
Study of Policy Implementation: Strategy of COVID-19 Plastic Waste Management in Indonesia

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Abstract: Plastic waste is an issue highlighted in Indonesia, especially the management of plastic waste and COVID-19 plastic waste. Now it is often the talk of society about how to manage plastic waste, COVID-19 plastic waste, and why people throw it away not according to regulations. This study aims to analyze the weaknesses of the waste management policy strategy and provide the best solution. A qualitative research approach using purposive sampling has been determined for policy-makers at the provincial and city levels, COVID-19 waste and waste managers, informal community leaders, and community members. Initial data was obtained using a Systematic Literature Review, and further data was obtained from in-depth interviews with 180 key informants. The results of this study indicate that the success of COVID-19 plastic waste management will run more optimally if it is communicated to the entire community through the information, communication, and education program, follows procedures, has an adequate budget, increases knowledge through training, and disseminates regulations to improve community behavior. The contribution of this research lies in two key factors; namely, success is largely determined by the involvement of the House of Representatives Province and City to increase the budget for plastic waste and Covid-19 waste management and increase public knowledge through regulatory communication.

Keywords: Policy Strategy, Plastic Waste Management, COVID-19 Waste, Local Government

1. Introduction

The World Population Review, in its 2022 report, released the 20 most waste-producing countries in the world. Countries in Southeast Asia dominate the ranking, and Indonesia ranks fifth. These countries already have various regulations and standards for waste management, but these regulations do not cover plastic waste, masks, and COVID-19 Personal Protective Equipment (PPE). These countries have sewer-related laws, including wastewater quality regulations for sewer systems. Urban planning and water pollution control laws are usually associated with sewer measures [1]. The results of Villanueva's research explain that waste is a problem because of the lack of public awareness, technical knowledge, laws and regulations, policies, and strategies are still the main problems in waste management. The government is trying to control the rapid

growth rate of waste generation and allocating adequate resources for waste management. Measures to increase reduction, recycling, reuse, and recovery should be implemented immediately. Governments may also have to amend appropriate legislation to promote these measures with financial incentives. In addition, improvements in proper data collection should be made to achieve sustainable waste management.

Research by Rizani et al., [22] explained that Indonesia has challenges managing national waste, especially ex-COVID-19 waste. People in big cities in Indonesia produce 62 million tons of household waste per year (70% of the total volume of waste). Data from the Ministry of Environment and Forestry, 2020, explains that garbage piles in cities and villages reach 73 million tons annually. The high generation of waste is

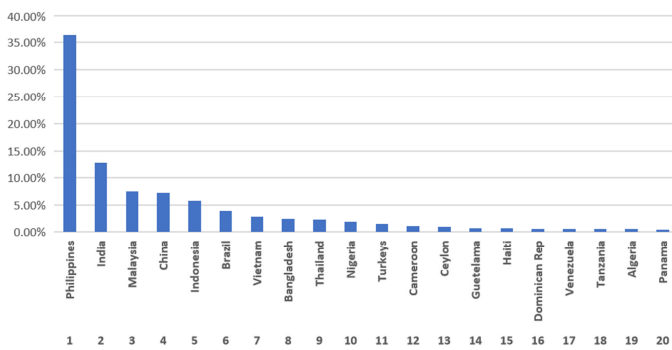
influenced by the function and level of mobility in urban areas [4]. Wilson DC [27] says that the volume of rubbish has increased since people moved from rural to urban areas.

In Indonesia, before 2008, waste management followed the classic collection, transportation, and disposal pattern in Final Disposal Sites (TPA). This traditional method results in increased waste accumulation in landfill. If left unchecked, it will cause new problems because the landfill cannot accommodate the increasing volume of waste. In 2008, the Central Government issued Law Number 18 of 2008 concerning Waste Management. Article 2, paragraph (1) explains that waste consists of household waste, namely waste originating from daily activities in the household, excluding dirt and special waste originating from commercial areas, industrial areas, special areas, social facilities, public facilities, and other facilities. He also explained three types of waste: liquid, solid, and gas. Subsequently, Government Regulation Number 81 of 2012

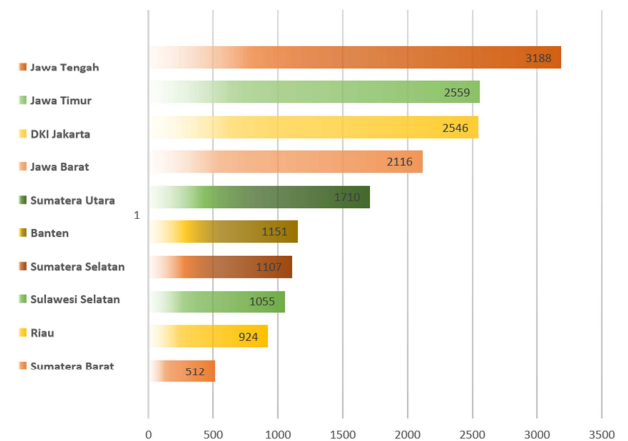
was issued regarding Household waste management. This regulation seeks to change the old paradigm; the industrial world, local governments, and the community must reduce waste by recycling and making useful materials. Regulation should includes food waste recycled for composting [16].

The research focuses on the ten largest waste-producing provinces in Indonesia, focusing on the capital cities of the province. On average, cities produce waste to reach 1,666 tons per m³ per day in 2020 and 1,684 tons per m³ per day in 2021, with a total waste production of 1,702 tons per m³ per day. The City Government has made a paradigm shift by involving community groups [1]. However, the rapid population growth rate of an average of 14% per year cannot be controlled and has an impact on many factors, including an increase in the number of generation waste such as textiles, metal, paper, plastic, and how to handle them that is not procedural [30] as shown below.

20 Countries with Most Plastic Waste

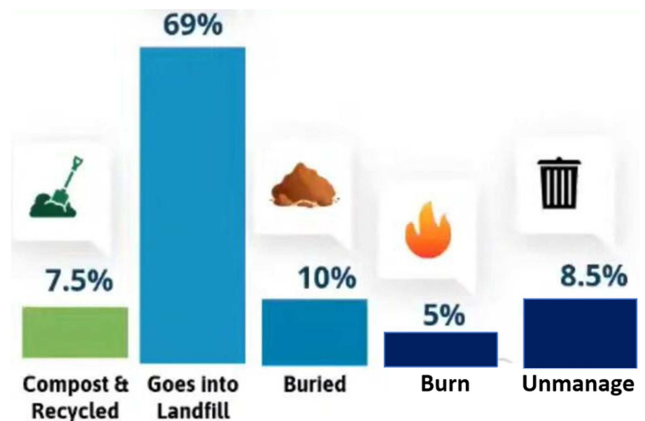
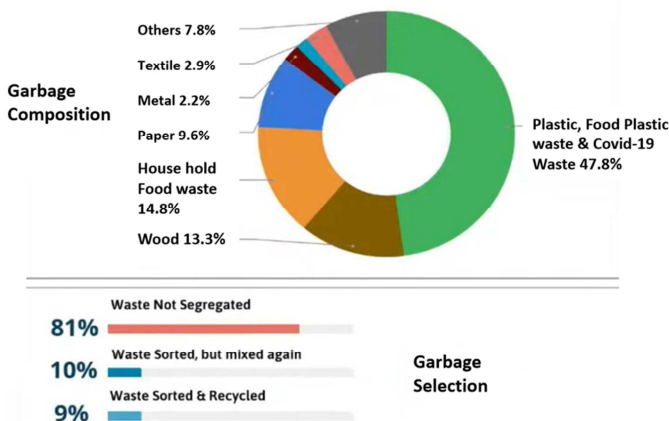


10 Provinces in Indonesia with Most Plastic Waste



Source: World Population Review 2022, and the Indonesian Central Bureau of Statistics, 2021

Figure 1. Countries in the World and Province in Indonesia with the Most Plastic Waste.



Source: Indonesian Central Statistics Agency, 2021

Figure 2. Waste Management in Indonesia 2020-2021.

Research questions, what are the obstacles and the best solutions for managing plastic waste during the COVID-19

pandemic in Indonesia? This study is useful for finding solutions to various problems faced by the Provincial

Government in Indonesia in managing plastic waste during the COVID-19 pandemic.

2. Methodology

This study obtained important information about policy-making steps [9] in managing used plastic waste from COVID-19. The reason for choosing the quantitative method is to understand the opinions of policy-makers, experts, community leaders, and community members in 10 provincial capitals in Indonesia.

2.1. Research Design

Data were obtained through in-depth interviews with 180 key informants. Researchers prepared interview sheets to obtain data on key informants' understanding of mechanical recycling, incineration, stockpiling, and mismanagement in the pre-pandemic, during, and post-pandemic. With the qualitative method, the more information obtained, the easier it will be to understand the hidden opinions of key informants using the probing technique [13].

Table 1. Number of Key Informants in 10 Provinces.

No	Provinces	Public Policy Maker (Province)	Public Policy Maker (City)	Waste Management Officer	Community Leader	Community Members	Total
1	Jawa Tengah	4	4	4	3	3	18
2	Jawa Barat	4	4	4	3	3	18
3	Jakarta	4	4	4	3	3	18
4	Jawa Barat	4	4	4	3	3	18
5	Sumatra Utara	4	4	4	3	3	18
6	Banten	4	4	4	3	3	18
7	Sumatra Selatan	4	4	4	3	3	18
8	Sulawesi Selatan	4	4	4	3	3	18
9	Riau	4	4	4	3	3	18
10	Sumatra Barat	4	4	4	3	3	18

Source: Researcher, 2022.

2.2. Data Collection Instruments

Interviews were conducted with 18 people to informants for each province. In detail, it consists of 4 policy-makers (provincial government officials), four city government officials, four waste managers in the field, three community leaders, and three community members. After that, in-depth interviews, triangulation techniques, and 2 FGD meetings were held for each province to obtain accurate data. This research is also supported by the Systematic Literature Review technique [12], which obtains initial data from various reading sources, laws and regulations, journals, proceedings, books, and other supporting documents. These results will be obtained by classifying the categories of supporting and inhibiting factors in the implementation of COVID-19 waste management. It begins by reviewing the legal basis and direction of policies, programs, resources, budgets, attitudes and dispositions of implementers, and procedures.

2.3. Ethical Considerations

The entire research process is carried out concerning ethical considerations in this study. The researchers obtained approval from the University, government, and local government to participate in the research and take care to avoid causing physical or psychological harm to key informants by asking embarrassing or irrelevant questions and using language that threatens or makes them nervous. Researchers treat key informants' views with respect and the highest confidentiality. Generally, the researchers observe a

high level of openness about the purpose and nature of the research.

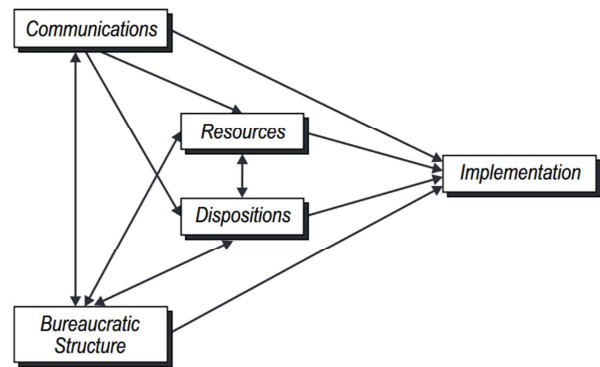
3. Theory and Concept

In Indonesia, plastic waste in the COVID-19 era is a problem in many countries because plastic waste is always produced by humans daily. Since the pandemic started in 2020, the Indonesian government and environmentalists have reminded the public about the dangers of infectious waste. Together they are redefining the scope of infectious and medical waste: all waste used by patients, suspects, caregivers, asymptomatic persons, and medical personnel will be treated as infectious waste [17]. Whereas humans in their daily lives always sided with waste, such as household waste, mineral water packaging, tissue, and various other types of waste also originating from human production [26], also about COVID-19 masks [6]. Besides household waste, there is industrial waste such as metal and glass. If the amount of waste cannot be controlled, it will cause new problems for human survival [3]. For example, poor waste management will impact health and disrupt environmental ecosystems [24].

In overcoming the problem of plastic waste in 10 Provinces and Capital cities, the policy model developed by Edwards is used [18]. According to him, the success of public policy implementation is influenced by several factors; a). Communication is communicating matters relating to policies that are communicated to organizations and the public, the availability of resources to implement policies,

attitudes and responses of the parties involved, and the organizational structure of implementing policies; b). The local government provides supporting resources, namely skilled human resources, in implementing public policies effectively; c) disposition regarding the willingness of implementers to implement public policies, skills alone are not enough without the will and commitment to implement policies; and d). The bureaucratic structure explains the bureaucratic structure related to the suitability of the bureaucratic organization that organizes public policies. The challenge is how to prevent bureaucratic fragmentation because this structure prevents the implementation process from being effective. In Indonesia, policy implementation is often ineffective due to a lack of coordination and cooperation between government agencies. Of these factors, interactions occur and, in turn, affect implementation. The

model in question can be presented in the image below:



Source: George C Edwards, 1980: 148

Figure 3. Public Policy Implementation.

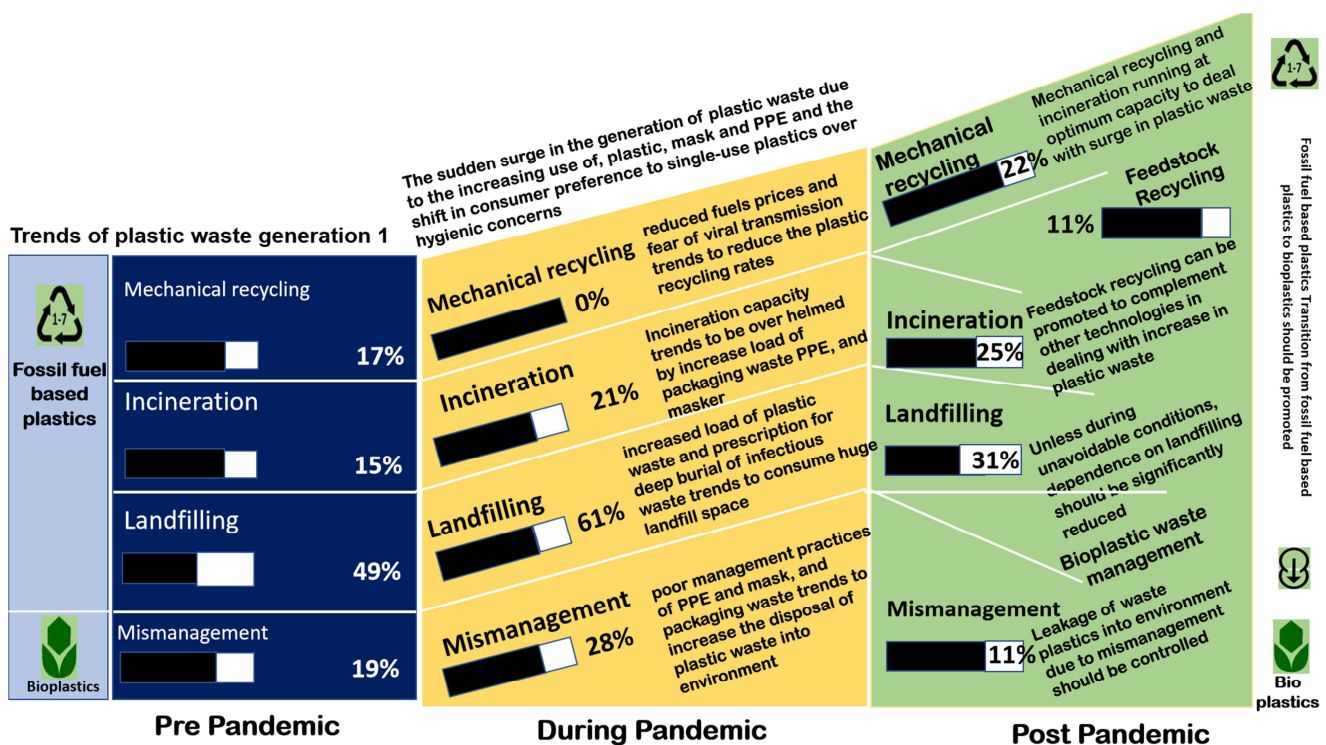


Figure 4. Trends in plastic waste generation and the implications of COVID-19 on existing waste management systems and possible solutions to challenges in post-pandemic waste management systems (data obtained from key informants, adapted from Vadapalli, (2021), and the Ellen MacArthur Foundation, (2017).

In this study, Edward's policy theory is combined with the concept of plastic waste management during the COVID-19 pandemic developed by the Macarthur Foundation [25]. Vanapalli explained that with the limited solutions available, there is a substantial need for innovation which should include addressing key challenges in plastic waste collection and integrating new technologies in separation and treatment into existing waste management systems. While increasing the capacity and efficiency of legacy processes and technologies, these new advances can complement their ability to sustain future surges in waste production. Similarly, scientific sterilization of infectious waste in processing facilities at the Puskesmas, such as steam sterilization (autoclaving), energy-based treatment (microwave, radio

waves), incineration, and chemical disinfection, will ensure a reduced risk of virus transmission from contaminated PPE and other plastics [29].

WHO has recommended high-temperature incineration as the preferred technique for infectious waste treatment [15, 23]. It is further suggested that in an emergency without access to such technology, deep burial should be preferred [11]. In addition, while considering the transfer of waste to centralized biomedical waste treatment and disposal facilities, safe collection and storage practices should be ensured in medical facilities to prevent infection from mismanagement of contaminated single-use waste [7]. Equipping sanitation staff involved in waste collection and transport with adequate safety equipment and supplies will minimize risks [10].

Besides that, the switch to automated systems with integrated artificial intelligence for waste segregation will reduce risks to the health and safety of the workforce. The introduction of automated systems with artificial intelligence for separation can increase the efficiency and speed of recycling and the quality and value of recycled products [8]. While automation can eliminate the need for manual labor, the increased value of wastage can result in jobs in areas associated with the profitable utilization of this by-product. While automation can eliminate the need for manual labor, the increased value of wastage can result in jobs in areas associated with the profitable utilization of this by-product. So, this should be seen as redefining employment and developing a skilled workforce, not just eliminating it.

4. Analysis and Result

All provinces and cities in Indonesia have a legal basis for waste management, namely Provincial Regulations and Mayor Regulations. For example, Serang City, Banten Province, has Mayor Regulation Number 43 of 2019. Article 7 of the regulation describes policies and strategies for waste management, namely (1) waste reduction and handling policy directions and (2) waste reduction and handling programs through waste generation reduction programs and priority waste types. This activity is carried out in stages with a pre-determined period.

Then each Province and City have a landfill facility with an average area of 5-15 hectares. Several provinces are trying to increase the land area by 5-10 hectares within ten years. The TPA applies a waste management method by covering the waste generation with covered soil. The thickness of the cover layer is at least 20 cm, with a layer height of 5 meters. Before being covered with soil, the waste is sprayed with a special chemical EM4 to help decompose the waste, then sprayed with Lannate Dupont chemical to reduce the breeding of flies. They then installed a methane gas collection pipe. The application of this method can reduce the volume of waste generation by an average of 7.34 million tons per year. Each province is trying to socialize waste management to the community and improve the ability to handle waste through a change in mindset, that waste is no longer a source of problems but becomes a commodity that provides added economic value through waste bank management [28]. By 2022, the 'ground cover' method will no longer be effective. According to Booth and Cox [5], land cover is a key indicator of land condition and influences land management decisions, but there has been little progress in land cover measurement methods. Soil cover is a key indicator of pasture condition and influences pasture management decisions, but there has been little progress in measuring ground cover.

According to the latest research [2, 19], landfill waste management in Indonesia has three main problems: (a). The traditional waste management system with 'ground cover,' namely by collecting, transporting, and disposing of waste, is no longer effective; and b). Community understanding,

where not all of them have the mindset that waste can provide high added value through waste banks, and people throw garbage carelessly. (c). Waste management is not bridged by environmental changes, namely sustainable waste management through resource capabilities, ecological conditions, economy, and future-based management. The results of interviews with key informants obtained results as described below.

4.1. Communicating Policy Direction

Government Regulation Number 43 of 2019 concerning Regional Policies and Strategies for the Management of Household Waste and Similar Household Waste States that the direction of waste reduction policies is carried out by limiting waste generation, recycling waste, and recycling waste. Waste management is done through sorting, collection, transportation, and final processing. The strategy is in the form of a Waste Reduction Strategy, which includes the application of waste norms, standards, procedures, and criteria, strengthening coordination and cooperation between the central and local governments, and strengthening the commitment of executive and legislative institutions in the regions, in the provision of budgets, capacity building of leaders, institutions, and human resources, and the establishment of information systems. From interviews with key informants in 10 provinces, it can be concluded that the Waste Management strategy is problematic due to the low ability of public communication. As a result, socialization of the application of norms, standards, procedures, and criteria for waste sorting is not well socialized. Obstacles also occur in coordination and cooperation between institutions related to waste management, weak executive and legislative support in the regions in the provision of budgets, and human resources, community involvement through communication, information, and education, as well as weak law enforcement, and the absence of institutional roles. Outside the government to develop investment, operation, and maintenance schemes, or involve the business world through partnerships in managing and utilizing waste into compost, traditional technology. In reducing and handling waste, the target of 30% of the waste generation rate has not been achieved, and 70% of waste management has not been achieved from the amount of waste generated. When asked for advice on waste management, the key informant suggested that the government follow the Jakstrada program, namely the National Program for Management of Household Waste, Similar Waste, and Household Waste, which is a breakthrough in national and regional waste management. Jakstrada has a policy direction of reducing waste in 2025 by 30%, or 49.9 million tons of national waste generation, and the target direction of waste management in 2025 is 70%. Meanwhile, the projected waste generation in 2025 is 71.3 million tons.

4.2. Organizational Structure and Program Implementation

The bureaucratic structure explains the structure related to the suitability of the bureaucratic organization implementing public policies. The challenge is preventing bureaucratic

fragmentation, as this structure hinders an effective implementation process. Provincial and policy-makers explained that many city governments still traditionally do the general waste management paradigm. The traditional way is to collect, transport, and dispose of waste in landfills. This traditional method has begun to be improved by introducing the 3R (reducing-refuse-recycle) concept with an environmentally friendly waste management pattern. The trick is to start the selection of waste sources; then transported by officers, disposed of in a temporary shelter, recycled, and finally stored in a waste bank. As of 2018, the average number of waste banks managed in a circular economy per province is 7,488 units, with an average ability to manage 3.3 million tons per year and attract 245,938 customers with an average total income of IDR. 3.5 billion per month. When this research was conducted, Waste Banks had already been introduced in several real estates in several big cities. The establishment of a waste bank aims to make

the public understand the management of waste banks and can continue waste bank activities to improve the community's economy. In addition to the waste bank, the TPA is targeted to be able to manage waste using EM4 and will be used as biogas [21]. This activity is supported by research that biogas waste is useful for turning on electric lights around the landfill and as fuel for gas stoves.

4.3. Resources and Funds

Financial resources play an important role in policy implementation. The waste management budget in the study area in 2020 is an average of IDR. 230.4 billion (equivalent to \$51,594,394). The budget is used for dump truck repairs and operations, infrastructure conservation, and honorarium costs. The City Environment Agency manages this fund. The following data shows the limited budget for waste management in 10 provincial capitals.

Table 2. Waste Management Budget in 10 Provinces.

No.	Provincial Capitals	Waste Budget per Provincial Capital	
		Billion IDR	US Equivalent
1	Semarang (Jawa Tengah)	117	7,860,083.4
2	Surabaya (Java Timur)	368	24,722,313.6
3	Jakarta (Nation Capital)	1,400	94,052,280.0
4	Bandung (Jawa Barat)	121	8,128,804.2
5	Deli Serdang (Sumatra Utara)	42	2,821,568.4
6	Tangerang Serang (Banten)	109	7,322,641.8
7	Palembang (Sumatra Selatan)	52	3,493,370.4
8	Makasar (Sulawesi Selatan)	66	4,433,893.2
9	Pekan Baru (Riau)	12	806,162.4
10	Padang (Sumatera Barat)	17	1,142,063.4
Total Budgets in 10 Provinces		2,304	154,783,180.8

Source: Revenue and Expenditure Budget Document Provinces, 2020.

The data obtained from key informants indicate that the waste transportation facilities are not adequate. There are 35 dump trucks supporting facilities and infrastructure for waste management, 10 of which were heavily damaged, 3 of them rather damaged, and 22 in good condition. The number of TPS, as many as 58, spread in several corners of the city. With such conditions, the government seeks to anticipate delays in transporting waste in urban areas, but the limited number of garbage trucks. The Environment Agency gets its budget from the Regional Revenue and Expenditure Budget (APBD) and retribution funds. The APBD funds are as described above, while the retribution funds are obtained from the retribution for waste services. The number of retribution funds received in 2020 is an average of IDR 15 billion – IDR. 600 billion (equivalent to \$1,006,740 – \$40,308,120).

The levy is set in stages based on the type, characteristics, and volume of waste. The levy results are used for waste handling activities, providing waste collection facilities, handling emergencies, restoring the environment due to waste handling activities, and increasing waste management competence. With the total funds obtained by the Environment Agency, it turns out that they are still

complaining about the lack of budget for waste management. The key informant added that the government could still make efforts to increase budget funds by adding to the official budget from the collected cleaning levies. The growth of GRDP per capita in the city is quite high, an average of 7.66% per year. This condition shows the potential for increasing regional income from the cleaning sector is very large. In addition, the agency must also increase revenue by developing the potential for waste and generating economic value. Waste should not only be considered as an object of regional financial expenditure but can be a source of Regional Original Income.

4.4. Attitude Disposition

Waste management is led directly by each Governor and Mayor. However, these findings explain that the district does not synergize with the agency in its implementation. The key informant explained that the sub-districts involved in environmental cleanliness have only been seen as implementers, ordered, and do not need deliberation and socialization. The top-down policy allows for a tendency for sub-districts not to do what the Environment Agency

wants them to do. Implementers can resist the successful implementation of waste management policies. The attitude of the sub-district is influenced by its views on waste management policies and environmental services policies towards the interests of the sub-district. The intensity of the disposition of the sub-district as a policy implementer can affect the implementation of waste management policies. The intensity of the limited disposition will also lead to failure in implementing waste management. The sub-district expects the office to include a budget and waste management program. The perceived impact is the increasing volume of waste produced, and people are not fully aware of the dangers posed by waste. For example, a waste bank recycles waste into compost, liquefied gas, and carbon, aiming to reduce the volume of upstream waste into residual waste. This activity involves elements of the provincial, city/district governments. The areas with the most waste are those with the densest population. People in the densely populated villages have formed waste banks with self-help funds. If the Environment Agency does not immediately anticipate it, the kelurahan and the community can apply a dispositional attitude towards waste management policies.

4.5. Waste Management Implementation

The key informant explained that the weakness of the city government's procedures was seen in the monitoring activities of waste management. Government personnel is rarely seen in the field monitoring plastic waste generation for PPE and masks. They only hand over waste management to field officers. Due to the absence of supervisory officers, garbage transportation is often scattered when transported by dump trucks. There are no sanctions and warnings for dump truck drivers and people who litter.

Figure 1 illustrates the phenomenon of illegal waste, where waste management in Banten and Jakarta uses a dump truck. The following picture shows that people are still littering in the river. The impact is river pollution, garbage accumulation, and health problems for the surrounding community. This incident shows that the government's socialization and communication efforts do not significantly impact behavioral society and mindset. Key informants explained the contributing factors, namely the lack of supervision, facilities, infrastructure, and human resources and the lack of budget availability. Aspects of socialization and coordination are very important because the success rate of waste management policies greatly affects the implementation of socialization and policy coordination. The city government has conducted socialization by holding waste management seminars and cooperating with various agencies. This socialization and coordination have not involved many sub-districts and community groups. As evidenced by the lack of information obtained by the public, they still throw garbage carelessly. Figure 2 shows that the wastage of COVID-19 masks and PPE is not managed according to the use of tools and can lead to transmission.



Figure 5. The phenomenon of Legal and Illegal Waste Management in ten Big Cities.

Source: Provincial and City Government Environment Agency, Indonesia, 16 February 2022.



Figure 6. Waste Management of PPE and COVID-19 Masks.

Source: Provincial and City Government Environment Agency, 16 February 2022.

4.6. Distance from RIVER

The key informant explained that landfill is a potential threat to rivers, wetlands, ponds, and lakes, due to the production of leachate and gaseous pollutants. Therefore, this location should not be near the surface of the water. The distance from the landfill to the river must be more than 2 km. A distance of more than 2 km from the river is considered safe for the landfill site. However, the study area is flood-prone, indicating that the distance of 2 km between the river and the landfill is an appropriate value [10].

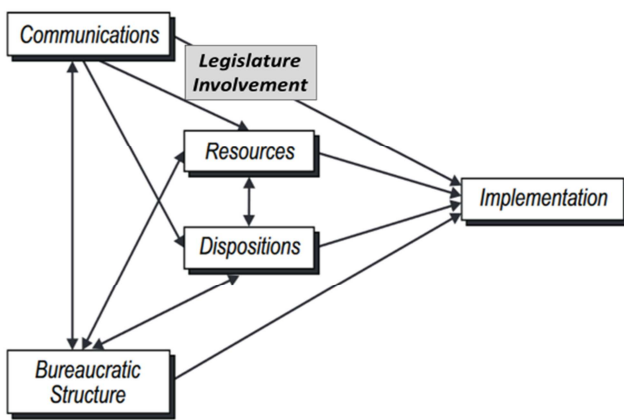
5. Model Analysis

5.1. Adjustment of the COVID-19 Plastic Waste Management Policy Model

House of Representatives Province and City (DPRD) has a budget function: preparing and determining regional budgets with the executive (local government). The budget function refers to financing all activities the government has planned. In carrying out the budget function, the DPRD must actively and proactively participate in every budget preparation process. DPRD must understand the essence of the budget used for the needs and welfare of the community. If it does not follow the community's needs, then part of the budget will be eliminated. The DPRD has the right to determine the number of local government budgets and programs. Important informants obtained from key informants that the role and involvement of the Regional House of

Representatives are very much needed to increase the waste management budget. They determine the amount of the waste management budget. They are the key to successful funding for the implementation of any policy. The city government needs to approach and disseminate information to every legislature member.

On the other hand, the city government needs political support from the City Council to facilitate policy implementation. Although the Serang City Regional Regulation Number 10 of 2012 already exists, it is still constrained by budgetary politics. From the analysis of the model developed by Edwards, the model needs to be modified to successfully implement the waste management policy. In the study area of this model, it is necessary to add the role of DPRD (legislative involvement). The model is described in the following figure.



Source: modified from George C Edwards, 1980

Figure 7. Implementing Public Policy in Regional Studies.

5.2. Adjustment of the COVID-19 Plastic Waste Management Concept

Since 2018 Indonesia has been considered the world's second-largest plastic waste contributor. It is estimated that 80% of the waste that enters the sea and rivers comes from land, of which 36% is COVID-19 waste. The Muara Gembong area, in the capital city of Jakarta, a coastal area, is traversed by the Citarum Watershed. Every rainy season the garbage that flows from the Citarum River to the sea reaches approximately 1 ton daily. Of 80% of the piles of garbage, 38% is COVID-19 plastic waste that is not recycled. The ministry explained that piles of garbage occur due to a lack of public awareness to dispose of waste. The answers in key informants are presented in the image below about trends in the generation of plastic waste, the implications of COVID-19 on the existing waste management system, and possible solutions to challenges in the post-pandemic generation.

In this study, factor weights were determined to clarify the level of importance. In this study, factor weights were determined to clarify the importance level intended to indicate each factor's priority level, based on data and information, as well as the reflection of different and similar

opinions. This study requires the opinion of key informants about the observed conditions and shows that more opinions are expressed, leading to greater priority and importance. In this study, the researcher obtained the weighting of key informants' opinions from 2 FGDs and triangulation. The picture is as follows.

Mismanagement of plastic waste occurs during a pandemic, misinformation, scary news, and death when in contact with other people's plastic PPE and masks. In the pre-pandemic period (2020), 17% of key informants observed that the mechanical recycling system for plastic waste had begun to be carried out manually by community housing groups. In 2021 the Ministry of Maritime Affairs and Fisheries will build a waste recycling center. In 2021, the Ministry of Maritime Affairs and Fisheries built a waste recycling center. PDU will continue in the next few years with the Root Analogous Municipal Solid Waste System RA-MSW [14], a new management system that manages waste, biogas, and leachate in bioreactor landfills [20]. Incineration (15%) in the pre-pandemic period increased during the pandemic (21%) and continues today (post-pandemic, 20%).

None of the key informants said the recycling system had worked well during the pandemic. Based on the data obtained from the interviews, none of the key informants observed the operation of the plastic waste recycling system. What happens is that people throw COVID-19 plastic waste into rivers, seas, and everywhere. Mechanical recycling during the pandemic does not work (2020-2021). The main reason is that the recycling center was only built mid-2021, and there are no skilled recyclers. There is tremendous fear from the public about the trend of virus transmission because various hoaxes are always circulating about the COVID-19 issue. Also, there is no fuel price reduction policy to reduce the COVID-19 plastic recycling rate. Instead, an increased combustible materials price increased up to 25%-30%. Some people burn garbage mixed with COVID 19 plastic waste in their home gardens or behind their houses, causing air pollution. There was an increase in incineration from 15% in the pre-pandemic to 21% during the pandemic.

Post-Pandemic 2022, the COVID-19 curve has started to tilt, and the economy is starting to run again. mechanical recycling and incineration are running at optimal capacity to handle the surge in plastic waste. The government and community groups collect plastic PPE and use masks for recycling (22%) and incineration (25%). Plastic materials are recycled into plastic buckets and children's toys (recycled raw materials, 13%). However, according to the key informant, there was a delay in waste management activities during the 'pandemic period' and 'post-pandemic.' Some people no longer wear and dispose of COVID-19 masks due to many factors. The main factor is miscommunication between government agencies and the community, where the ministers made many comments misleading the public in dealing with COVID-19. Some ministers say masks are unnecessary, or ministers talk on television about who does not want to be vaccinated, confusing the community, coupled with newsHoax Deathevery.

6. Conclusion

The study found that the COVID-19 waste and recycling system did not work well during the pandemic. Provincial and City Governments seem to panic during the pandemic. In the recycling system, only a small number of skilled workers are in each provincial and municipal landfill.

During the pandemic, there was tremendous fear from the public due to various hoaxes always circulating and rapid deaths. In addition, there is no government policy to reduce fuel prices to reduce the rate of COVID-19 plastic recycling; on the contrary, fuel prices have increased by 25%-30%.

Most of the community burns household waste mixed with COVID-19 plastic waste in the garden or behind the house or throws it into the river, causing pollution.

It seems that the government is releasing responsibility to the people. The COVID-19 incident is a valuable lesson for provincial and city governments to be better prepared to deal with post-pandemic COVID-19.

In discussing the factors of COVID-19 waste and plastic waste management, four factors determine success: policy direction, communication, organizational structure, program implementers, resources, funds, and dispositional attitudes. The Provincial and City Governments already have a plastic waste management strategy, but this policy encounters many obstacles in its implementation. Weak public communication causes these obstacles, lack of socialization of the application of norms, standards, procedures, and waste sorting criteria, coordination between agencies does not work, weak legislative support, and insufficient budget. The waste management budget is largely determined by the APBD, while the legislature determines the budget amount in the APBD at the time of ratification of the APBD. In Indonesia, the role of the legislature is very large. They are the ones who crossed out, reduced, and increased the amount of the budget in the context of efficiency. The performance of the department determines the criteria for increasing the amount of the budget. Therefore, the success of the waste management model in the study area is not enough to be determined solely by these four factors, and the involvement of the legislature is necessary.

7. Policy Recommendations

Provincial and municipal governments must be able to conduct training on waste management and COVID-19 waste from hand over responsibility to society. The provincial and city governments should guess useful information to deal with COVID-19 and plastic waste at any time.

Strict adherence to the COVID-19 plastic waste management policy requires all community groups, including direct involvement in starting planning, designing and implementing policies for dealing with plastic waste and COVID-19, which directly affects them, so that the participation of society increases.

The government needs a persuasive approach and intensive communication with the legislature, community

leaders and community groups so that the solution to plastic waste and COVID-19 waste can be handled properly.

Authors' Contributions

The authors contributed to the conception and design of the study. The first author wrote the draft of the manuscript, and the other authors read, approved, and translated the final manuscript.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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