disposal and monitoring mechanisms and administrative penalties for non-compliance.[63]

South Korea has implemented a sustainable waste management strategy since the 1990s, focusing on demand-side management to reduce waste generation at the source.[64] Several new policy measures have been implemented to limit waste generation before disposal.[65] The Waste Control Act, first enacted in 1986 and revised in 2007, and the Act on Promotion of Saving and Recycling of Resources, first enacted in 1992 and updated in 2008, are the governing legislation on waste management in South Korea.[66] The Waste Control Act establishes the Basic Framework for waste management in South Korea, including waste classification, national and local government and citizen responsibilities, standards and norms for waste disposal and treatment methods.

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61 Bayarsaikhan, Tsolmon, Moon-Hyun Kim, Hee Jin Oh, and Tae-Hyoung Tommy Gim. "Toward sustainable development? Trend analysis of environmental policy in Korea from 1987 to 2040." *Journal of Environmental Planning and Management* 66, no. 8 (2023): 1640-1654.

62 Nam, Sangmin. "The Legal Development of the Environmental Policy in the Democratic People's Republic of Korea." *Fordham International Law Journal* 27, no. 4 (2003): 1322-1343.

63 Amsden, Alice Hoffenberg. *Asia's next giant: South Korea and late industrialization*. Oxford University Press, USA, 1989.

64 Massoud, M. A., et al. "Environmental Management System (ISO 14001) certification in developing countries: challenges and implementation strategies." *Environmental Science & Technology* 44, no. 6 (2010): 1884-1887.

65 Song, Young-Il, and John Glasson. "A new paradigm for Environmental Assessment (E.A.) in Korea." *Environmental Impact Assessment Review* 30, no. 2 (2010): 90-99.

66 Yang, Won-Seok, Jun-Kyung Park, Se-Won Park, and Yong-Chil Seo. "Past, present and future of waste management in Korea." *Journal of Material Cycles and Waste Management* 17 (2015): 207-217.

Additionally, the Act requires the Minister of Environment to submit a master plan for proper waste management.[67]

In March 2002, the Ministry of Environment (MOE) developed the 2nd Comprehensive National Waste Management Plan (2002–2011), a national framework plan.[68] The plan aims to establish a sustainable and resource-circulating socio-economic base. To achieve this goal, significant policy areas to be addressed include the promotion of waste reduction policies, the increased use of waste resources, and the safe treatment and strengthened management of waste materials.[69]

A. Waste Control Act 1986

The Waste Control Act is the primary legislation governing waste-related matters in South Korea.[70] Its objective is stated in Article 1, which aims to contribute to environmental conservation and enhance the quality of life by reducing waste to the maximum extent possible, treating waste generation to the maximum extent possible, and treating generated wastes in an environmentally friendly manner. The Act defines waste as "*garbage, burnt refuse, sludge, waste oil, alkali, and carcasses of animals that are no longer useful for human life or business activities*." According to this Act, an object is classified as waste if the holder intends to dispose of it, even if it has value and is saleable. The object is still considered waste if the initial discharger does not require it.[71]

Each local government in South Korea is responsible for treating HSW and is not required to report on the discharge of such waste. However, while unlawful dumping of industrial waste is subject to criminal penalties, the dumping of HSW results in the imposition of administrative fines under Articles 63(i) and 68(3)(i) of the Waste Control Act.[72] This Act contains

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[67] Cho, Pan-Ki, and Syung-Uk Lee. *Modularization of Korea's Development Experience: Waste Resources Management and Utilization Policies of Korea 2016.* (Korea: Ministry of Strategy and Finance, Republic of Korea, 2016).

[68] Jang, Yong-Chul, Gain Lee, Yuree Kwon, Jin-hong Lim, and Ji-hyun Jeong. "Recycling and management practices of plastic packaging waste towards a circular economy in South Korea." *Resources, Conservation and Recycling* 158 (2020): 104798.

[69] Jang, Lee, Kwon, Lim, and Jeong.

[70] Cheong, Hoe-seog. *Pricing for municipal solid waste disposal in Korea*. CSERGE, School of Environmental Sciences, University of East Anglia, 1995.

[71] Cheong.

[72] Patil, Rashmi Anoop, and Seeram Ramakrishna. "A comprehensive analysis of e-waste legislation worldwide." *Environmental Science and Pollution Research* 27 (2020): 14412–14431.

numerous provisions that govern the management of HSW.[73] Article 3-2, which outlines the 'Basic Principles of Waste Management,' stipulates that (1) every business must reduce waste generation and minimize waste discharge by recycling, and (2) every person must take appropriate measures before discharging waste to prevent harm to public health. Additionally, subsection 4 of this section places responsibility on anyone who pollutes the environment by discharging waste to bear the expenses incurred in restoring the damage caused by such pollution.

Article 7 of the Act mandates that all citizens reduce waste generation and recycle waste to keep the natural and living environment clean. Furthermore, subsection 2(7) requires every owner, occupant, and manager of parcel land or building to keep their respective property clean.[74] The Act, in Article 8, prohibits waste dumping and, under subsection 2(8), requires each household waste discharger to separate all untreated HSW and keep them separately according to type, nature, and condition, as prescribed by the ordinance of the competent particular self-governing city. Additionally, article 15 enumerates some of the obligations regarding the discharge of food waste. Subsection 1 mandates that any person specified by presidential decree, among others, who discharges large quantities of food waste must comply with rules prescribed by the ordinance of the competent particular self-governing city to restrain the generation of food wastes and adequately treat such wastes.[75]

B. The Act on the Promotion of Saving and Recycling of Resources

The Act on the Promotion of Saving and Recycling of Resources was enacted in 1993 to achieve various objectives, including conserving the environment, promoting the efficient use of resources, deterring waste generation, and contributing to continued economic growth and enhancement

[73] Herrador, Manuel, Wil de Jong, Kiyokazu Nasu, and Lorenz Granrath. "Circular economy and zero-carbon strategies between Japan and South Korea: A comparative study." *Science of The Total Environment* 820 (2022): 153274.

[74] Leong, Seng-Yi, Siang-Yin Lee, Thiam-Young Koh, and Desmond Teck-Chye Ang. "4R of rubber waste management: current and outlook." *Journal of Material Cycles and Waste Management* 25, no. 1 (2023): 37–51.

[75] Kho, Pan-Ki, and Syung-Uk Lee. "Waste Resources Management and Utilization Policies of Korea." *Korea Research Institute for Human Settlements, Publications Registration* 11-10510000 (2016): 000755-01.

of national welfare.[76] Given the limitations of traditional waste treatment methods and the challenges of securing landfill sites, the Act aims to address the root causes of waste generation by promoting waste reduction and recycling, which can lead to saving resources and conserving the environment.[77] Other indirect HSW legislation includes the Act on the Control of Transboundary Movement of Hazardous Wastes and their Disposal for the management of hazardous wastes and the Act on the Promotion of the Development, Use, and Diffusion of Eco-Friendly Vehicles for the Reduction of Emissions from transportation, which is a significant source of air pollution and greenhouse gas emissions in South Korea.[78]

Furthermore, the Act on the Promotion of Saving and Recycling of Resources has restricted the usage of certain disposable products (products intended for single-use only).[79] Such products include disposable cups, bowls, plates, wooden chopsticks and toothpicks, plastic tablecloths in cafeterias and restaurants, and the free distribution of disposable goods. Over the years, these prohibitions have been expanded. [80]

South Korea has implemented the 4Rs policy,[81] which emphasizes reducing waste as much as possible, reusing, recycling, recovering energy, incinerating, and landfilling.[82] These priorities should be considered during the production, use, and disposal stages to ensure that raw materials have a complete

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[76] Jang, Yong-Chul, Kyunghoon Choi, Youngsun Kwon, Hakyun Song, and Hyunhee Kim. "Recycling and Material Flow Analysis of End-of-Life Fluorescent Lamps in South Korea." *Energies* 15, no. 23 (2022): 8825.

[77] Yi, Junglem, et al. "Methods of establishing the foundation of a zero waste city". *GRI Policy Research* No. 63. (Gyeonggi: Gyeonggi Development Research Institute, 2013).

[78] Chung, Chang Soo, Ki-Young Choi, Chang-Joon Kim, Jun-Mo Jung, and Yeon S. Chang. "Overview of the policies for phasing out ocean dumping of sewage sludge in the Republic of Korea." *Sustainability* 12, no. 11 (2020): 4553.

[79] Meneses, Rodrigo A. Muñoz, Gerardo Cabrera-Papamija, Fiderman Machuca-Martínez, Luis A. Rodríguez, Jesús E. Diosa, and Edgar Mosquera-Vargas. "Plastic recycling and their use as raw material for synthesizing carbonaceous materials." *Heliyon* (2022): e09028.

[80] Kim, Jeonghyun. "Construction and demolition waste management in Korea: Recycled aggregate and its application." *Clean Technologies and Environmental Policy* 23 (2021): 2223–2234.

[81] Wang, Qiufei, and Wei Liang. "Comparative Study on Foreign Experience of Municipal Solid Waste Management." *Journal of Civil Engineering and Urban Planning* 4, no. 3 (2022): 59-71.

[82] Leong, Seng-Yi, Siang-Yin Lee, Thiam-Young Koh, and Desmond Teck-Chye Ang. "4R of rubber waste management: current and outlook." *Journal of Material Cycles and Waste Management* 25, no. 1 (2023): 37–51.

life cycle.[83] During the consumption phase of the 4Rs policy, a garbage rate system based on the amount of waste and the regulation of used disposable goods is implemented. In addition, waste storage and transportation standards, installation, and management of waste treatment facilities have been established in the disposal phase.[84] According to Namil Um et al., effective waste minimization requires implementing key strategies to reduce waste, conserve landfill space, stabilize and remove hazardous substances from waste, and optimize waste treatment to enable energy and material recovery.[85] Recently, policy developments in South Korea have been geared towards transforming waste into valuable resources, emphasizing achieving a "*sustainable and circular society*" and "*waste to energy and resources*" in current and future waste management plans.[86] Korea has implemented various systems and measures for waste management in addition to the Waste Control Act. The subsequent analysis delves into some of these systems and measures.

1. Volume-Rate Waste Disposal System 1995

The Volume-Rate Waste Disposal System, introduced in 1995, adopts the *'Pay-As-You-Throw'* principle to encourage waste reduction at the source and promote the sorted discharge of waste.[87] It replaces the previous fixed-fee system based on property taxes with a proportional fee system considering the volume of waste discharged. The Volume-Rate Disposal System is a waste management system that adopts the *'Pay-As-You-Throw'* principle. Its objective is to minimize waste at the source and promote the sorted discharge of waste.[88] The

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[83] Zainol, Noor Ainee, Ahmad Anas Nagoor Gunny, Hamidi Abdul Aziz, and Yung-Tse Hung. "Rubber Tire Recycling and Disposal." In *Solid Waste Engineering and Management: Volume 3*, pp. 55-114. Cham: Springer International Publishing, 2022.

[84] Um, Namil, Young-Yeul Kang, Ki-Heon Kim, Sun-Kyoung Shin, and Youngkee Lee. "Strategic environmental assessment for effective waste management in Korea: A review of the new policy framework." *Waste Management* 82 (2018): 129-138.

[85] Um, Namil, Young-Yeul Kang, Ki-Heon Kim, Sun-Kyoung Shin, and Youngkee Lee. "Strategic environmental assessment for effective waste management in Korea: A review of the new policy framework." *Waste Management* 82 (2018): 129-138.

[86] Yang, Won-Seok, Jun-Kyung Park, Se-Won Park, and Yong-Chil Seo. "Past, present and future of waste management in Korea." *Journal of Material Cycles and Waste Management* 17 (2015): 207-217.

[87] Kim, Yeji, and Jeongho Cho. "AIDM-Strat: Augmented Illegal Dumping Monitoring Strategy through Deep Neural Network-Based Spatial Separation Attention of Garbage." *Sensors* 22, no. 22 (2022): 8819.

[88] Park, Seejeen, and T. J. Lah. "Analyzing the success of the volume-based waste fee system in South Korea." *Waste Management* 43 (2015): 533-538.

system operates by transitioning from a fixed-fee system based on property taxes to a proportional fee determined by the volume of waste discharged. The system applies to various types of waste, HSW. Under this system, recycled products are collected by the relevant authorities at no cost but only if they are discharged separately. This necessitates consumers segregating recycled waste and minimizing the waste that must be discharged in a volume-rate disposal system. Furthermore, the Volume-Based Rate System application is guided by several principles directly relevant to HSW management, such as the Polluter Pays Principle (3 P's), the User Pays Principle, the Prevention Principle, and the Economic Incentive Principle.[89]

The target beneficiaries of the Volume-Based Waste Fee (VWF) are primarily households and small businesses (such as markets and shopping arcades) that generate less than 300 kg of waste daily.[90] The Minister of Environment has outlined the fundamental principles of VWF, which include: (1) households (or small businesses) must purchase standardized plastic waste bags produced and sold by local governments, (2) wastes are to be deposited in the plastic bags and placed for collection, and (3) recyclables such as paper, plastic, and cans are collected from containers or bins placed near residences at no cost.[91]

2. *Food Waste Volume-Bases Disposal System 2010*

The 2010 Volume-Based Food Waste Disposal System is a collaborative effort of various agencies and departments aimed at environmental conservation.[92] It is based on the principle that waste dischargers should be responsible for the cost of collection and treatment in proportion to the amount of waste generated. In addition, this system aims to encourage a shift in consumption patterns and disposal practices to reduce the volume of food waste generated.[93]

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[89] Min, Dal-Ki, and Seung-Whee Rhee. "Management of municipal solid waste in Korea." *Municipal Solid Waste Management in Asia and the Pacific Islands: Challenges and Strategic Solutions* (2014): 173–194.

[90] Ko, Sungmin, Woojae Kim, Sang-Cheol Shin, and Jungwoo Shin. "The economic value of sustainable recycling and waste management policies: The case of a waste management crisis in South Korea." *Waste Management* 104 (2020): 220–227.

[91] Park, Seejeen, and T. J. Lah. "Analyzing the success of the volume-based waste fee system in South Korea." *Waste Management* 43 (2015): 533-538

[92] Karim, Ghazi A. *Fuels, energy, and the environment*. CRC Press, 2012.

[93] Karim.

3. Waste Levy System

The waste levy system is designed to dissuade waste generation and promote efficient use of resources.[94] It involves the imposition of fees on products, materials, and containers that contain hazardous substances that are difficult to recycle. The system applies to product producers and importers and aims to reduce waste generation from the manufacturing stage while enhancing product composition.[95] According to the polluter pays principle, the waste deposit system involves imposing environmental conservation costs on products that exert significant environmental pressure.[96] It mandates companies to reduce waste generation during the production and distribution phases and to manage waste effectively to minimize the costs associated with environmental conservation arising from waste management.[97]

4. Producer Responsibility System

Extended producer responsibility (EPR) aims to promote waste reduction, reuse, and recycling and establish a resource-recycling economic and social system.[98] This system requires producers to actively engage in eco-friendly economic activities throughout all phases, including design, production, distribution, consumption, and disposal.[99] The EPR system is built upon the shared producer responsibility (SPR) framework, expanding the obligations of governments, consumers, and producers alike. Under the previous framework, the government was responsible for disposing of non-recycled waste and collecting all recyclable waste.[100] However, in the EPR system, consumers also

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[94] Japan Environmental Council. "Republic of Korea." *The State of the Environment in Asia: 1999/2000* (2000): 53–62.

[95] Idris, Azni, Bulent Inanc, and Mohd Nassir Hassan. "Overview of waste disposal and landfills/dumps in Asian countries." *Journal of Material Cycles and Waste Management* 6 (2004): 104-110.

[96] Alzamora, Bruno Ribas, and Raphael Tobias de V. Barros. "Review of municipal waste management charging methods in different countries." *Waste Management* 115 (2020): 47-55.

[97] Alzamora and de V. Barros.

[98] Kojima, Michikazu, Aya Yoshida, and So Sasaki. "Difficulties in applying extended producer responsibility policies in developing countries: case studies in e-waste recycling in China and Thailand." *Journal of Material Cycles and Waste Management* 11 (2009): 263-269.

[99] Gupt, Yamini, and Samraj Sahay. "Review of extended producer responsibility: A case study approach." *Waste Management & Research* 33, no. 7 (2015): 595-611.

[100] Kim, Soyoung, and Akihisa Mori. "Revisiting the extended producer responsibility program for metal packaging in South Korea." *Waste Management* 39 (2015): 314-320.

bear a portion of the recycling costs paid by manufacturers by contributing to the waste collection through segregation and sorting since recycling costs are included in the price.[101]

5. *Package Waste Regulation*

To reduce the generation of packaging waste and encourage the reuse and recycling of packaging materials, regulations have been implemented for the handling of wastes discharged from packaging materials that protect products during distribution.[102] Furthermore, this policy advocates for promoting eco-friendly packaging materials and prohibits using materials that are difficult to recycle.[103] In addition, article 15 of the Act on the Promotion of Saving and Recycling of Resources and guidelines on the method of packaging products and the composition of packaging materials have been established to enforce regulations on excessive packaging materials. [104]

In addition, the Korean government has endorsed the Korea Master Plans for Resource Circulation (2018-2027), which has two primary objectives: (i) the realization of a Zero Waste Social Settlement and (ii) a 20.3% rate of resource circulation along with a 26% decrease in final landfill capacity.[105] Additionally, the Republic of Korea has been diligently implementing the Waste Control Act, which outlines regulations for the safe handling of waste, and the Recycling Promotion Act, which aims to decrease waste generation and promote recycling practices. In addition to establishing and enforcing waste legislation and systems, Korea has implemented various measures to promote

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[101] Min, Dal-Ki, and Seung-Whee Rhee. "Management of municipal solid waste in Korea." *Municipal Solid Waste Management in Asia and the Pacific Islands: Challenges and Strategic Solutions* (2014): 173–194.

[102] Jang, Yong-Chul, Gain Lee, Yuree Kwon, Jin-hong Lim, and Ji-hyun Jeong. "Recycling and management practices of plastic packaging waste towards a circular economy in South Korea." *Resources, Conservation and Recycling* 158 (2020): 104798.

[103] Sakai, Shin-ichi, Hideto Yoshida, Yasuhiro Hirai, Misuzu Asari, Hidetaka Takigami, Shin Takahashi, Keijirou Tomoda et al. "International comparative study of 3R and waste management policy developments." *Journal of Material Cycles and Waste Management* 13 (2011): 86–102.

[104] Ministry of Environment of Republic of Korea. “Evaluation of 20-Year Outcomes of the Volume-Rate-Based System and Research on Measures for Improvement: Two Decade in Effect Volume-Based Waste Fee System in South Korea”. *Korean Environmental Policy Bulletin* XIV, no. 3 (2016).

[105] Jung, Seok-ho, Mee-hye Lee, Seong-ho Lee, and Ji Whan Ahn. "A study on the trend of domestic waste generation and the recognition of recycling priorities in Korea." *Sustainability* 13, no. 4 (2021): 1732.

education on food waste reduction.[106] A food waste reduction campaign and improvements to legislative and policy systems were launched. In addition, television advertising on food waste reduction was broadcast, and workshops on food waste and treatment were conducted.

The Republic of Korea's waste management policy must prioritize several critical areas in the future. Firstly, it is essential to disseminate widespread preventive waste management strategies to reduce waste throughout the entire production, consumption, and disposal lifecycle.[107] Secondly, it is crucial to allocate the roles and duties of stakeholders involved in discharge, collection, transportation, and disposal fairly, guided by the polluter pays concept.[108] Thirdly, increasing administrative transparency is critical to enhancing stakeholder participation. Therefore, stakeholders should be able to access HSW generation and disposal information. Fourthly, information technology should support the implementation of an advanced waste management policy. Finally, it is imperative to encourage international collaboration on waste management in the Asia-Pacific region.[109]

Indonesia Solid Waste Management Law

According to research, each household resident generates 0.22–0.4 kg of waste daily in Indonesia, whereas municipal solid waste (including traditional markets, commercial areas, public facilities, and other areas) generates 3.4 million metric tons of plastic waste.[110] Waste management in Indonesia operates through two primary mechanisms: ' reduction' and 'handling. The waste reduction mechanism encompasses three key activities: (a) the reduction of waste generation, (b) recycling of waste, and (c) the reuse of waste materials. On the other hand, the handling mechanism encompasses five essential actions,

[106] Jang, Yongchul, Kyung Nam Kim, and JongRoul Woo. "Post-consumer plastic packaging waste from online food delivery services in South Korea." *Waste Management* 156 (2023): 177–186.

[107] Lee, Seunghae, and Hae Sun Paik. "Korean household waste management and recycling behavior." *Building and Environment* 46, no. 5 (2011): 1159-1166.

[108] Salemdeeb, Ramy, Erasmus KHJ Zu Ermgassen, Mi Hyung Kim, Andrew Balmford, and Abir Al-Tabbaa. "Environmental and health impacts of using food waste as animal feed: a comparative analysis of food waste management options." *Journal of Cleaner Production* 140 (2017): 871-880.

[109] Salemdeeb, Ermgassen, Kim, Balmford, and Al-Tabbaa.

[110] Ministry of Environment and Forestry of the Republic of Indonesia (MoEF). "Waste Composition Graphic". In *National Waste Management Information System*. (Ministry of Environment and Forestry of Republic of Indonesia (MoEF): Jakarta, Indonesia, 2022).

including (i) waste sorting, (ii) waste collection, (iii) waste transportation, (iv) waste processing, and (v) waste final processing.[111]

Waste management laws and regulations are in place in Indonesia at various national and regional levels. The cornerstone of waste management legislation in Indonesia is the Waste Management Law, officially known as the Law of the Republic of Indonesia Number 18 Year 2008 (Law 18/2008).[112] Subsequently, several subsidiary regulations were introduced. These include Government Regulation of the Republic of Indonesia Number 81 Year 2012 concerning the Management of Household Waste and Waste Resembling Household Waste (GR 81/2012) and Government Regulation of the Republic of Indonesia Number 27 Year 2020 regarding the Management of Specific Types of Waste (GR 27/2020).[113]

Although the legal instruments may contain distinct provisions tailored to the specific types of waste they address, they fundamentally share a standardized framework rooted in the regulations outlined in Law 18/2008.[114] In the subsequent stages of development, the collective endeavors to reduce and effectively manage waste, as stipulated in the existing laws and regulations, are channeled toward accomplishing the objectives outlined in the National Policy and Strategy for Household Waste and Household-like Waste Management, referred to as "*Jakstranas*" in Indonesian. This strategic plan is formalized through the Presidential Regulation of the Republic of Indonesia Number 97 Year 2017 (PR 97/2017) and serves as Indonesia's overarching blueprint for waste management, with an implementation timeline spanning from 2017 to

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[111] Kamaruddin, Hanim, Farida Patittingi, Hasbi Assidiq, Siti Nurhaliza Bachril, and Nurul Habaib Al Mukarramah. "Legal aspect of plastic waste management in Indonesia and Malaysia: Addressing marine plastic debris." *Sustainability* 14, no. 12 (2022): 6985.

[112] Ministry of Energy and Mineral Resources Republic of Indonesia. *Government Regulation of the Republic of Indonesia Number 81 Year 2012 on Household Waste and Household-like Waste Management.* (EU-Indonesia Trade Cooperation Facility: Jakarta, Indonesia, 2015).

[113] Government Regulation of the Republic of Indonesia Number 27 Year 2020 on Specific Waste Management. Available online: http://jdih.menlhk.co.id/uploads/files/PP_Nomor_27_Tahun_2020_menlhk_06222020120956.pdf (accessed on January 14, 2021).

[114] Ministry of Energy and Mineral Resources Republic of Indonesia. *Law of the Republic of Indonesia Number 18 Year 2008 on Waste Management.* (EU-Indonesia Trade Cooperation Facility: Jakarta, Indonesia, 2015).

2025.[115] Furthermore, there are additional Regulations Governing Domestic Waste and Equivalents in Indonesia, such as:

A. Solid Waste Management Act (Act 18/2008)

On May 7, 2008, Indonesia introduced the Solid Waste Management Act, Act 18/2008. This landmark legislation is poised to bring about significant transformations and new challenges in waste management, effectively serving as the overarching framework for sound municipal solid waste management practices in the country. [116]The SWM Act clearly defines solid waste, encompassing residues arising from daily human activities or resulting from natural processes in solid forms.[117] This Law categorizes waste into three main types: domestic waste, domestic waste equivalents, and specific wastes.

Domestic waste originates from routine household activities but does not include faecal matter or specific waste items. On the other hand, domestic waste equivalents stem from commercial zones, industrial estates, special zones, social facilities, public facilities, and other similar establishments.[118] Some key highlights of Law 18/2008 include:

1) The adoption of an Extended Producer Responsibility (ERP) approach.
2) Implement the 3Rs (Reduce, Reuse, Recycle) approach throughout the waste management chain.
3) Strict prohibitions on open dumping and open burning of waste.
4) A ban on the importation of waste into Indonesian territories.[119]

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[115] Presidential Regulation of the Republic of Indonesia Number 97 Year 2017 on National Policy and Strategy for Household Waste and Household-like Waste Management. Available online: https://peraturan.bpk.go.id/Home/Details/73225/perpres-no-97 - tahun-2017 (accessed on January 14, 2021).

[116] Sondang Siagian, Erwin, Asep Sumaryana, Ida Widianingsih, and Heru Nurasa. "Public-private partnerships in solid waste management in Indonesia: the need for technical regulation." *Asia Pacific Journal of Public Administration* 41, no. 4 (2019): 246-250.

[117] Wibisono, H., F. Firdausi, and M. E. Kusuma. "Municipal solid waste management in small and metropolitan cities in Indonesia: A review of Surabaya and Mojokerto." In *IOP Conference Series: Earth and Environmental Science*, vol. 447, no. 1, p. 012050. IOP Publishing, 2020.

[118] Damanhuri, Enri. "A Future prospect of municipal solid waste management in Indonesia." In *Keynote Lecture in the 5th Asian-Pacific Landfill Symposium, Sapporo, Japan.* 2008.

[119] Purba, Laura Astrid Hasianna, and Anna Erliyana. "Legal framework of waste management in Indonesia." In *International Conference on Law, Governance and Islamic Society (ICOLGIS 2019)*, pp. 104-108. Atlantis Press, 2020.

These provisions mark a significant step toward more sustainable and responsible waste management practices in Indonesia.

The fundamental approach underpinning this new legislation prioritizes waste reduction through the 3Rs (reduce, reuse, and recycle) as the foremost objective, with waste management next in line. This conceptual shift departs from the conventional "*collect-transport-dispose*" approach, which most Indonesian cities have traditionally adopted.[120] All stakeholders unanimously endorse this new paradigm as the most effective means of waste reduction, recognizing that active community engagement and the concerted efforts of waste generators are pivotal to the success of any waste management initiative. In recent years, there have been notable advancements in waste management, including:

1) Many cities are initiating comprehensive waste management programs that are aligned with modern standards.
2) There is an increasing emphasis on public initiatives and campaigns to enhance public awareness regarding environmental protection, particularly proper waste handling.
3) Enhanced waste management education programs targeting staff and government civil servants responsible for waste treatment.
4) Heightened attention to waste handling issues raised by non-governmental organizations (NGOs), garnering increased public attention.
5) There is a growing recognition of the benefits of involving private contractors in waste collection and treatment.
6) The revival of national-level competitions among cities, such as the Adipura Program, which recognizes the cleanest towns in the country.
7) There is a rising interest in environmental education at the school and even preschool levels, focusing on proper waste disposal and recycling.
8) There is ongoing progress in developing improved final disposal methods, such as sanitary landfills, with a regional approach being applied in some metropolitan areas.

[120] Hotta, Yasuhiko, Chettiyapan Visvanathan, Michikazu Kojima, and Agamuthu Pariatamby. "Developing 3R policy indicators for Asia and the Pacific region: experience from Regional 3R Forum in Asia and the Pacific." *Journal of Material Cycles and Waste Management* 18 (2016): 22-37.

B. Government Regulation No. 81 of 2012 regarding The Management of Domestic Waste and Domestic Waste Equivalents

Article 11 of Government Regulation No. 81/2012 mandates that every individual must actively reduce and manage their waste volume, encompassing waste reduction, recycling, and reuse. Waste reduction can be achieved through reusable materials or the responsible collection and disposal of used packaging. Meanwhile, Article 11(2) imposes obligations on producers to limit and recycle their waste by developing supportive plans or programs, designing products with easily degradable packaging, and reclaiming waste generated from the product and its packaging for recycling. Furthermore, Article 14 mandates that producers take measures to reuse waste by employing reusable raw materials in their production processes or retrieving waste originating from both the product and its packaging for reuse.

C. Ministry of Public Work Regulation No. 3 of 2013 Regarding the Provision of Facilities and Infrastructure to Handle Domestic Waste and Domestic Waste Equivalents

Ministry of Public Work Regulation No. 3 of 2013, 'Regarding The Provision of Facilities and Infrastructure to Handle Domestic Waste and Domestic Waste Equivalents in Indonesia,' is a significant regulatory framework that addresses the management of domestic waste and waste equivalents within the country.[121] This regulation plays a crucial role in ensuring that the necessary facilities and infrastructure are in place to manage and handle these types of waste effectively. The law is essential in shaping Indonesia's waste management infrastructure and practices to align with environmental sustainability and public health objectives. It helps establish clear guidelines and standards for handling domestic waste and waste equivalents while promoting responsible waste management practices.

[121] Lestari, Prieskarinda, and Yulinah Trihadiningrum. "The impact of improper solid waste management on plastic pollution in the Indonesian coast and marine environment." *Marine Pollution Bulletin* 149 (2019): 110505.

D. Presidential Regulation No. 97 of 2017 regarding the Indonesian National Strategy Policy on Managing Domestic Waste and Domestic Waste Equivalents

Presidential Regulation No. 97/2017 serves as a strategic roadmap for achieving a cleaner, waste-free Indonesia by 2025. This comprehensive plan, known as the National Strategy Policy or Jakstranas, strongly emphasizes enhancing the management and reduction of domestic waste and waste equivalents.[122] The primary goal outlined in Jakstranas is to achieve a 30% reduction in waste production at its source while ensuring that 70% of all waste is effectively processed by 2025. This ambitious target is fully integrated into the national and medium-term development plans, ensuring its alignment with broader national objectives.[123] Moreover, Jakstranas serves as a valuable guide for shaping regional policies and strategies at the provincial and district levels. It provides a framework that enables local authorities to align their waste management initiatives with the overarching national vision for a cleaner and more sustainable Indonesia.

E. Regional-level Regulations

At the regional level in Indonesia, both provincial and regency/municipal governments are responsible for numerous tasks and functions pertaining to waste management. These authorities and functions are granted through various legal instruments, including Law 18/2008, the Law on Regional Government (Law Number 23 Year 2014, revised), and the Law on Environmental Protection and Management (Law Number 32 Year 2009, revised). One of the responsibilities vested in regional-level governments is formulating policies and strategies.[124]

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[122] Farahdiba, Aulia Ulfah, I. D. A. A. Warmadewanthi, Yunus Fransiscus, Elsa Rosyidah, Joni Hermana, and Adhi Yuniarto. "The present and proposed sustainable food waste treatment technology in Indonesia: A review." *Environmental Technology & Innovation* (2023): 103256.

[123] Farahdiba, Aulia Ulfah, I. D. A. A. Warmadewanthi, Yunus Fransiscus, Elsa Rosyidah, Joni Hermana, and Adhi Yuniarto. "The present and proposed sustainable food waste treatment technology in Indonesia: A review." *Environmental Technology & Innovation* (2023): 103256.

[124] Ministry of Energy and Mineral Resources Republic of Indonesia. *Law of the Republic of Indonesia Number 18 Year 2008 on Waste Management*. (EU-Indonesia Trade Cooperation Facility: Jakarta, Indonesia, 2015).

Regarding their authority to create policies and strategies for waste management within their administrative jurisdiction, regional-level governments have introduced several regulations focused on the control and generation of plastic materials and plastic waste within their respective areas. According to a report by Al Faqir (2021), based on information from the Ministry of Environment and Forestry of the Republic of Indonesia, as of January 2021, a total of 41 regions in Indonesia, comprising two provinces and 39 regencies/municipalities, have implemented regulations or policies that either restrict or prohibit the use of single-use plastics.[125]

Illustrative instances of these regional-level regulations include Bali Governor Regulation Number 97 of 2018, which pertains to the limitation of single-use plastic waste generation at the provincial level, and Balikpapan Mayor Regulation Number 8 of 2018, which addresses the reduction of plastic bag usage at the municipal level.[126]

Analysis of Sierra Leone Household Solid Waste Management Policy

This article presents the recognition of the Sierra Leone government regarding the need for environmental protection, explicitly concerning HSW. Despite this acknowledgment, the literature reveals that the existing legal and non-legal measures need to be improved in managing HSW generation and illegal disposal in Sierra Leone. Besides, there are very few pieces of writing and data on solid waste issues in Sierra Leone, making it even more challenging to know the magnitude of the problem. The article highlights significant inadequacies in Sierra Leone's waste legislation, particularly the need for a specific legal framework for HSW. Existing laws in the form of by-laws suffer from major loopholes, including the absence of waste definitions and general provisions that need more substance and focus on prohibitions rather than systematic waste management. The article also notes the need for waste

[125] Al Faqir, Anisyah. "41 Daerah Sudah Terapkan Larangan Penggunaan Kantong Plastik" (41 Regions Have Implemented a Ban on the Use of Plastic Bags). *Liputan 6*. 2021. Available online: https://www.liputan6.com/bisnis/read/4454331/41-daerah-sudah-terapkanlarangan-penggunaan-kantong-plastik (accessed on 16 January 2021).

[126] Kamaruddin, Hanim, Maskun Maskun, M.A. Marwan. "Plastic Waste Reduction in Malaysia: Shaping an Eco-Legal System". In *Proceedings of the Tuanku Ja'afar Conference and Workshop 2021 (TJC 2021*). Fakulti Undang-Undang, Universiti Kebangsaan Malaysia: Selangor, Malaysia, 2021; pp. 807–816.

management guidelines, including waste separation at the source, treatment, reuse, recycling, and illegal waste disposal.

Additionally, the existing penalties and terms of imprisonment provided for illegal waste disposal do not match the severity of the disposal offenses. In contrast, Korea and Indonesia have established an environmentally sustainable waste management structure with reduction and recycling guidelines. For example, the Koreans deeply understand the significance of waste management, with laws, policies, and programs focused on minimizing waste and recirculation. The success of these policies is demonstrated by the segregated discharge of waste, separation of recyclable waste, reprocessing and reusing of collected waste, and the payment of recycling costs.

Similarly, Indonesia has established a comprehensive legal framework for waste management, including specific laws like Law 18/2008. It encompasses two main components: waste reduction and waste management. Waste reduction encompasses practices to minimize waste generation, including limiting waste production, recycling waste, and reusing waste materials.[127] When engaging in various activities, Indonesians utilize materials for production that result in minimal waste generation, are reusable, recyclable, or can quickly decompose through natural processes. Law no.18/2008 is driven by the goals of enhancing public health, improving environmental quality, and harnessing waste as a valuable resource. It underscores the government's dedication to promoting the principles of the 3Rs policy.[128]

Sierra Leone can draw valuable lessons from the two countries' waste management practices, such as prioritizing the 3Rs for waste reduction, adopting Extended Producer Responsibility (ERP) to hold manufacturers accountable, enforcing strict anti-dumping and burning regulations, establishing a clear national strategy, and empowering local authorities through regional regulations to enhance its waste management system. Moreover, Sierra Leone faces increased budgetary pressures and challenges in waste management due to urbanization and the consequent surge in waste generation. Detailed HSW management goals will go through a volume-rate system, mandatory sorted discharge and promotion of recycling, and long-term waste generation deterrence should be prioritized.

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[127] Wibisono, H., F. Firdausi, and M. E. Kusuma. "Municipal solid waste management in small and metropolitan cities in Indonesia: A review of Surabaya and Mojokerto." In *IOP Conference Series: Earth and Environmental Science*, vol. 447, no. 1, p. 012050. IOP Publishing, 2020.

[128] Meidiana, Christia, and Thomas Gamse. "Development of waste management practices in Indonesia." *European Journal of Scientific Research* 40, no. 2 (2010): 199-210.

Additionally, a waste statistics data system is needed to facilitate efficient HSW management in Sierra Leone, and waste statistics should be gathered regularly to maximize management efficiency. As the waste collection system is a critical factor in waste management, appropriate waste collection measures should be identified and applied to each local government and community's unique circumstances. Educational programs that incorporate HSW management priorities and strategies, comprehensive perspectives on waste management and the environment, effective solutions, and practical waste management skills should be implemented to build capacity for HSW management suited to local circumstances. Local councils should also carry out educational campaign programs on waste policies, related laws and treatment systems, with booklets and promotional materials displayed on their websites.

Essentially, a solid waste management law emphasizes that waste management is a collective responsibility shared by individuals, communities, businesses, and the government. Local councils in Sierra Leone must establish a Temporary Waste Disposal Area for temporarily storing waste before it is transported to recycling, processing, or integrated waste treatment facilities. The area must meet specific technical criteria, including providing waste segregation facilities and adhering to the temporary nature of waste collection sites. Individuals should segregate waste before sending it to the Temporary Waste Disposal Area. Local councils in Sierra Leone must also develop a 3R Waste Treatment Facility where collection, segregation, reuse, and recycling processes occur. This facility handles organic waste processing, inorganic waste recycling, domestic and hazardous waste treatment, and the collection of residual waste, which is then transported to the final processing site. This is where waste undergoes processing and reintegrates into the environment without causing harm to human or environment.

Conclusion

Implementing effective and efficient policies for solid waste management enhances the governance and planning of resilient cities. This necessitates the utilization of both reactive and proactive policies, which can be employed simultaneously or sequentially based on the situation at hand. This paper has identified poor waste management practices and inadequacies in existing regulations as significant barriers to effective and sustainable HSW management in Sierra Leone. Existing weak laws and policies, characterized by ineptitude, lack of clarity, relevance, and appropriateness to current trends, content, and context, and inadequate enforcement mechanisms, collectively contribute to the

paradox of HSW management regulation. There is no uniform approach or a specific binding legal framework to deal with HSW management in the country. Most local councils manage waste with no laws in place, leaving room for ambiguities and unclarities. There is no accurate and updated data on waste generation, making it difficult for the authorities to handle and, as a result leaving most of the waste generated unregulated. This paper asserts the necessity to review and update existing laws and policies to reflect the relevant laws of South Korea and Indonesia while collaboratively designing new policies tailored to the specific needs and characteristics of diverse urban populations, waste trends, and waste types. Community sensitization is also vital to promote compliance and active involvement. Environmental activists should advocate for more outstanding government commitment and the allocation of additional resources for policy implementation efforts. Given Sierra Leone's rapid population growth and urbanization, it must conduct periodic studies focusing on various physical environments, such as the participation of stakeholders and HSW collection practices in informal settlements.

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In nature, nothing is wasted.
Everything is recycled.

David Suzuki

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