http://ejournal.seaninstitute.or.id/index.php/Ekonomi
Jurnal Ekonomi, Volume 12, No 01, 2023
ISSN: 2301-6280 (print) ISSN: 2721-9879 (online)

THE PROBLEM OF WASTE IN RIVERS AND SEAS AND THEIR EFFECTS ON WATER QUALITY USING THE DPSIR METHOD

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INFO ARTIKEL

Keywords :
waste problem,
water quality,
DPSIR method.

ABSTRAK

The problem of waste in rivers and seas is an environmental problem that must be solved with a comprehensive approach. To answer this, the Driving, Pressure, State, Impact, and Response (DPSIR) framework is a universal method that is widely used to evaluate environmental conditions. The increasing use of plastic at the final level (consumers) is not in line with efforts to reduce river and marine waste. Handling river and sea waste is an obligation of all parties, and must be carried out starting when the garbage is still on land, in the upper reaches of the river, in the river flow, and when the garbage is already in the sea. This study aims to determine the effect of waste in rivers and seas on water quality. This research uses the DPSIR method, the DPSIR method is a method in conducting a system analysis to observe environmental problems and the community's perspective on these problems. The results of this study state that the quality of water used by the community is below the quality standards.

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1. INTRODUCTION

The *Driving, Pressure, State, Impact,* and *Response* (DPSIR) framework is a widely used universal method for evaluating environmental conditions. Complex environmental problems require an approach framework that is able to describe and communicate environmental problems comprehensively and the DPSIR framework is able to answer these problems (USEPA, 2015). The DPSIR method describes the causal relationship between various components in sustainable development, namely economic, environmental, and social (USEPA, 2015). The DPSIR framework/model illustrates that human socio-economic activities (*Driving Force*) exert pressure on the environment, affect the quality and quantity of the environment and natural resources (*State*), cause impacts on humans. Then the government and society, responding to changes that occur through environmental, economic and sectoral policies, and through changes in awareness and behavior (*Response*). Therefore, this method is relevant to discuss causal relationships related to environmental issues in Indonesia. Thus, policy makers can follow information related to complex environmental problems through cause-and-effect relationships and solve environmental problems systematically.

Globally, waste is the second most important environmental problem and one of the most highlighted problems globally is plastic pollution in the sea which reaches 8 million tons per year (IUCN, 2020). A global study conducted by Jambeck et al. (2017), Indonesia is the second largest country in the world to contribute plastic waste to the ocean after China. In 2019, of the total waste generation of 67 million tons, the average composition of national plastic waste is 17.14% or around 11.4 million tons per year (SIPSN, 2018). Many of the plastic bag waste does not reach landfills and only a small amount is recycled, so a lot of the plastic bag waste ends up in waterways, rivers, and eventually into the ocean (SLHI, 2020). Studies conducted by the Directorate General of Pollution and Environmental Damage Control (PPKL) of the Ministry of Environment and Forestry show that the types of waste found in marine waters in Indonesia are plastic (42%), wood (24%), and rubber (13%). One of the impacts of plastic pollution conditions in the sea is on biodiversity (SLHI, 2020).

The large amount of plastic waste that cannot be decomposed and eventually carried into the ocean is estimated to cause more plastic than fish in the ocean by 2050 (Sari, 2021). The existence of plastic waste in the sea continues to be a problem that cannot be resolved even though many efforts have been made by various parties. For three years since the enactment of Presidential Regulation Number 83 of 2018

http://ejournal.seaninstitute.or.id/index.php/Ekonomi
Jurnal Ekonomi, Volume 12, No 01, 2023
ISSN: 2301-6280 (print) ISSN: 2721-9879 (online)

concerning Handling of Marine Debris, the production of waste in the sea is recognized to have been reduced by 28.5 percent. However, this percentage is still considered insufficient because the target expected to be achieved is to be reduced by 70 percent by 2050.

The problem of garbage in the sea is inseparable from the problem of garbage on land, especially garbage in rivers. Research detected microplastic pollution in river flows that are known to come from washing clothes from households, fragmentation, and fishing nets that are wasted into waterways and emptied into rivers. Microplastics are very dangerous for the human body because of their properties that can trigger the growth of cancer cells, allergic reactions, cell damage, metabolic disorders, hormonal disorders, and so on. It is undeniable that the presence of microplastics cannot be separated from human activities that are often consciously or unconsciously throwing plastic waste into rivers.

Based on these problems, a study was conducted to analyze the causal relationship related to environmental issues of waste problems in rivers and seas and their effects on water quality using the DPSIR analysis method to find out the main causes of problems and how the best steps to overcome this problem.

2. METHODS

DPSIR is a method of conducting system analysis to observe environmental problems and the community's perspective on these problems. DPSIR consists of *Driving Forces (D), Pressures (P), State (S), Impact (I),* and *Responses (R). Driving force* or called triggers are things related to causes related to the existence of human needs, such as economic conditions and social factors (USEPA, 2015). Changes in an environment are generally caused by the pressure of human activities on natural resources which will then provide a signal in the form of a status (*state*), and how to respond to humans to overcome the pressure problem.

DPSIR is a causal framework used to describe the interaction between society and the environment. The Driver-Pressure-State-Impact-Response (DPSIR) framework provides a structure for presenting the indicators necessary to enable feedback to policymakers on the quality of the environment and the resulting impact of political choices made, or to be made in the future. According to the DPSIR framework there is a chain of causal relationships that begins with the 'driving force' (economic sector, human activity) through 'pressure' (emissions, waste) to the 'state' (physical, chemical and biological) and 'impact' on ecosystems, health and human functioning, which ultimately leads to political 'responses' (priorities, target setting, indicators). Describing the causal chain from driving force to impact and response is a complex task, and tends to be broken down into sub-tasks, for example taking into account pressure-state relationships.

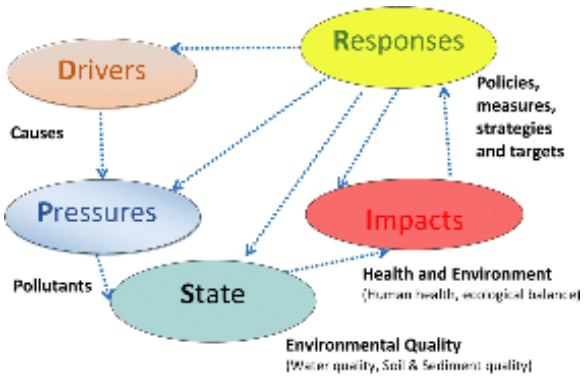

Figure 1. The DPSIR Assessment Framework
Sumber: Kristensen, 2004

3. RESULTS AND DISCUSSION

Driving Force

Driving force or called triggers are things related to causes related to the existence of human needs, such as economic conditions and social factors (USEPA, 2015). Various sources have explained that the driving factor for the waste problem is the increasing **population growth**. The increasing population and along with improving the welfare of the community encourages an increase in the amount of waste from human consumption. In addition to population growth, increased industrial activities, lack of technical knowledge of waste processing in the community, and the absence of a waste processing system are also

factors driving an increase in the amount of waste. The increase in population has the consequence of increasing the amount and type of waste produced. In addition, the increase in population raises the problem of solid waste disposal sites (TPA). The development of economic infrastructure increases industrial activity which causes an increase and variation in the types of industrial waste. Industrial waste is becoming more complex because it contains chemical substances that are very harmful to humans.

In addition, **a lifestyle** that is closely related to the **level of well-being**, especially in urban areas, will affect the composition of waste, especially food plastic **packaging waste,** which is expected to increase if it is not balanced with regulations that prohibit the use of plastic. As an overview, plastic is one of the materials that is often used in this modern era. Plastic is used in various sectors of the economy, including use for packaging, construction, transportation, health industry, agriculture, electronics, to all household needs. The use of single-use plastics has become an indispensable part of people's daily lives, regardless of the environmental consequences generated by the use of single-use plastic waste. It is currently projected that the global production of primary plastics will reach 34 billion tons by 2050. Of all the plastic products currently circulating globally, it was found that less than 10 percent of them have been recycled and the rest are still being dumped into the environment or reduced to microplastics. Government policies to ban the use of plastic waste or increase 3R efforts will help reduce the increase in plastic waste generation in the future.

Then from **geographical conditions**, where Indonesia is a maritime country with a large sea area, plastic waste is often found that is not handled properly. Whereas with the vast sea area that exists, Indonesia has a very large marine and fisheries potential. In addition, Indonesia holds enormous international and domestic tourism potential with its maritime nature. There are about 24 cities (provincial capitals) located in coastal areas where waste generated in land-bases is wasted on *sea-bases* as is the case now where only about 60 percent of waste goes to landfill. This indicates the vulnerability of *direct discharge* from land-base to *sea-base*.

The increase in population and the development of a city result in a pattern of changes in people's consumption which is quite high from year to year. An increase in the number of people with available land area will still result in severe pressure on the environment. Human activities in meeting their living needs derived from agriculture, industry and household activities will produce waste that contributes to the decline in the quality of surface water and groundwater.

Pressure

Pressure or emphasis is human activity that suppresses environmental components that are divided into two large groups, namely environmental suppressants and human behavior (Kristensen, 2004). In order to meet human needs, it causes pressure on environmental components as a result of the production of goods/services and human consumption which can cause a decrease in the quality of the human environment. The environmental components that receive such pressure are physical/chemical, biological, social, economic, cultural and health components.

The *driving force* above then creates other factors that directly affect the pollution of plastic waste in Indonesia's rivers and sea waters. This is known as the *pressure* factor against environmental conditions which is defined as follows:

a. Technical Waste Management Operations

Waste generation in Indonesia is predominantly generated in urban areas compared to rural areas. The majority of provincial capitals in Indonesia (24 cities) with a high population and waste generation, are located in coastal areas. The level of waste service in these cities (technical operational) will determine the generation of waste that is illegally dumped into surface water bodies (rivers and seas). The higher the level of service in urban areas, the higher the percentage of waste that is transported to the landfill, and vice versa, the lower the level of service, there will be a possibility of waste being wasted into surface water bodies. The limited capacity of municipal waste managers in the operational engineering aspect and financing dimension is not optimally supported by institutional aspects, law enforcement and community participation to reduce and handle waste. The service rate of waste transported to landfills nationwide only ranges from 65-69%. Financing is an important aspect of waste management in Indonesia. New financing potential through the Waste Bank concept by the Ministry of Environment and Forestry.

b. Participation (Public Awareness) and Lifestyle

Based on the results of BPS research (2018), it is known that there is still a lack of optimal community participation in waste management in Indonesia. The value of the indifference index related to waste

dimensions in Indonesia is very high, reaching 0.72 which indicates the level of public indifference to waste management. The survey also informed that waste management that is usually carried out by the community is by burning waste (53%), throwing waste into rivers/sewers (5%), and careless places (2.7%). In addition, to reduce plastic waste by carrying your own shopping bags is still little done by households in Indonesia. This condition greatly affects the amount of plastic waste generation in Indonesia. It is noteworthy that in general, people's indifference to waste is very large precisely on densely populated islands, which illustrates the magnitude of the pressure on waste management.

c. Maritime Tourism Activities

According to PP No. 60 of 2007, 10 marine conservation areas have been designated to be able to protect biodiversity through sustainable tourism programs. The carrying capacity and carrying capacity include maintaining the disposal of plastic waste into the sea and the disposal of liquid waste into the sea which can interfere with the carrying capacity and carrying capacity.

d. Marine Dumping

Marine Dumping is the deliberate disposal of waste into the sea.

e. Activities and Types of Business Around the RiverBank

The river's water quality has declined due to excessive use of agricultural chemical drugs and the disposal of factory and household waste. As is known, waste from chemical fertilizers is one of the largest sources of microplastics. One of the causes of polluted rivers, among others, is suspected to be from the disposal of textile waste. Similar to chemical fertilizer waste, textile waste is also one of the wastes that causes microplastics in a medium.

Environmental problems arise in line with the progress of all fields, including the progress of the business world, both household businesses, industry, mining, agriculture and housing so that awareness and participation from all parties are absolutely necessary. All companies engaged in the exploitation of natural resources are classified as companies that have the potential to disrupt the environment, be it mining companies, timber and oil palm plantation companies.

f. Land Use

The condition of the height aspect greatly affects the use of land for the types of commodities that the community strives for. The characteristics of human activities and their business activities are expected to affect changes in surface water, air quality, and the initial hue of the environment.

State

Pressure on environmental components will generally cause negative access to the work of an environmental state / condition / system (status). *States* are environmental conditions, in this case the condition of water quality and quantity, air environmental conditions, land conditions, and waste management conditions in Indonesia. Current environmental conditions related to plastic pollution in the sea are divided into 3 (three) major parts, namely:

Increased Amount of Plastic Waste Generation

The average percentage increase in plastic waste generation is directly proportional to the percentage increase in population with an average aggresat of 1.96% per year. This profile will change in the following year as efforts to reduce plastic waste generation. The disposal of waste and/or garbage results in the discovery of microplastics in rivers, which results in polluted water sources and dangerous if consumed as drinking water. The dumping of household waste by the community into the river results in garbage from the river flowing to the beach and the mouth of the river. This overflow of garbage has an impact on tourism conditions, especially beach and sea tourism.

Taking the example of the water quality of the progo river downstream in the period 2009-2013 shows that there has been a decline in water quality, from good levels to mild pollution. Meanwhile, quoting from the results of research on water quality and quality status of the upstream Progo river sampled on July 8, 2014, the conclusions of the quality status of the upstream Progo River can be divided as follows: Class I water quality standards (moderately polluted); Class II water quality standards (mild pollutants – moderate pollutants); Class III water quality standards (mild pollutants – moderate pollutants); and Class IV water quality standards (mild pollutants – moderate pollutants).

Increased Amount of Plastic Waste Dumped into Rivers and Seas

Data on the amount of plastic waste in marine waters in Indonesia has been estimated by a global study conducted by Jambeck et al (2017). Furthermore, the LIPI Oceanographic Research Center has conducted a study on the initiation of marine debris data in Indonesia to complement the NAP for Handling Marine Debris in accordance with Presidential Regulation No. 83 of 2018. Based on this, it is known that

the generation of plastic waste increased from 6.7 million tons in 2013 to 7.4 million tons in 2019. The average percentage increase in plastic waste generation is directly proportional to the percentage increase in population with an aggregate average in cities and villages of 1.96%. The LIPI Oceanographic Research Center has conducted a study on the initiation of Indonesian marine debris data to complete the national action plan for Marine Debris Handling in accordance with Presidential Regulation No. 83 of 2018. In this study, LIPI collaborated with various UPTs and universities and non-governmental organizations.

The stranding marine debris monitoring survey was carried out in six regions (18 locations) in Indonesia from February 2018 to March 2019, namely in the Sumatra region (Aceh, Belawan, Bintan, Padang), Java region (Pramuka Island, Pari Island, Semarang), Kalimantan region (Pontianak), Nusa Tenggara region (Denpasar, Mataram, North Lombok, Kupang), Sulawesi region (Makassar, Manado, Bitung), Maluku Papua region (Ambon, Tual, and Biak). The categories of marine debris that are monitored are grouped into 7 (seven) categories of waste, namely plastic and rubber, metal, glass, wood (processed), fabrics, others, and hazardous materials. The marine debris research approach carried out in this academic paper adapts the standard methods of the NOAA Technical Memorandum NOS-OR & R-46, in particular the shoreline survey methodology method and the NOAA Technical Memorandum NOS-OR & R-48.

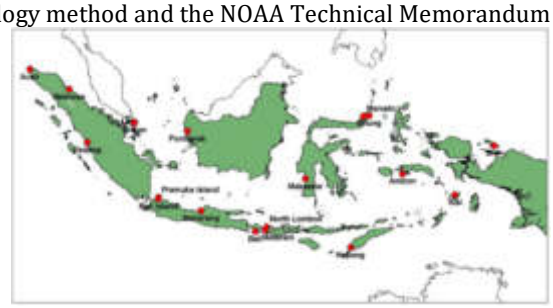

Figure 2. Marine Debris Observation Location in 2018
Source: LIPI, 2019.

The average percentage of plastic waste observed during monitoring is 11.79% of the total marine debris stranded on the beach. Of the 18 observation locations, there are five beach areas with the most plastic waste, namely Padang, Makassar, Manado, Bitung, Ambon. The dominant plastic waste found in all areas and observation sites is single-use plastic waste, such as crackle bags, straws, cigarette butts, and styrofoam. Assuming no plastic waste comes from outside Indonesia (including carried away by the current), from all plastic waste consumed by anthropogenic activities accumulates 30% on the coastline and coastline of Indonesia 99,093 km; The estimated waste generated by community activities is 268,740 – 594,558 tons per year. The largest amount of plastic waste is observed in Makassar, Ambon, and Manado consistently in both seasons where these locations are major cities in Eastern Indonesia and Manado which is a well-known marine tourism location.

Figure 3. Distribution of Percentage of Plastic Waste Stranded at the Study Site
Source: LIPI, 2019.

In addition, during the period 2017 – 2019, the Directorate General of PPKL KLHK has carried out marine debris monitoring in 24 locations in 22 provinces throughout Indonesia. The site selection is adjusted to the criteria contained in the Marine Debris Guidelines of the Directorate General of PPKL. Along with what LIPI has done, an inventory of marine debris is carried out to obtain basic data on marine *litter* on the coast, especially beach waste. This is to determine the threat to coastal and marine ecosystems, which is useful as an input in efforts to control coastal and marine pollution and damage. In general, the largest waste density is in the provinces of South Sulawesi and Central Sulawesi followed by West Java and Aceh.

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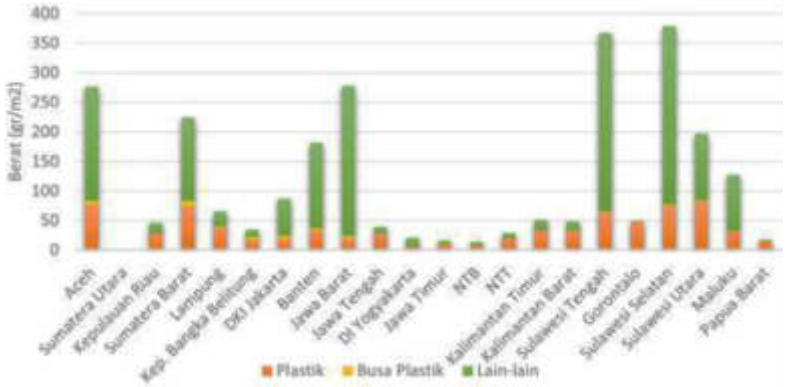

Figure 4. Weight of Garbage in the Sea and Its Plastic Composition (in grams/m^2) in various locations in Indonesia
Source: Directorate of PPKPL KLHK, 2019

1. **Current Conditions Regarding Biodiversity**
   Indonesian waters are a place of life and migration routes for the world's marine mammals. All Indonesian marine mammals have been designated as protected marine life in accordance with PPRI No. 7 of 1999 including whales, dolphins, mahakam pesut, and dugongs which are getting smaller in number from time to time. These aquatic biota are vulnerable to being affected by the increasing amount of plastic waste in the ocean.
2. **The quality of the water** used by the community is below the quality standards.

Impact

Impact is access to changes in environmental conditions/conditions/systems, especially the decrease in the carrying capacity of the environment. *The impact* is related to population welfare and public health (Kristensen, 2004). *Impact* is a negative excess of changes in environmental conditions/conditions/systems, especially the decrease in the carrying capacity of the environment which can have an impact on the quality of human life. The existence of plastic waste can have a serious impact on the economy, especially from the tourism sector and the fishing industry, environmental and life disturbances under the sea and public health.

a. **Threats to the Fishing Industry and Marine Tourism**
   Plastic waste that has not been managed properly has the potential to cause environmental pollution and affect the cleanliness of tourist areas and can interfere with the comfort of tourists in traveling (Kurihara in Khalik, 2014). This condition is certainly a threat to the development of marine tourism in Indonesia where tourism is one of the pillars of the community's economy. In addition to its impact on marine tourism, the presence of plastic waste has a negative impact on the fishing industry. It is estimated that seven million Indonesians who make a living from the fisheries sector will be affected by the damage to the sea caused by the presence of plastic waste. The flow of garbage to the beach, which certainly disturbs the marine ecosystem, as well as the condition of trisik beach tourism.
b. **Threats to the Environment and Underwater Life**
   The presence of plastic waste in the sea causes damage to the nutrient balance in the sea, endangers the safety of underwater animals, damages coral reefs and mangroves, reduces phytoplankton populations, and threatens the existence of seabirds. The content of microplastics is harmful to metabolism and reproductive function. When the existence of feeder filter fauna is threatened, the underwater ecosystem is threatened due to the destruction of nutrient balance in the sea. The presence of plastic waste in Indonesian waters can threaten the survival of various marine species. Another example of the impact of the presence of plastic waste in the sea is the death of a Sperm Whale that was found dead stranded in the waters of Wakatobi National Park as a result of ingesting nearly six kilograms of plastic and flip-flops. Microplastics are also found in shrimp bodies where as much as 63 percent of shrimp (Budi Widianarko et al, 2018). The presence of plastic waste in the ocean causes the number of pathogens in the waters to increase rapidly, affecting the quality and function of mangrove and coral reef ecosystems.
   Decreased oxygen content in the water, rotting of garbage is carried out by aerobic microorganisms. Quoting from Water Pollution, a lot of biodegradable waste enters the water, the number of

microorganisms will increase and use available oxygen, which causes aquatic plants to be unable to photositension, so that plants and animals in rivers can die. Meanwhile, in the long run, the discovery of microplastics in rivers can affect and change aquatic ecosystems. Microplastic contamination in river ecosystems can damage their long-term functioning, affect biological interactions, threaten aquatic species, and even harm local communities that rely on these water sources.

c. ***Health Effects*** **(Permasalahan Kesehatan bagi Masyarakat)**
The results of LIPI's research on the distribution of microplastics in various Indonesian waters show the threat of the spread of microplastics spread in various Indonesian marine waters. Plastic contamination in the body of marine animals will be harmful if these marine animals are consumed by humans. This plastic waste in the ocean will interfere with the role of the ocean as a food resource and be harmful to health. Polluted drinking water sources by microplastics according to current data, endangering customers of the Regional Public Water Company MInum (PDAM). These microplastics can be ingested by animals in marine areas, which then if the animals are eaten by humans, can have a harmful impact on humans. Quoting from Compound Interests, the slow initial decomposition of waste organic substances and consumption by microorganisms produces a series of chemical compounds that smell bad. Quoting from the World Health Organization ("WHO"), polluted water can transmit diseases such as diarrhea, cholera, dysentery, typhoid and polio.
Most of the activities of people who still depend on the river for their daily lives, such as bathing, washing, defecation, of course, are at risk of disease because in quality they are not qualified. Diarrheal diseases (loose stools) often suffer from children, in the last year the number of children affected by diarrhea has increased. Another disease that children often suffer from is fever. Older groups are often affected by gout, rheumatism, and malaria. Recently, the rate of frequent malaria disease has decreased. Groups of mothers are more often affected by whitish disease.

d. ***Climate Change***
Plastic waste will survive in the oceans for a very long time and take hundreds of years to decompose. Sunlight and heat will decompose plastic into methane and ethylene which contribute to climate change. The increasingly massive use of plastics, from production to disposal, will release large amounts of greenhouse gas emissions. In 2019, the impact of plastic production was calculated to be equivalent to the output of a total of 189 coal-fired power plants. By 2050, it is estimated that plastic production will triple, the resulting carbon emission impact will be equivalent to the carbon emission output of 615 coal-fired power plants, and will contribute about 13% of the world's total carbon emissions.

e. **Economic Effects**
The domino effect of marine plastic pollution also has a significant effect on the global economy. The global economic cost of marine pollution to tourism, fisheries, aquaculture and other activities is estimated to be at least US$ 6 billion - 19 billion in 2018. In addition, it is projected that by 2040, businesses will have to bear approximately US$ 100 billion in annual financial risks if the government requires them to cover the costs associated with waste management at predicted recycling volumes and rates.

f. **Disruption of Raw Water Sources**
To meet the needs of clean water for the community, one of the provisions of clean water is sourced from the provision of clean water by the Regional Drinking Water Company (PDAM). The river is one of the main sources of raw water for PDAM which is widely used by the surrounding residents for various life activities such as MCK, coal mining, water transportation, fisheries, power plants, shipyards. This situation makes the river a body of water that receives waste from these various activities so that it can result in changes in water quality.

Response

Response is the response of policymakers or the community to the impacts and environmental conditions of the community (Kristensen, 2004). Due to the negative impacts/consequences of meeting human needs and desires, humans will respond to impacts and usually in a normative order such as decision making and policy on different scales in order to control and reduce the negative impacts that occur. *Response* shows how much the community, government, and business respond to environmental issues; refers to actions and reactions carried out individually and collectively, aimed at mitigating, adapting or preventing negative human influences on the environment; prevent or restore environmental damage that has occurred; and protecting and conserving nature and natural resources.

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Jurnal Ekonomi, Volume 12, No 01, 2023
ISSN: 2301-6280 (print) ISSN: 2721-9879 (online)

In response, the Government of Indonesia stated a target of reducing plastic waste by up to 70% by 2025. As a strategic guide to accelerate the handling of plastic waste until 2025, a National Action Plan (RAN) for Marine Plastic Waste for 2018 – 2025 was established. The NAP on marine plastic waste consists of five main strategies as follows:

1. National movement to raise awareness of all stakeholders;
2. Management of plastic waste from source (land);
3. Management of coastal and marine plastic waste;
4. Mechanisms for enhancing institutional, funding, and law enforcement powers; and
5. Research and development.

Gambar 5. Kolaborasi Antar Pemerintah Strategi Utama RAN Sampah Plastik Laut
Sumber: SLHI, 2020

Table 1 Regulation

Regulation	Details
Law No. 32 of 2009 concerning Environmental Protection and Management, as amended by Law No. 11 of 2020 ("**Job** Creation Law") on Job Creation (collectively referred to as "654**Law 32/2009**")	The environment must be protected and managed through the following steps: 1) Planning; 2) Utilization; 3) Control; 4) Preservation; 5) Supervision; and 6) Law enforcement. (Article 4, Law 32/2009)654 Furthermore, environmental pollution and/or destruction must be controlled through a framework aimed at preserving environmental functions and through the following efforts: 1) Prevention; 2) Mitigation; and 3) Restoration. One of the efforts that can be made to prevent pollution and/or destruction is the issuance of environmental-based laws and regulations, which are therefore related to the framework of Law 18/2008. According to this law, single-use plastics can be classified as solid waste, meaning that everyone is prohibited from: 1) Carrying/importing such plastic waste into the territory of Indonesia; 2) Mixing such plastic waste with hazardous and toxic waste materials; 3) managing the plastic waste in a way that can cause pollution and/or damage; 5) Disposing of the plastic waste in a prohibited place; and so on.
Law No. 18 of 2008 on Waste Management ("**Law 18/2008**")	In addition, each individual is required to manage the waste by reducing and handling waste in an environmentally friendly manner. The mandatory waste management procedures must be further regulated through their respective regional regulations. It should be noted that this Law also provides that: 1. Manufacturers must include labels or marks related to reducing and handling waste on their packaging and/or products; 2. Producers are obliged to manage the packaging and/or goods they produce that cannot or are difficult to decompose by natural processes. In its explanation, this

Regulation	Details
	provision requires manufacturers to manage packaging in the form of recalling packaging for recycling and/or reuse. More information about local regulations can be found below.
Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management ("**Regulation 22/2021**")	As a follow-up to the issuance of the Job Creation Law, this regulation includes various provisions that specifically address the following areas: 1) Environmental permits; 2) Protection and management of water, air and sea quality; 3) Environmental damage control; 4) Waste management; 5) Environmental function restoration guarantee fund; 6) Environmental information systems; 7) Development and supervision; and 8) The imposition of ateringcive sanctions.655655655
Regulation of the Minister of Industry ("**Minister**") No. 55 of 2020 concerning Green Industry Standards for the Plastic, Shopping Bag and Bioplastic Bag Industry ("Regulation 55/2020")	Regulation 55/2020 provides for the obligation of atering businesses to comply with the Green Industry Standard ("655**SIH**") for plastic and ateringc shopping bags through SIH certification. SIH for atering plastic shopping bags and ateringc includes the following requirements:655655655655655 1. Technical requirements (i.e., materials, energy, water, products and production processes, packaging, waste, and greenhouse emissions); 2. Management requirements (i.e., policy and organization, strategic planning, implementation and supervision, management evaluation, corporate responsibility, and employment).655
Regulation of the Minister of Environment and Forestry No. P.75/MENLHK/SETJEN/KUM.1/10/2019 on Roadmap for Waste Reduction by Producers ("**Regulation 75/2019**").	In general, the provisions stipulated in Regulation 75/2019 should be applied in relation to any products, product packaging, and/or containers that are not biodegradable, non-recyclable, and/or non-reusable, including plastics. In addition, these provisions apply to business actors engaged in the following fields: 1. Manufacturing 2. Food and beverage service 3. Retail Activities aimed at waste reduction regulated in Regulation 75/2019 are detailed as follows: 1. Restriction of waste generation through the following methods: a. Through the use of products, product packaging and/or containers that are easy to recycle and produce as little waste as possible; and/or b. By refraining from the use of non-biodegradable products, packaging and/or product containers. 2. Waste recycling (i.e., through the use of recyclable raw materials and/or raw materials recycled during production); 3. Reuse of waste (that is, through the use of reusable raw materials during production). The framework also states that governments can offer incentives or disincentives to producers. The incentive will be given in the form of awards, publications of good performance of producers and/or other forms. While disincentives can be in the form of publication of the manufacturer's poor performance through print or electronic media. Incentives can be given to associations,

Regulation	Details
	administrators of production areas and production holding companies with due regard to the following aspects: 1. Company policies that support the implementation of waste reduction efforts; 2. Waste reduction performance, implemented by subsidiaries or members; and 3. Compliance of subsidiaries and/or members with the provisions stipulated in Regulation 75/2019. In its definition, it is explained that the Waste Bank is a facility for managing waste with the 3R principle (*reduce, reuse*, and *recycle*), as a means of education, behavior change in waste management, and the implementation of a circular economy formed and managed by the community, business entities and / or local governments. The waste referred to in this regulation is household waste, similar waste of household waste (waste originating from commercial areas, industrial estates, special areas, social facilities, public facilities, and/or other facilities. The regulation also explains that the government can provide incentives to local governments and waste bank managers who have waste banks with good performance in the form of awards, providing recommendations for waste management financing assistance, waste management training, and so on.
Regulation of the Minister of Environment and Forestry No. 14 of 2021 concerning Waste Management in Waste Banks ("**Regulation 14/2021**")	
Minister of Finance Regulation No. 26/PMK.07/2021 concerning State Budget Funding Support ("**APBN**") for Waste Management in the Regions ("**Regulation 26/2021**")	The central government can provide state budget funding support for waste management in the regions, including: 1) central government spending; 2) transfer to the regions; and 3) budget financing. Receive support for the assistance including local governments and business entities.

Broadly speaking, basically, the government has established various regulations related to: 1) minimizing the use of single-use plastics; and 2) the use of waste to create a *circular economy*, including the industry's obligation to recall single-use plastic packaging. In addition, in 2019, the Government through the Coordinating Ministry for Maritime Affairs also established the *National Plastic Action Plan* (NPAP), which is a multi-stakeholder platform that brings together policymakers, experts, the business sector, entreprenueurs, and civil society organizations to work together to reduce 70 percent of marine debris by 2025.

Although the government has taken various steps to overcome the problem of plastic waste in the sea, up to 3 (three) years since the establishment of the National Action Plan (RAN) for Marine Plastic Waste 2018 - 2025, this marine debris problem has not been resolved. Therefore, it is necessary to take other steps to respond to the problem of plastic waste in the sea.

The high use of plastic materials for daily needs is one of the causes of marine debris that needs to be addressed as part of environmental responsibility by producers which can be done through Expanded Producer Responsibility (EPR). Other efforts can be in the form of preventing land waste from entering the waters, both rivers and oceans as has been done by the Government using River Cleaning up System (RCS) technology.

In the implementation of waste management, each region has the authority to manage its own regional waste. Local governments need to set policies that are implemented in accordance with the conditions and problems of waste in each region. The government's commitment needs to be emphasized so that waste management is also a priority in regional development plans. The handling of marine debris also needs to be strengthened by more aggressive and massive technological interventions to manage the increasing amount of waste. One way to reduce plastic waste in the ocean is to shift the habit of using certain items made of plastic, examples of which are straws and packaging made of plastic.

A paradigm shift in waste management is needed. The need to make all parties aware in carrying out the NAP for handling waste on land and sea, becomes very important to do because it concerns the survival of living things. In carrying out handling, what must be considered is how to do it with an integrated approach because the problem starts not at sea, but further upstream. Examples are how the industry produces and distributes plastic products, how retailers use plastic in packaging wrappers, and how consumers handle the plastic waste it produces. Improper waste management in land areas will cause dampah in the form of plastic waste pollution in the sea. There needs to be unusual steps and breakthroughs by applying a new paradigm in waste management. Handling plastic pollution in the ocean must be carried out in an integrated and collaborative manner.

DPSIR Analysis Results

Based on the explanation of the study above, a DPSIR framework can be formulated to see the causal relationship in the problem of waste in rivers and seas and its effect on water quality. The following is the DPSIR framework that was successfully formulated by the author:

Figure 6. DPSIR Framework
Source: Analysis Results, 2022.

4. CONCLUSION

The increasing use of plastic is not in line with efforts to reduce marine debris. Handling marine debris is an obligation of all parties, and must be carried out starting when the garbage is still on land, upstream of the river, in the stream, and when the garbage is already in the sea. To achieve the target of handling marine debris by 2025, several efforts need to be implemented decisively such as changes in people's mindsets and habits towards waste management, commitment to reduce the production of single-use plastics by producers, strengthening government regulations, and appropriate technological interventions. The main focus of handling in addition to the policies that have been set is the commitment of all governments, private companies, and communities to deal with the waste problem. This waste problem needs to be addressed from upstream starting from waste disposal by the community to waste management carried out by the government. The community as the main source of waste producers needs to understand the problem if the garbage disposal is not done correctly. This understanding of the community needs to be done by socializing waste handling and the impact of waste from the lowest level of the community. This socialization process also cannot be done only once or twice but needs to be carried out continuously and supervised by the government. In addition to understanding the community regarding waste management, the procurement of facilities and infrastructure in waste management is also a key factor in overcoming the problem of waste upstream. The government needs to be committed to providing good and correct waste management facilities and infrastructure.

In the household waste sector, local governments in particular must intensively carry out regular socialization of the adverse impacts of plastic waste dumping into rivers. In addition to socializing, the government is also encouraged to actively encourage the community to create waste banks. Besides being able to prevent environmental pollution, waste banks can be a solution for the community to get a job. Meanwhile, in the large industrial sector, strict sanctions and supervision must also be implemented on people who often throw their industrial waste/waste into rivers and or other prohibited media. In particular, the implementation of the provisions for retracting packaging mandated by Law 18/2008 must be optimally enforced for both large industries and their control in terms of government. Maximum

enforcement of the implementation of national-scale regulations, especially Law 18/2008 can be one of the responses of DPSIR that occurs in pollution of waste in rivers and seas.

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