A Review of the Implementation of Sustainable Plastic Waste Management

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Abstract

Since the Chinese government prohibited the import of plastic waste, it has encouraged the Japanese government to increase the domestic processing of plastic waste. In 2018, among the highest rates worldwide, Japan successfully recycled up to 84 percent of all plastic collected. Although some efforts have been made by the Indonesian government to collect plastics, the overall performance of plastic recycling is unknown due to the failure to integrate informal sector recycling actors' activities with the government and community activities in the formal sector. This limited information on the generation and management of plastic waste is a gap that needs to be addressed. This study was conducted using a qualitative descriptive method through an article review. The article review was conducted on several scientific articles on post-consumer plastic waste management policies in Japan and Indonesia. In general, plastic recycling activities in Japan are more formalized in terms of collecting and recycling through a special organization founded by the Japanese government, namely the Japan Containers and Packaging Recycling Association (JCPRA). The JCPRA helps the Japanese government to provide more detailed documented data on policy development and technical management of plastic waste. One that can be applied by Indonesia is to form an organization similar to JCPRA in Japan to become an operator in managing the plastic materials flow and plastic waste recycling in Indonesia so that Indonesia can provide valid information on plastic waste generation and management to develop plastic waste management strategies to control plastic waste pollution in the environment.

Keywords: *Plastic Waste*, *Plastic Waste Management*, *Recycling.*

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A. INTRODUCTION

Plastic manufacturing in the world has increased from 1.5 millions of tons in 1950 to 367 millions of tons in 2020. China manufactured 32 percent of all plastics in 2020, coming in behind the North American Trade Agreement produced 19 percent followed by Asia with 17 percent. Europe has the fourth highest plastic manufacturing, accounting for 15 percent of the worldwide production (Plastics Europe, 2021). Plastic packaging has the greatest demand nevertheless has the briefest lifecycle; a majority of these polymers are discarded in similar year of manufacture. Plastic is pervasive in today's culture, and innumerable things are wrapped in plastic wrapping. Approximately 6300 millions of tons of plastic litter has been produced in 2015, with around 4900 millions of tons accumulating in dumping sites or in the earth's ecosystems (Geyer et al., 2017).

According to Deus et al. (2020), the production of waste, which includes plastic, metal, and glass, is growing more commonplace in modern civilization as well as is quickly becoming a pervasive component of everyday life. The growth of plastic waste, with its diverse uses and forms, is a worldwide catastrophe with wide-

ranging consequences (Andeobu et al., 2022). Plastic waste pollution of the environment has grown to be a serious global problem (Huang et al., 2020). Plastic waste has harmed ecosystems by redistributing species, ensnaring creatures, and inflicting biologically loss or harm throughout consumption. Additionally, hazardous compounds may be released by plastics that wind up in landfills. These substances have the potential to contaminate groundwater (Welden, 2020). According to research, there are over 5 trillion pieces of plastic debris in the world's seas, endangering ocean creatures and disturbing sensitive marine ecosystems. Furthermore, it is anticipated that by 2050, plastic would outnumber fish in the marine (Brindha et al., 2021; Ramasubramanian, Sundarrajan et al., 2022). Currently, the linear plastic economy is both mankind and the earth's concern; it actively contributes to climate change, depletes the earth's resources, harms the health of humans, and creates unimaginable quantities of trash (Barra et al., 2018). Otherwise the condition of the system improves, plastics manufacturers are going to keep harming environments, causing more ecological, societal and economical destruction (WWF et al., 2020).

The Extended Producer Responsibility (EPR) principle is an integrated strategy that demands producers to assume monetary – and often organizational – responsibility for collecting, separating, and processing the goods they produce at the final stage of their useful lives (Dimitropoulos et al., 2021). The EPR initiatives are often a deeply integrated blend of state regulation and manufacturer responsibility. The initial EPR systems were established in the last decade of the 1980s and have since been extensively implemented. Approximately 65 EPR programs for packaging are in existence worldwide (Ocean Conservancy & Trash Free Seas Alliance, 2019; Ellen Macarthur Foundation, 2021), 45 of which are obligatory and charge-based. The approach is currently acquiring traction, primarily in high-income nations (Ocean Conservancy & Trash Free Seas Alliance, 2019). The EPR mechanism, which encourages less packaging use and the promotion of more reusable packaging alternatives, is seen as an effective way to mitigate the damaging effects on the environment related to post-consumer waste in order to quickly achieve the circular economy within the framework for waste management (Pandey et al., 2021; Lorang et al., 2022; Ragupathy et al., 2022; Subbaiyan et al., 2022). About 400 EPR programs are in operation globally, with the majority of them situated in European Union (EU) member states where waste law provides basic guidelines for their usage. Regardless of EU legislation, national EPR systems and their effectiveness in achieving stated reuse and recycling targets vary among nations but have comparable aims (Deus et al., 2020; Pandey et al., 2021). The EPR programs in Europe have contributed in the improvement of waste reduction, recovery, and recycling. About 26 millions of tons of post-consumer plastic waste produced in 2015 were recycled 30 percent of the time and burnt with the extraction of electricity 40 percent of the time (Oke et al., 2020; Ramasubramanian, Chinglenthoiba et al., 2022). Pre-determined disposal costs and return-recycling stipulations may compel producers to utilize fewer plastic packaging in their products. The Producer

Responsibility Organization (PRO) is essential for promoting knowledge and encouraging responsible waste management among producers and consumers (Gu et al., 2019). The scope of the PRO was expanded in 2003 to include manufacturing, company, and transportation packaging debris, as well as home packaging waste. This organization was established in response to the Packaging and Packaging Waste Directive (PPWD), and the trademark "the Green Dot" is registered for packaging subject to such regulations (Lorang et al., 2022).

A circular economy's primary goal is to minimize both the use of earth's resources and the amount of waste generated by the human activities and returned back into the earth. Consequently, strategies for the circular economy focus on enhancing the efficiency in operation of capitalist economies in order to sustain their enduring ecological and economic viability. The concept of circular economy suggests that resources and things be kept at their best value for as long as feasible (Lorang et al., 2022). Therefore, the adoption of EPR mechanisms is dependent on producers, governments, and extensive consumer engagement. The most critical factor in efficient plastic waste management is consistent and reliable policy (Tsai et al., 2021). Unlike previous rules, which emphasized end-user responsibility, the new EPR regulations stress the importance of producers and proprietors of brands in controlling plastic waste. In the lack of a defined national strategy, waste management programs undertaken at the level of local governments are ineffectual (Fernando, 2019).

By the implementation of the Chinese government's plastic waste import restriction in 2017 as well as the modification to the Basel Convention in 2021, numerous nations noted the decreasing of destinations for plastic waste export and the necessity for domestic recycling of plastic waste. Therefore, many nations have established plastic waste policies to be applied locally in order to respond to China's import restriction on plastic waste and the Basel Convention amendment (Ishimura, 2022). China, followed by nations in South East Asia, is currently the biggest plastic waste producer worldwide. A total of 8.9 millions of tons of plastic trash are produced annually in Indonesia, the Philippines, Vietnam, Thailand, and Malaysia. In per capita terms, Japan is ranked as the second largest producer worldwide (Gong & Trajano, 2019). Prior to China's import restriction, Japan sent out about 1.36 millions of tons of plastic trash to China and South East Asia in 2017. This was approximately one-sixth of its annual production. By 2018, the ban had dramatically reduced that figure to 0.91 millions of tons, prompting the Japanese government to increase the domestic processing of plastic waste and look for alternative destinations, like South East Asia, that would be willing to take its plastic waste (Kuan et al., 2022). In 2018, among the highest rates worldwide, Japan successfully recycled up to 84 percent of all plastic collected (PWMI, 2019). Approximately 23 percent of Japan's plastic waste is mechanically recycled, followed by 57 percent which is thermally recycled, and 4 percent which is chemically recycled (Morita & Hayashi, 2018).

In Indonesia, plastic waste is managed as part of domestic waste management. Plastic waste management is mostly carried out through recycling markets involving informal sector actors such as waste traders and scavengers (Damanhuri & Padmi, 2012). Although some efforts have been made to collect plastics, the overall performance of plastic recycling is unknown due to the failure to integrate informal sector recycling actors' activities with formal sector governments' and communities' activities (Sembiring & Nitivattananon, 2010). The absence of data on waste generation and management, including information on marine litter and recycling sectors and activities, as well as the lack of centralized data and information on plastic waste generation and management have a significant impact on the plastic waste management process in Indonesia (Akenji et al., 2020). This limited information on the generation and management of plastic waste is a gap that needs to be addressed.

This study takes Japan as a reference in plastic waste management, considering that Japan has a special instrument in the form of an organization established by the Japanese government by law, namely the Japan Containers and Packaging Recycling Association (JCPRA), which aims to protect the environment in Japan and contribute to the development of a healthy domestic economy by recycling container and packaging waste in accordance with sorting standards on behalf of designated business entities, as well as promoting the recycling of container and packaging waste, educating consumers, and collecting and disseminating information (JCPRA, 2022). Through the JCPRA, the Japanese government can monitor and assess the performance of container and packaging waste generation and recycling. An important element for both countries is the marine area in both countries that need to be protected from plastic pollution due to the alarming increase of plastic waste in the ocean, especially from land-based sources. This study is expected to serve as a basis for Indonesia to develop a plastic waste management strategy to control plastic leakage into the environment by improving an efficient and effective recycling system, leading to plastic circularity, through the establishment of a body or organization that promotes the plastic container and packaging waste recycling of Indonesia.

B. METHODS

This study was conducted using a qualitative descriptive method with data collection techniques through an article review. The article review was conducted on several scientific articles on post-consumer plastic waste management policies in Japan and Indonesia. This study examines how post-consumer plastic waste management policies in Japan contribute to increasing the rate of plastic recycling in order to decrease the amount of plastic waste discharged into the environment through a review of the literature on post-consumer plastic waste management policies in Japan, including the work of Kuan et al. (2022) and Ishimura (2022). A comparison of the implementation of post-consumer plastic waste management policies in Indonesia is made by referring to related literature published in scientific

journals, such as the research of Pramiati et al. (2021) and Maskun et al. (2023). By documenting various laws and policies in Indonesia regarding the post-consumer plastic waste management, an analysis of opportunities to increase plastic recycling and reduce plastic waste discharged to the environment is formulated descriptively in this comparative study. Through the documentation of regulations and policies related to plastic waste management in Indonesia, this comparative study describes the gap in the completeness of legal and organizational instruments in supporting plastic waste management in Indonesia compared to Japan, which has been more successful in increasing plastic recycling rates and reducing the amount of plastic waste wasted to the environment.

(a) (b)

Figure 1. Study Area:
(a) Japan; (b) Indonesia
Source: nationsonline.org (2023)

C. RESULTS AND DISCUSSION

1. Plastic Waste Management Regulations and Policies in Japan

According to research carried out by Kuan et al. (2022), Japan's plastic recycling laws and policies were formed over time. The issuance of the Dirt Removal Law in 1900 marked a milestone in Japan's regional and local government's ability to start handling waste disposal. Since the law's enactment, household waste production in urban regions of Japan has rapidly increased.

To enhance community cleanliness, the Japanese government issued the Public Cleansing Law in 1954. The Waste Disposal and Public Cleansing Law followed in 1970. The foundational legal framework for waste management in Japan today is comprised of these two statutes. In order to control waste recycling and disposal, the Promotion of Resource Recycling and Reuse Law and the revised Waste Disposal and Public Cleansing Law were both published in 1991. The Promotion of Resource Recycling and Reuse Law was issued with the intention of promoting recycling on multiple levels, including production, distribution, consumption, waste generation reduction, resource efficiency, and the environment preservation. In 1991, the components of waste disposal management and recycling

promotion were included in the revised Waste Disposal and Public Cleansing Law (Kuan et al., 2022).

Partially implemented in 1997 and fully enacted in 2000, the Law for the Promotion of the Sorted Collection and Recycling of Containers and Packaging mandates that producers and industries involved in the production and use of containers and packaging bear the cost of recycling these materials by paying fees to the Japan Containers and Packaging Recycling Association (JCPRA), a government-established organization. The Fundamental Law for Establishing a Sound Material-Cycle Society (FLMS), issued by the Japanese government, became operative in 2000. Extended producer responsibility (EPR), which mandates that producers assume primary responsibility for product manufacturing from the point of manufacture to the point of sale as well as the post-consumer phase, is a key component of the FLMS. Other parties with a stake in the establishment of a sound material-cycle society, including the national government, municipal governments, businesses, and consumers, are also held accountable under the Fundamental Law for Establishing a Sound Material-Cycle Society. Referencing the FLMS framework, a number of product-specific targeted recycling laws have been issued (Kuan et al., 2022).

The Green Purchasing Law was passed in Japan in 2000, requiring the central government, municipal governments, and affiliated entities to be in charge of acquiring ecologically friendly goods. The Act on Promotion of Recycling of Small Waste Electrical and Electronic Equipment was passed in 2010, encouraging the recycling of waste electrical and electronic equipment and giving business owners permission to do so. In 2018, the 4th Fundamental Plan for Establishing a Sound Material-Cycle Society was authorized, and periodic reviews will now be carried out every five years. A regional circular economy, ecological sphere, efficient waste management, environmental restoration, global resource circulation, and a disaster waste management system are all incorporated into the plan (Kuan et al., 2022).

To increase the plastic materials circulation, restrain plastic waste from entering the ocean, and encourage the utilization of bioplastics to replace non-biodegradable plastic materials, Japan published the Resource Circulating Strategy for Plastics policy in 2019. The strategy seeks to achieve a 25 percent reduction in single-use plastic waste creation by 2030, a 60 percent increase in container and packaging plastic recycling by 2030, and a 100 percent effective recovery rate for used plastics by 2035. The Japanese government also developed the Marine Plastic Litter Implementation Action Plan in 2019, which aims to reduce the unrestrained flow of plastic waste entering the ocean, foster innovation in the creation of materials to replace single-use plastics, and strengthen international partnerships with developing nations (Akenji et al., 2020). The history of Japanese laws and policies governing plastic recycling is depicted in Figure 2.

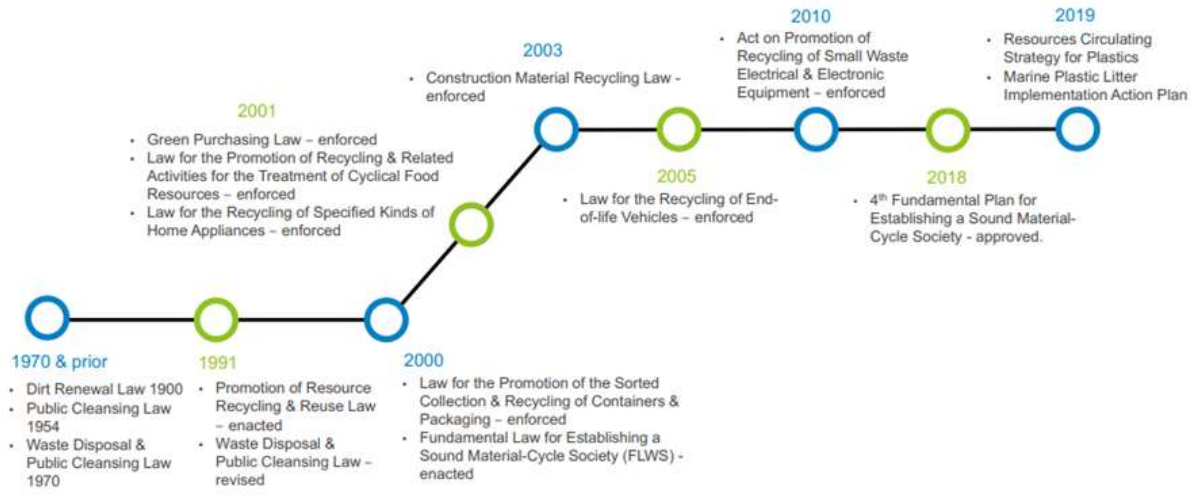

Figure 2. The Chronology of Regulation and Policy on Plastic Recycling in Japan
Source: Kuan et al. (2022)

Another research by Ishimura (2022) noted that the Containers and Packaging Recycling Law (CPRL), officially known as the Law for the Promotion of the Sorted Collection and Recycling of Containers and Packaging, offers municipal governments two incentives to recycle domestic plastic waste. With regard to the first incentive, the CPRL enables the municipal government to spend less money on locating recyclers who will participate in municipal waste recycling. Instead of local governments hunting for recyclers, the national government assists in locating and selecting recyclers to exchange plastic waste. Referring to the CPRL, municipals sell the waste that has been collected through competitive bidding by recycling businesses that are required to recycle household waste and are chosen by the national government. The second incentive is a subsidy to encourage local governments to raise the quantity and caliber of recycled plastic garbage. The Ministry of the Environment of Japan (MOE) revised the CPRL in 2008, enabling municipal governments to obtain financial assistance in accordance with the quantity and efficiency of plastic waste treatment and collection. To determine the value of the subsidy, the MOE examines the quantity and quality of each type of plastic waste in practically all municipal governments that have adopted the CPRL. The CPRL cannot be imposed by the national government on local governments. Because of this, some municipal governments choose not to implement it if they can deal independently with recyclers who will pay more for plastic waste; nonetheless, in such circumstances, plastic waste can be exported overseas.

According to Kuan et al. (2022), the partnership between the JCPRA and customers, municipal government, manufacturers or producers, and recycling enterprises is the foundation of the recycling process in Japan. The government established the JCPRA as part of the CPRL in order to promote recycling. On behalf of the manufacturers or producers, the JCPRA manages recycling programs for plastic packaging and containers used in retail, manufacturing, and transportation. The JCPRA is entitled to receive recycling fees from these manufacturers or

producers. When disposing of waste, consumers must adhere to the municipally mandated waste separation methods. The waste is subsequently collected and stored by the municipal government. As small enterprises are now exempt from recycling rules, the municipal government is also in charge of collecting their waste. Then, the JCPRA contracts recycling businesses to collect waste packaging and containers from approved storage places and to recycle the material. Each year, the JCPRA sets up a registration exam that recycling businesses must pass in order to be qualified to bid on public waste recycling bids. The winning bidder receives a one-year contract after nationwide bidding. The flow of plastic waste across stakeholders in Japan is depicted in Figure 3.

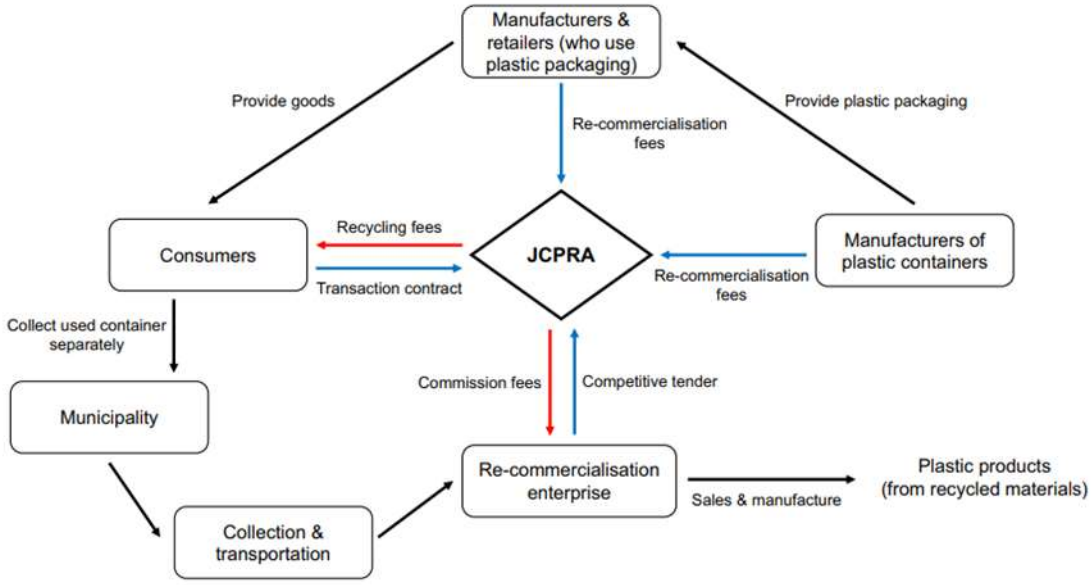

Figure 3. The Flow of Plastic Waste Across Stakeholders in Japan
Source: Kuan et al. (2022)

2. Plastic Waste Management Regulations and Policies in Indonesia

Currently, Indonesia does not have a legal instrument that specifically regulates the treatment of plastic waste. However, there are currently a number of regulations and laws that set the groundwork for how waste should be handled and controlled generally. The phrase "plastic waste" is not used expressly in any of the extant legal documents. The terms "difficult to biodegrade" and "reusable waste" as well as "recyclable waste" are used frequently in the legislative instruments' articles and paragraphs. The laws governing plastic waste are thus denoted by these phrases (Maskun et al., 2023).

Pramiati et al., (2021) revealed that the Indonesian government has demonstrated its concern for waste management issues by passing Law Number 18 of 2008 on Waste Management (Law 18/2008). The legal framework for waste management in Indonesia is Law 18/2008 (Maskun et al., 2023). The primary goal of this law's waste management mandate is to shift the waste management paradigm from the collecting-transporting-disposing system to minimizing at-source and

recycling. The government uses the EPR principle, the 3Rs strategy (reduce, reuse, recycle), and the processing and utilization of waste to resources, both as raw materials and renewable energy sources to replace the end-of-pipe approach (Pramiati et al., 2021).

Law 18/2008 was then supplemented by a number of derivative regulations for further clarification and application, including Government Regulation of the Republic of Indonesia Number 81 of 2012 on the Management of Household Waste and Waste Similar to Household Waste (PP 81/2012) and Government Regulation of the Republic of Indonesia Number 27 of 2020 on Specific Waste Management (PP 27/2020). The goals outlined in the National Policy and Strategy for the Management of Household Waste and Waste Similar to Household Waste (Jakstranas), which was adopted through Presidential Regulation Number 97 of 2017 (Perpres 97/2017), are then targeted by the approaches and strategies for waste reduction and waste handling outlined in these laws and regulations. Jakstranas is an eight-year, long-term master plan for Indonesia's waste handling and reduction that has several important goals (Maskun et al., 2023).

Furthermore, legal documents with more definite regulatory goals have also been passed in Indonesia. A legal instrument specifically adopted to deal with ocean litter is the Presidential Regulation of the Republic of Indonesia Number 83/2018 on Marine Debris Management (Perpres 83/2018). The most essential part of Perpres 83/2018 is in its annex, which outlines a National Action Plan (RAN) for a period of eight years. The RAN includes strategies, programs, and activities that serve as a reference for communities and businesses as well as a guide for other pertinent government ministries or non-government institutions in order to promote effective marine debris management (Maskun et al., 2023).

The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 75 of 2019 on the Roadmap for Waste Reduction by Producers (PermenLHK 75/2019) is another legal basis with a particular regulatory objective that addresses waste issues, particularly plastic waste, in Indonesia. By compelling producers to accept bigger responsibility for their products and/or product packaging until they reach the end of their life cycle and become waste, this instrument exemplifies the EPR principle. In accordance with Article 4 paragraphs (1) and (2) of PermenLHK 75/2019, the reduction mechanism established in this regulation applies to waste produced by goods, good packaging, and/or containers that (a) have difficulty decomposing through biological mechanisms, (b) not recyclable, and/or (c) not reusable. Plastic, aluminum cans, glass, and paper are considered products, as product packaging, and/or containers. Appendix I of PermenLHK 75/2019 provides a specified road map for producers to reduce waste (Maskun et al., 2023). The Republic of Indonesia's Ministry of Environment and Forestry (KLHK) has given producers until 2029 to minimize product waste and/or packaging by 30 percent. The reduction goal for plastic packaging waste in Indonesia has been incorporated into the producers' roadmap for reducing plastic waste, as stated in PermenLHK 75/2019 (Pramiati et al., 2021). Table 1 provides an

overview of the main provisions of Indonesia's laws and regulations pertaining to waste management as whole, and specifically plastic waste.

Table 1. Main Provisions of National Waste Management Legislation in Indonesia

National Legislation	Main Provisions
Law 18/2008 PP 81/2012 PP 27/2020	Two mechanisms are applied in waste management: 1. Waste reduction, waste recycling, and/or waste reuse are the three components of the reduction mechanism. 2. A handling mechanism that entails five steps, including the following: waste segregation, waste collecting, waste transportation, waste processing, and/or waste ultimate processing
Perpres 97/2017	1. A target of 30 percent waste reduction, or roughly 20.9 million tons, by 2025; and 2. A target of 70 percent waste handling, or 49.9 million tons, by 2025.
Perpres 83/2018	1. A commitment to reduce plastic waste by 70 percent by 2025 2. Has five strategies: (a) national campaign to educate stakeholders; (b) management of solid waste on land; (c) management of solid waste in coastal and ocean areas; (d) funding mechanism, institutional strengthening, institutional oversight, monitoring, and law enforcement; and (e) research and development. 3. Consists of 13 programs and around 57 activities
PermenLHK 75/2019	1. Recycling and/or reusing by manufacturers through the take-back or collection of waste from products, product packaging, and/or post-consumer containers. 2. Manufacturers are required to provide collection facilities 3. Manufacturers are required to reduce their waste in five stages of action, which must be completed between 2020 and 2029: planning, implementation, monitoring, evaluation, and reporting.

(Source: Maskun et al., 2023)

The jurisdiction and function of the government to establish policies and apply regulations and laws regarding the waste management in Indonesia extends not only to the national government but also to the local governments. Local governments, in partnership with the national government, are responsible for guaranteeing the execution of proper and environmentally-based waste management, according to Law 18/2008. One of the important competencies that local governments have in connection to completing the responsibility to regulate government affairs in the environmental sector, including waste management, is the capacity to develop policies and strategies. Several local governments in Indonesia, both at the district/municipal and provincial levels, have issued laws particularly regulating the utilization of plastic goods and the management of plastic waste in their jurisdictions, some of which have gone as far as banning some or all use of

plastics, especially plastic bags, which are the most commonly used plastic product in everyday life (Maskun et al., 2023).

According to KLHK, as of January 2021, at least two provinces and 39 districts/cities out of all provinces and districts/cities in Indonesia have adopted policies and/or legislation that limit or prohibit the use of single-use plastics (Liputan6.com, 2021).

4. Lessons from Japan and Future Perspectives

Indonesia should adopt Japan's system of establishing a central organization to oversee recycling activities under government supervision, similar to Japan's JCPRA. This organization can play a role in building relationships with all stakeholders and modeling the flow of plastic waste. Producers pay the organization a recycling fee, and the organization holds competitive bidding for recycling industries to bid on. In return, the organization may pay recycling industries commission fees. The existence of JCPRA in Japan makes it easy for the Japanese government to identify the flow of plastic waste material and assess the performance of plastic waste management and recycling.

This system by Bunemann et al. (2022) is referred to as an EPR system for packaging based on collective responsibility. In the collective responsibility system, the responsibility for packaging waste management is transferred from producers and importers to a third party called the Producer Responsibility Organization (PRO). The PRO is responsible for organizing all packaging waste management activities that represent all participants in the system so that the required producers do not need to sort packaging waste by brand. This is in line with what Amin et al. (2022) revealed in their research that the development of EPR with collective form is the most promising in supporting the circular economy transition in Jakarta. It is therefore recommended that the development of EPR for PET plastic in Jakarta focus on the establishment of an inter-organizational body that is able to improve the collection of plastic waste from households and reuse it into new products (Amin et al., 2022).

The PRO uses the fees they get to enhance separated trash collection while rendering it economically sustainable. Producers are obligated to pay different prices depending on how quickly the plastics may be recycled as well as the sort of plastic, i.e., household, manufacturing, or commercials (Nakajima & Vanderburg, 2006; Lorang et al., 2022). Figure 4 depicts an overview of the PRO's role in the plastics chain of value, encompassing take-back standards and initial discard charges.

Figure 4. Overview of the PRO's role in the plastics chain of value, encompassing take-back standards and initial discard charges

(Source: Ramasubramanian et al., 2023)

The EPR mechanisms varied significantly across Europe, and diverse methods may be noted in terms of the amount of PROs, the participation of local governments, cost mechanisms, and producer and municipal responsibilities and obligations (Cahill et al., 2011). For example, Germany possesses ten PROs rivaling amongst them, but Austria possesses seven PROs that have no competition amongst them. Spain possesses two PROs. The Netherlands and the Czech Republic as well as Portugal, on the other hand, each possess a single PRO. In the Czech Republic, municipal governments own the packaging waste after collecting and separating it, and they are allowed to trade it on the open trash market. In some packaging mechanisms, such as Austria or the Netherlands, municipal governments trade the packaging trash to a PRO after collecting and separating it (Ramasubramanian et al., 2023).

D. CONCLUSIONS

In general, plastic recycling activities in Japan are more formalized in terms of collecting and recycling through a particular agency or organization established by the Japanese government, namely JCPRA. Most of the plastic management policies in Japan are developed to address the economy circular aspect in order to achieve effective use of plastic waste through recycling on a proper formalized collection system. Additionally, Japan has more comprehensively documented technical development data and policies for managing plastic waste. Finding technical and policy solutions to lessen plastic pollution in the ocean environment is necessary for developing countries like Indonesia. To manage plastic material flows and plastic waste recycling in Indonesia, Indonesia can establish an organization similar to JCPRA in Japan. By doing so, Indonesia will be able to provide accurate information on plastic waste generation and management, enabling the development of plastic waste management strategies to reduce plastic pollution in the environment by enhancing efficient and effective recycling systems. This alternative can be put into practice by contrasting the management strategy for plastic waste in Japan with the

technique used in Indonesia, both of which are archipelagic countries with the issue of ocean plastic pollution.

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