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National Policy Innovation Reflections: Advancing Sustainable Policies to Reducing Waste

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Abstract: *Increasing national waste volumes are causing significant environmental and public health issues. There is a need for policy innovation to tackle waste management issues. This research aims to understand new methods that led to formulating national-level policies to reduce waste. A literature review was used as the research method to understand how policy innovation can be used further to reduce the volume of waste. Searches were made in Google Scholar and Scopus with the keywords "policy innovation" and "waste reduction." The new methods derived from the research and the formulation of the framework can be brought into use by the authorities. The results of the research provided a framework for innovative waste-reduction policies. The framework was developed using Technical Regulations, Public Private Partnerships, Circular Economy and Incentive-Disincentive Policies. Technical Regulations provide the legislation and technical foundation for proper waste management. Public-private partnerships ensure that private sector expertise and resources are used in such a way that sustainability goals can be met. Circular Economy details ways how consumption of resources can be altered to make it more sustainable and reduce wastage. Incentive-Disincentive Policies are used to enforce a particular behavior or acceptance of a policy. These frameworks can be helpful for the government and stakeholders to understand how innovative steps can be implemented to solve waste problems and how sustainable development can be used to catch up with the national waste crisis.*
Keywords*: Policy Innovation; Waste Reduction Policy; Reducing Waste; Sustainability*

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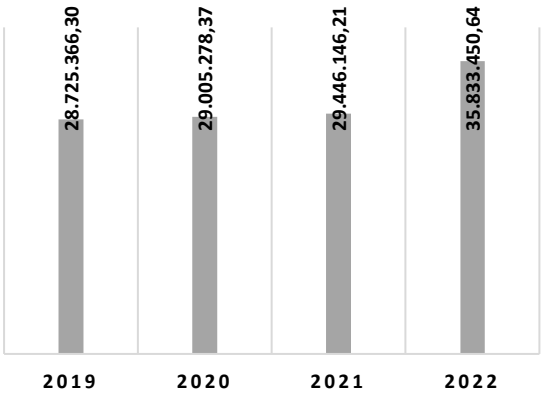
Introduction

In the midst of efforts to achieve sustainable development, developing waste policies is an important part of addressing waste management problems throughout the world. Reducing waste has become an increasingly crucial worldwide issue, with far-reaching consequences for environmental sustainability, public health, and community well-being. As the globe faces expanding issues caused by increasing waste creation, governments must develop and adopt strong policies to properly manage and reduce the effects of this growing catastrophe. Waste management is a difficult problem requiring complete policies. The stakes are especially high in Indonesia, a country known for its natural beauty and diversified environment. The Ministry of Environment and Forestry's National Waste Generation Volume data for the years 2019 to 2022 shows a significant rise in the amount of waste produced in Indonesia. According to Annur, 2023b, the national trash volume was 28,725,366.30 units in 2019 and increased to 29,005,278.37 units in 2020. The rising trend continued in 2021, with a volume of 29,446,146.21 units. In 2022, there was a significant increase in the national garbage volume, reaching 35,833,450.64 units. This increase highlights the growing significance and intricacy of waste management, requiring significant focus in environmental management and recovery endeavors.

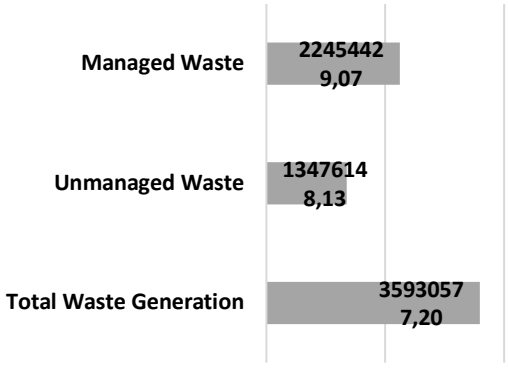
Figure 1. National Waste Generation Volume (2019-2022)



Source: (Annur, 2023b)

Still based on data from the Ministry of Environment and Forestry (Annur, 2023a), the overall trash volume in Indonesia in 2022 was 35,930,577.20 units, comprising both managed and unmanaged waste. The study underlines a crucial difference between controlled and unmanaged waste. Organised trash management handled 22,454,429.07 units, while mismanaged waste totaled 13,476,148.13 units. This discrepancy highlights a significant issue in trash management in Indonesia.

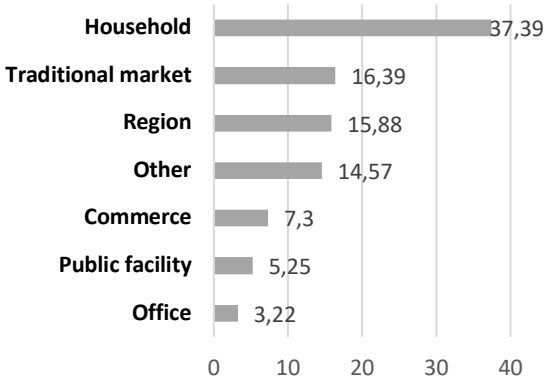
Figure 2. Managed and Unmanaged Volume of Waste Generation in Indonesia (2022)



Source: (Annur, 2023a)

Although there have been attempts to manage a large portion of the garbage, there is still a considerable volume that does not receive proper treatment. Given the continuous increase in population and urban development, it is imperative to implement more measures to improve infrastructure and waste management regulations in order to minimize their negative effects on the environment and public health. Moreover, the 2020 report by Rizaty (2021) provides information on the distribution of garbage sources in Indonesia. Household waste made the most significant contribution at 37.39%, becoming the greatest contributor to the total national garbage. Traditional market waste accounted for 16.39%, followed by regional or area-based garbage at 15.88%. 14.57% of garbage came from sources other than those mentioned, and waste from the commercial sector accounted for 7.3%. Public facilities and offices contributed 5.25% and 3.22%, respectively. This data offers a comprehensive perspective on the sources of garbage at the national level, which can be used as a basis for creating improved and environmentally friendly waste management plans. By comprehending the contributions of each trash source, authorities can concentrate on specific prevention and recycling initiatives.

Figure 3. Composition of National Waste Based on Waste Sources (2020)



Source: (Rizaty, 2021)

Those conditions show how waste has become a serious problem in this country. However, a comparison of practices in waste management across the world yields enlightening possibilities of policy innovation that can be adaptable to variable local contexts. The nature of waste management practices varies between regions and is dependent on influences such as political, socioeconomic, and environmental (Kumar et al., 2021). For instance, developed nations usually embrace municipal and regional management, highly dependent on technology and heavy on economic instruments and regulatory mechanisms (Awino & Apitz, 2024). In turn, impelled by needs related to subsistence, most governments in the Global South rely on informal economies for waste management. Successful policies in the frame of waste include the Zero Waste Program of San Francisco, the Sustainable Materials Management Initiative by Flanders, and the Sound Material-Cycle Society Plan by Japan, among others. These show that there are sustainable materials management, waste

prevention, and recycling approaches important to this shift into a circular economy. Silva et al. (2017) While there are many community-driven initiatives that have succeeded with support at a local government level, due to different cultural and economic factors, there are also some strategic and operational barriers to the same (Chin & Mees, 2021).Ultimately, sustainable practices will be inevitable for waste management in order to lessen environmental impacts and achieve long-term circularity by reduction, reuse, and recycling (Nieves & Ramos, 2023)

Also, as we navigate the complex terrain of waste governance, the concept of policy innovation emerges as a beacon of hope. This study intends to answer critical concerns about the country's waste governance trajectory. Thus far, the community has emerged as a leader in pioneering waste reduction strategies. There have been several studies about community service or empowerment initiatives that describe the diverse waste management technologies that have emerged as a consequence of community initiatives. However, this program has not been implemented continuously and institutionally (Anaperta et al., 2022; Maulana et al., 2022; Munawar et al., 2023; Mutia Basri et al., 2024; Permata Sukma et al., 2022). Conversely, it is limited studies about government intervention that are directed towards further systemic policy enhancements. Environmental sustainability necessitates the resolution of waste management as a public concern; thus, comprehensive policy innovation is, in fact, of the utmost importance. Hence, it is imperative that the government assume a proactive stance in formulating policies that encourage, involve, and guide the commercial sector and the community in their joint endeavors to attain more sustainable waste management.

Therefore, this study will contribute to this discussion. First and foremost, we want to understand the complexities of Indonesia's waste policy environment by answering the question, "What is the current landscape of waste policy innovation in Indonesia?" This question acts as a compass, directing our study into the core of the policies in place and their influence on the larger sustainability agenda. Research reviewing how policies reduce this problem has previously been discussed in previous studies (Karjoko et al., 2022). Therefore, this study will enhance previous studies by drawing on global experiences and ideas, which is essential for developing successful waste governance solutions. As a result, we propose a second research question: "How can the pioneering sustainability efforts in crafting an innovation policy for reducing waste in Indonesia be assessed and refined?". The core of our commitment lies in not comprehending existing projects but actively participating in enhancing them. Our aim is to assess these projects with an eye, pinpointing areas of success that need potential areas for growth. This approach ensures a cycle of improvement in reducing waste policies within Indonesia. The main objective of this piece is to provide an overview of Indonesia's waste policy landscape, encompassing its state, global perspectives, and innovative initiatives. Our goal is to recognize endeavors, assess their impacts, and distill insights to craft policies tailored to Indonesia's unique socio-environmental context. By analyzing and enhancing sustainability efforts, we aim to contribute to the establishment of enduring waste management policies in Indonesia. This study seeks not to highlight the nations challenges but to chart a course towards a

more sustainable and resilient future for waste governance.

Method

The research follows the literature review technique to get insight and complete knowledge in the innovation in the waste reduction policy. This study follows techniques from some previous studies about literature reviews (Galvan & Galvan, 2017; Paul & Criado, 2020; Torraco, 2005). We searched in Google Scholar and Scientific Database Scopus by using the terms "innovation" and "waste" in the literature review for going through various sources. Reports from 279 articles were gained through these newspapers. To sustain the relevance and reliability of the material, we avoided studying the theses, dissertations, and posts irrelevant to our subject. Finally, we selected these 20 specific journals that fell under high relevance and quality after passing through the screening procedure. We used those reports as our main materials in analyzing and addressing our problem in the study in line to establish a good base for the innovation of waste management policy and figure out the best practices to establish waste decline policies sustainability.

Result and Discussion

Indonesia's Waste Policy Innovation: A Comprehensive Overview

Prior research indicates that there is barely any policy innovation in waste reduction. It was previously mentioned that this innovation in reducing waste primarily emerges from the community rather than government initiatives. Thus, this study initiates a systemic policy innovation approach plan by mapping prior waste reduction policy innovation projects in a table.

Table 1. Various Innovations in Waste Processing

Innovation Programs
Community Empowerment: 1. Waste Bank Programs in regions like Majalengka, Semarang, Lombok Barat, and Bekasi encourage community participation in recycling and waste management efforts (Pratama, 2020; Albab & Christiani, 2020; Ariani, 2023; Hartono et al., 2020). 2. At TPS3R Pemogan, Denpasar, plastic waste is creatively transformed into interior products like furniture, showcasing a model of innovation in processing waste materials (Dewi et al., 2023). 3. Educational programs that teach students waste sorting, repurposing inorganic waste into useful items such as plastic bottles and waste paper into creative products (Nizar, 2022).
Technology-Based Innovation: 1. The "Kang Pisman" movement in Bandung uses biodigester machines to process organic waste, transforming it into gas for energy (Setianingsih et al., 2022). 2. Malang City's landfill utilizes sanitary landfill technology to capture methane, which is used to generate electricity, while Surabaya's Waste Power Plant (PLTSa) uses Gasification and Landfill Gas Collection technologies to generate renewable energy from waste (Anwar et al., 2020; Sucahyo & Fanida, 2021). 3. Magelang City's Organic Village Program synergizes waste management with food

security through the composting of organic waste and bioconversion technology using maggots (Arifin et al., 2019). 4. Banyumas Regency has introduced digital waste management applications such as Salinmas and Jeknyong, making waste management more accessible through online platforms (Rusmawan et al., 2022).
Corporate Social Responsibility: 1. PT Pertamina EP Tambun Field's "Megabox" innovation, in collaboration with the Dadali Waste Bank, offers an alternative in managing household waste at the community level in Bekasi (Wulandari et al., 2021).
Government-Community Program: 1. The Waste Bank Program in Malili City, which was awarded the Top 20 Public Service Innovation in 2018, highlights the role of government-initiated innovations in fostering sustainable waste management practices (Taufik, 2021). 2. The Cleaning and Landscaping Office (DKP) collaborates with environmental activists to develop and socialize environmental programs, emphasizing government-community partnerships in waste management (Lestari, 2014).

From the table, it is clear that there are many different ways that have been taken to solve the problem of waste elimination. Community Empowerment is the first and most common focus currently being utilized. As a means of fostering accountability from its participants, this program seeks to bring about change at the grassroots level by encouraging collective participation in the handling of waste. Additionally, the program seeks to foster personal responsibility and active engagement through the utilization of waste management practices. Waste banks are the program that has been implemented the most frequently across a variety of regions and scheme combinations. In the city of Semarang, for instance, the system mandates that users must trade in three pieces of trash in order to borrow one book. For the purposes of this program, the primary focus of library administrators is on children who are of school age. According to Albab & Christiani (2020), a significant number of students and members of the community are excited about the prospect of actively participating in the waste bank innovation program. These kinds of programs offer a wide range of advantages. Not only has the community in Majalengka experienced an increase in their awareness of the importance of environmental sustainability, but they have also experienced an increase in their economic capabilities and the capabilities of their customers and members of the waste bank (Pratama, 2020). To others, design innovation in the processing of plastic waste through waste management at TPS3R Pemogan, Denpasar is an attractive empowerment model. This model involves the transformation of plastic waste into useful interior products, such as furniture, accessories, and decorations (Dewi et al., 2023). As part of the process of community empowerment, there are also efforts being made to invite and educate students about the importance of cleanliness and the separation of organic waste and inorganic waste in solid waste. Increasing the productivity and operational reliability of educational institutions is the most important factor in educational institutions, particularly in accordance with the vision and mission of educational

institutions, which is to create a healthy environment and produce students who are moral and beneficial to society (Nizar, 2022). Innovative ways in the use of solid waste are the most important factor in educational institutions.

One that is productive in the waste reduction policies is the technology-based innovation program. For example, Kang Pisman is a movement that processes wastes using technological advantages that are supported by Bandung City Regional Regulation No. 17 of 2012 concerning Reducing the Use of Plastic Bags and Bandung City Regional Regulation No. 9 of 2018 concerning Waste Management. Waste is processed with technological advantages, namely a biodigester machine that processes organic waste into a gas source (Setianingsih et al., 2022). Expansion of the final disposal site (TPA) and disposal system is being developed using technology in Malang City. With the help of loan funds from the German State through KfW, a leading bank in Germany, this project uses advanced technology to produce heat, electricity, and household gas (Anwar et al., 2020). Others, in Tangerang City, integrated waste management innovation at the Rawa Tikus Final Disposal Site (TPA) has been running successfully. An extruder machine in the innovation of making compost has increased the production capacity to 200 sacks, and so rather than processing methane gas in areas surrounding it, it is carried out in the TPA as a conspicuous project (Widyawati et al., 2021). By and large, these are all the various examples of technological innovations in the waste management process in producing healthy stacked waste that is 'smell-free' and convenient for city lifestyle. Apart from that, there are digital-based innovations, such as the Salinmas and Jeknyong waste management applications in Banyumas Regency. The Banyumas Regency Environmental Service is collaborating with sub-district heads, village heads, the general public, and PT Banyumas Investama Jaya (BIJ) to develop applications that can facilitate waste management at the local level. This step reflects the integration of technology in waste management policy efforts, which can increase community participation and operational efficiency (Rusmawan et al., 2022).

Several innovative policies to reduce waste generated have been implemented. It has been done by adopting the Corporate Social Responsibility (CSR) and the Government-Community Program. An example of implementing CSR is the Megabox innovation done by PT Pertamina EP Tambun Field Labors collaborating with Dadali Waste Bank from Bekasi. This Megabox could be an effective alternative for collecting waste on the local level so that more sustainable solutions can be found when private organizations coordinate with societal initiatives (Puspadewi Wulandari et al., 2021).

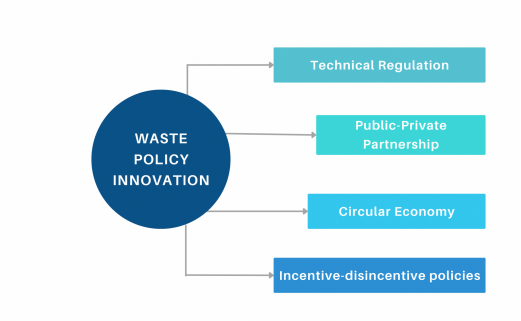
The government-community program has also been successful in several cases. In DKI Jakarta, handle waste in a cleaner and parks by cleaning with an innovative program; the innovative strategy is to invite environmental activists to sewers in the area plan together. Environmental activists in the region have helped them develop the idea so that borrowing insects hit marsh and closer between DKP and environmental care community (Lestari, 2014). Similarly, officials in Malili City succeeded in implementing innovation, a city with fewer innovators achieved to get into the Jury's 20 By sticking to the three 2018 top Public Service Innovations (Taufik, 2021).

However, a number of innovative initiatives to reduce waste generated have not been optimal due to the limitation in maximizing the role of the government in being policymakers. There are still a number of challenges in achieving an optimized synergy in maximum coordination between the private and community sectors. The innovation in the government and society is more like an individual sector, basically at the local levels and lower class, not a sectoral, and the result is that innovation can be shown. This shows how there is an intensity for the existing gap in integrating and coordinating policies as a whole, nationally. The government's role as policymaker has to be improved to create a total and integrated policy frame, just like around it. In this effort, the national government's strategic framework is needed.

Pioneering Sustainability: Crafting an Innovation Policy Framework to Reducing Waste in Indonesia

After reviewing all the innovation approaches that have been implemented, Here, this study proposes a framework for reduction waste policy by taking lessons learned from global success. It is because waste production continues to rise due to urbanization and population expansion; as such, policies that focus on both waste reduction and environmental sustainability must be put in place in order to combat this challenge and set the ground for meaningful discussions within Indonesia's waste management system.

Figure 4. Framework of National Innovation Policy in Reducing Waste



Sources: Authors Analysis. 2024

Regulations in waste management play an important role in supporting the movement from traditional waste management towards comprehensive resource management. There are numerous ways available to mix and blend innovative policy and governance tools to manage the waste well and maintain the environment clean and healthy. It is less difficult to evaluate the efficacy of waste policy frameworks and motivation at the national level and may show regulatory and motivational shortcomings that may give significant hints in creating effective, frequently referred to as technical rules (Wilts et al., 2016).

In some studies only a speculate that the transition from tradition waste management toward comprehensive resource management is to be supported by an innovative policy blend abiding by various issues of resource efficiencies (Wilts et al., 2016). Innovative policy and governance are seen as crucial for the advancement of the circular bioeconomy and waste valorization, according to some (Bugge et al., 2019). The EPR program in Quebec has clearly shown how stakeholder interests and interaction play a significant role in the design and

functioning of the EPR program, highlighting the role of governance in creating innovative waste policies (Leclerc & Badami, 2020).

One Indonesian regulation that builds the foundation for waste management is Regulation No. 18 of 2008 concerning waste management in households and industries'. This regulation is a technical regulation that lists out guidelines, arrangements, and procedures for better waste management and maintaining a clean environment. Hence, developing technical regulations for the management of critical and general waste helps plan guidelines and processes that include waste management in households and industries. This ensures everyone involved in collecting and managing waste is following the correct procedure. These technicalities will change according to the requirement. For instance, one can have the technology, while on the other hand, the equipment maintained suitably is crucial for avoiding breakdowns and repairs.

Furthermore, fixed equipment ensures that the disposal does not harm the environment. This suggests that there is a need for policy measures for increasing waste treatment facilities' permit approval times and making state aid rules more flexible. This can be facilitated through the public-private partnership (Di Foggia & Beccarello, 2023). Waste Operations done under a public-private partnership (PPP) can enhance environmental sustainability in numerous ways. Public-Private Partnerships (PPPs) are nothing but merge and include even citizens in waste governance and the distribution of duties along with local authorities (Visvanathan & Kashyap, 2016). In Phnom Penh and Bangkok, waste management services and public-private partnerships, including inter-municipal cooperation, can be further utilized in the most efficient manner to make them sustainable and to enhance the effectiveness of waste management services (Spoann et al., 2019; Sukholthaman et al., 2017). The combination of Public-Private Partnerships (PPP) and Inter-municipal cooperation in waste can drive environmental sustainability, particularly for the final disposal, and Citizen Involvement (Villalba-Diez & Zheng, 2020). Here, also, PPPs in Indonesia are acknowledged for playing a beneficial role in tackling waste management issues and balancing the needs of both the public and private sectors (Siagian et al., 2019).

The method that deals with applying circular principles to the waste problem system is the circular economy. The circular economy is the best way to address the waste policy and dispose of pollution (Chenavaz & Dimitrov, 2024) and establish circular economic policies. In recent years, the circular economy has become the critical role of governance of natural resources and waste generated due to the method established in many policies (Fitch-Roy et al., 2020). The circular idea for the economy suggests that in generating revenues, which will bring into effect a reduction in waste productions (Karstensen et al., 2019), The circular economy concept involves reusing/recycling waste resources to build a more sustainable system (Ibrahimi et al., 2010; Pahrijal, 2023). The solid byproduct from producing levulinic acid can be utilized to implement a circular economy strategy (Antonetti et al., 2016; Pahrijal, 2023). Converting garbage is crucial for sustainable development, pollution reduction, and using a circular economy strategy. New materials of high intrinsic value and superior

environmental impact may be created as a result (Pahrijal, 2023)

This was entirely made possible through many changes in waste management knowledge, behavior, and legislation of how waste is viewed in an economy. The circular economy is essentially designed to benefit the national government of every country to use the true potential of waste generated. The circular economy concept must be integrated into the waste management system in Indonesia. It was the watchdog of the producers to ensure the explanation of how they will get the circular benefit of circular economic policies. Emphasizing the reduction of waste generated rather than the thought of an economy is the ideal start to the profile of a sustainable pattern (Moalem & Kerndrup, 2023).

Moreover, the application of some specific types of tax credits in the development of industrial and environmental strategies is suggested as part of incentive-disincentive policies (Di Foggia & Beccarello, 2023). The use of tax credits may also motivate or demotivate the taxpayers to implement some waste policy innovations. This scheme is better described as the approach of incorporated policy (Di Foggia & Beccarello 2023). A block of Incentive-Disincentive Policy may be framed in the Integrations policy approach. To acquire the approach, a few alternative ways are Incentive Funds and Compensation Policies. Any change in the law relating to waste management cannot provide incentives or disincentives without changes in the tax laws. The de-motivation acts as imposition (Di Foggia & Beccarello, 2023). Residents are keen to respond to incentives, rewards, fines, and benefit distribution coefficients (Jiang, 2024). This might generate some residents' participation if incentives and rewards, as well as fines or taxes, are imposed. The generation of financial surpluses and attainment of environmental objectives may improve the technique and arrangements of Waste Management. The creation of cost-reflective tariffs with Gain-sharing and a new methodology for competition may be practiced, as well as a criterion for their effectiveness (Di Foggia & Beccarello, 2023).

The policies of Incentives and Disincentives are not used or imitated separately. This approach may be utilized and linked with the circular economy. It may transform the rubbish into valuable things. As a result, the approach offers several environmental benefits. Effective waste management may also be used as a source of producing a heap of money and other resources (Alvarez-Risco et al., 2022). The participants may employ some other reward generation measures in addition to the monetary rewards and financial gains (Jiang, 2024). Enforcing these standards has economic consequences, including employment creation and value addition, as well as environmental advantages such as resource recovery and waste minimization. Implementing these policy measures is crucial, as using incentives or penalties can effectively influence waste management practices within communities and businesses (Wilts et al., 2016). Reward-based programs that offer monetary benefits can motivate eco-friendly waste management behaviors, while disincentives such as disposal fees or fines for breaking regulations can drive behavioral changes. Nevertheless, obstacles in implementation and institutional discrepancies need to be addressed (Souza Piao et al., 2024). When crafting policies, it's essential to consider both the societal impacts by conducting

thorough impact analyses for policy development purposes.

The implementation of waste management policy driven by sustainability issues carries a great sense of impact on environmental conservation and public health. For instance, the incorporation of the concept of circular economy in waste management policies focuses on reusing, recycling, and recovering materials, hence minimizing waste and pollution. It is through such policies that a shift of paradigm occurs from mere waste disposal to resource recovery, opening avenues toward environmental sustainability in the long term, besides economic opportunities through the creation of green jobs and industries. Public-private partnerships have been pivotal in promoting innovation and investment in infrastructure pertaining to waste management, thereby improving efficiency and environmental outcomes. Incentives and disincentives in the form of tax credits and waste management fees would go a long way toward making sure individuals and businesses alike behave responsibly, thus also reducing environmental impact caused by their waste. Here, a waste management approach oriented toward sustainability will not only address current challenges but also set up a model for resilience and resource efficiency in the long term.

Conclusion

This study has been done to present a comprehensive analysis of waste innovation policy in Indonesia. This research focuses on the different methods of waste innovation, including community empowerment, technology-based innovation, Corporate Social Responsibility (CSR), government-community programs, etc. The study presented different kinds of waste reduction innovation programs used in several places; for example, the learning students on waste management in the educational field, the waste management in the CSR field, and various public and private technology-based policy-managing authorities in different international tourist spots and hot spots of tourists in the major cities so far drowned backward. However, one severe critical observation of the study is as follows: Although the use of community empowerment to reduce waste is innovative and has been able to implement in any local case study, the overall effect of the new policy of waste reduction may not be able to maximize the role of the government while considered as the policy makers. Thus, most of the innovative waste reduction activities can be stated as the flattery activities to hideout, which the government does not have. Such statements are mentioned in the conclusion and secondary source with data on the possible waste reduction by the use of waste innovation policy. The platform of the policy innovation in any local case studies will not be the last word to them, meaning the scope or boundary for developing such policy at the national level. Many innovative ideas cannot be used in most of the cases, but most of the case studies are based on local policy implementation. The scope for the locally used policy, as mentioned earlier, also limits the overall method in Indonesia. People are now looking forward to new policies. Hence, if compared on an international scale, the waste innovation policy of Indonesia will last by using a technical regulation and policy to incentivize - disincentivize, different public and private partnership policies and policies for circular economy reduction of waste. Some environmentalists, along with some

specialists and principal investors in the country, are seeking new policy on waste for the perfect and sustainable growth of the country. Also, an incentive-disincentive policy solution, for instance, tax credits and rewards-based programs, is suggested for the grand strategy to prevail in altering the behaviors towards a responsible waste management practice and making an all-inclusive society. According to the studies conducted, people and businesses are heavily and effectively influenced by incentives to perform or not to perform any act, and the plan will help in aligning the individual's and the businesses' interests with environmental sustainability and development. However, further empirical research and policy development are required to modify and implement this structure for a more effective waste reduction policy in Indonesia.

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