Reduce marine debris policy in Indonesia

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Abstract. The massive use of plastic, from the production process to the disposal, will release a lot of greenhouse gas emissions into the atmosphere, which will exacerbate climate change. The large amount of plastic waste that can not be decomposed and eventually carried away into the sea is estimated to cause more plastic than fish in the ocean in 2050. Indonesia is the second-largest country in the production of marine plastic debris in the world after China. It occurs because of misleading in waste management while still on land. Plastic debris in the marine will adversely affect the ecosystem in the sea and also the coastal. The reduction of marine debris will not run optimally if it is not supported by active involvement from the government, producers, and the community. This research was normative research based on primary and secondary legal materials. This study aimed to review the implementation of policies based on action plans to reduce marine debris. The result showed that with the baseline marine debris policy at 0.49 - 0.86 million tonnes/year, it required acceleration efforts from the government, producers, and the community to reduce marine debris by 70% by 2025.

1. Introduction
In recent years, the marine debris issue, notably plastic waste in the oceans, has become environmentalists’ main concern. The world seems to have just been awakened to the dangers of plastic waste, which is increasing in number from day to day because of human activities that cannot be separated from plastic use in every need. There are currently more than 150 million tonnes of plastic in the oceans. Under the current scenario, there will be one tonne of plastic waste for every 3 tonnes of fish by 2025, and there will be more plastic waste than fish by 2050 (by weight) [1].

Indonesia, as one of the largest archipelagic countries, turns out to be a country with the world's second-largest marine plastic debris production after China. There are about 275 million tons of plastic debris produced from 192 coastal countries studied, and among this plastic debris, about 4.8 - 12.7 million tons enter the ocean. This problem happened because of the mismanagement of waste while still on the mainland [2].
According to the International Union for Conservation of Nature, there are at least more than 300 million tonnes of plastic produced every year from various activities around the world. Among the plastic production, there are at least 8 million tons of plastic debris that ends up in the oceans and accounts for up to 80% of the total marine debris from sea level to deep-sea sediments [3]. This plastic waste pollution threatens food security, human health, coastal tourism and also contributes to climate change.

Plastic, which is a petroleum product, if it burns, it will release carbon dioxide into the atmosphere, increasing carbon emissions. In the oceans that provide the largest natural carbon sink for greenhouse gases, plastic waste will stay in the oceans for a very long time and take hundreds of years to decompose. Sunlight and heat will decompose plastics into methane and ethylene, which contribute to climate change.

The increasingly massive use of plastics, from the production process to disposal, will release large amounts of greenhouse gas emissions. In 2019, the impact of plastic production is calculated to be equivalent to the output of a total of 189 coal-fired power plants. By 2050, where it is estimated that plastic production will increase triples, the resulting carbon emission impact will be equivalent to the carbon emission output of 615 coal power plants, which will contribute around 13% of the world's total carbon emissions [4]. The more plastic we make, the more fossil fuels we need, the more we exacerbate climate change.

Marine debris will also have a negative impact on the ecosystem in the ocean and the coast. Marine debris will damage carbon sink ecosystems such as mangroves, seagrass beds and coral reefs. Based on reports, in 2016, marine debris has endangered more than 800 species, where 40% of these species are marine mammals and 44% are seabird species [5]. The data was then updated at the UN Ocean Conference in New York in 2017, where it is stated that every year marine debris has killed around 1 million seabirds, 100,000 marine mammals, sea turtles, and fish in large numbers. Moreover, marine debris will also have a negative impact on the fisheries, shipping and tourism sectors.

The increasing use of plastics is not in line with efforts to reduce marine debris. Stricter policies are needed to reduce plastic waste. This study aims to review the implementation of marine debris management policies based on the national action plan for marine debris reduction, identify barriers and shortcomings, and provide input and policy recommendations related to marine debris management.

2. Materials and methods
This research was legal research using a normative approach based on the main legal materials, that was applicable laws and regulations and other documents relating to this research. This study used primary legal material sources in the form of legislation and derivative regulations as well as secondary legal materials derived from previous studies relating to the problem under study. The scope of this research includes review of national and international regulations related to marine debris management.
3. Result and discussion

3.1. Marine debris in Indonesia

Marine debris can be defined as tough and solid materials produced by manufacturing or production that are dumped or left behind in oceans and coastal areas. Three-quarters of marine debris is plastic, which is a tough and potentially dangerous pollutant, where the shards or debris are microplastics that can be absorbed by many marine organisms. Among the types of marine debris, the ten most common types of marine debris are cigarette butts, plastic food wrappers, plastic from beverage bottles, straws and stirrers, plastic bags, glass drink bottles, other plastic bags, paper bags and beverage cans. Seven of the ten types of waste are plastic waste [6].

The current estimate shows that around 85,000 tonnes of waste are generated daily in Indonesia, with an estimated increase of up to 150,000 tonnes produced per day by 2025, an increase of 76% in just ten years. Around 40% of solid waste is generated by households. As much as 80 percent of marine debris is known to come from activities on land that enter through rivers. Of all the waste that enters the sea, around 45-70 percent is known to be plastic waste [7]. According to data from the National Waste Management Information System, the amount of unmanaged waste in 2018 reached 3.9 million tons [8]. This unmanaged waste can enter the river and stream down into the ocean.

Marine debris also comes from household waste that has leaked into waterways or rivers and eventually is carried to the ocean. Some of the leakages of waste that enters the river mainly come from houses on the banks of rivers and canals. The survey results in 14 cities in Indonesia found around 95 hotspots for plastic waste leakage into the marine environment. These hotspots are the points where large amounts of waste are generated in river flows, so it requires great attention in an effort to prevent plastic waste from entering the river, which will eventually stream down into the ocean. With around 30-50% of uncollected waste discharged into the waterways, the amount of plastic waste enter the waterways is estimated to reach 400,000 tons/year [7].

3.2. Marine debris reduction policy in Indonesia

To address the issue of marine debris, the Government of Indonesia has issued a National Action Plan for Handling Marine Debris for 2018-2025 as stipulated in Presidential Decree Number 83/2018 concerning Handling Marine Debris. In this regulation, the Indonesian government committed to reduce marine debris by 70%, reduce solid waste by 30%, and handle 70% solid waste within a period of 8 (eight) years from 2018 to 2025.

The 2018-2025 National Action Plan for Marine Debris Management is described into 5 (five) main strategies in reducing marine debris in Indonesia's oceans, which are then broken down into activities with a clear and measurable timeline for the quantity target and the implementation year. These five strategies are:

1. The National Movement for Stakeholder Awareness Raising
2. Landbase Waste Management
3. Coastal and Marine Waste Management
4. Funding Mechanisms, Institutional Reinforcement, and Law Enforcement
5. Research and Development

Previously, in 2017, monitoring Indonesia's marine debris was carried out by the Ministry of Environment and Forestry. This monitoring activity is carried out on the beaches in 18 regencies/cities in Indonesia, targeting the macro (> 2.5 cm) and meso (0.5-2.5 cm) waste with a marine debris type classification using LCS (litter classification system). As a result, the national estimate of marine debris on the coast is around 1.2 million tonnes, of which 41% is plastic waste, or around 0.49 million tonnes of plastic waste on Indonesian beaches [9].

Meanwhile, in 2019, a study on monitoring marine debris was carried out by LIPI, which was carried out in six regions (18 locations) in Indonesia from February 2018 to March 2019, by dividing the classification of marine waste into seven categories of waste, namely plastic and rubber, metal, glass, wood, cloth, others, and hazardous materials. Of the 18 observation locations, there are five coastal areas...
with the most plastic waste, namely Padang, Makassar, Manado, Bitung, Ambon. These five regions have a percentage of plastic waste > 50% with the amount of plastic waste > 4pcs/m² and an average weight of > 190g plastic per m². In total, the national estimated plastic waste produced by community activities (land base and seabase) is in the range of 268,740-594,558 tons per year [10].

The government, through the Coordinating Ministry for Maritime Affairs in 2019, also established the National Plastic Action Plan (NPAP), which is a multi-stakeholder platform that brings together policymakers, experts, business sectors, entrepreneurs and civil society organizations to work together to reduce 70 percent of marine debris by 2025. In preliminary research, the flow of plastic waste into national waters is projected to grow by 30% between 2017 and 2025, from 620,000 tonnes per year to around 780,000 tonnes annually [11].

The conduct of several research on marine debris in Indonesia, especially plastic waste, has led to many estimates of the plastic waste amount that enters Indonesian waters every year. This is a response to the previous statement that stated Indonesia as the world’s second-largest plastic waste producer [2]. This initial estimate of plastic waste is important as an initial baseline for calculating the target plan for reducing plastic waste in 2025.

**Table 1. Various estimates of marine debris in Indonesia**

| Research                                      | Year | Marine debris estimation (million tonnes/year) |
|-----------------------------------------------|------|------------------------------------------------|
| Jambeck *et al* [2]                          | 2015 | 0.48–1.29                                      |
| Ministry of Environment and Forestry [9]     | 2017 | 0.49                                           |
| World Bank [7]                               | 2018 | 0.40                                           |
| LIPI [10]                                     | 2019 | 0.27–0.59                                      |
| NPAP [11]                                     | 2019 | 0.62                                           |
| Implementation team of the National Action Plan Marine Debris Reduction [12] | 2019 | 0.49–0.86                                      |

The emergence of various estimates of the amount of marine debris is due to the use of different methods. Therefore, the Implementation Team for the National Action Plan for Marine Debris Management set the baseline range for initial data at 0.49–0.86 million tons/year. However, there are limitations from each study that have not been taken into account in determining the baseline data so that the data range can still change after the limitations in determining the national marine debris are determined [12]. This baseline figure from the implementation team for the National Action Plan for Marine Debris Management will be used as the basis for calculating the 70% reduction in marine debris by 2025.

### 3.3. Implementation of marine debris reduction in Indonesia

Concern at the increasing projection in plastic production, doubles or triples increase in recycling rates in the future is still not sufficient to stop the large amounts of plastic waste pollution in our waste streams. One of the most effective solutions is to stop single-use plastics from being produced right at the source.

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 the environmental responsibility of producers who make products using plastic through Expanded Producer Responsibility (EPR). At Our Ocean Conference, 29-30 October 2018, in Bali, there were commitments from several manufacturers and companies to reduce plastic waste, including Danone-Aqua committed to making all plastic packaging 100% recyclable and increasing the proportion of recycled plastic in bottles up to 50% by 2025. The Coca-cola Company is committed to making packaging 100% recyclable by 2025 and 50% recyclable in all major global packaging by 2030. Unilever targets by 2025, all plastic packaging can be recycled, reused or it could be compost material. Kentucky Fried Chicken (KFC) has also implemented a plastic straw-free program at 630 outlets
throughout Indonesia. This campaign is also conducted by McDonald’s Network, which also does not provide plastic straws in all outlets [13].

In addition, to reduce plastic from its source, efforts should also be made to prevent landbase waste entering the waters, both rivers and oceans. In fact, there are about 27.5 million people whose lives depend on this river. Based on research by the Indonesian Institute of Sciences (LIPI), Jakarta Bay and the Seribu Islands have become giant garbage dumps. As much as 21 tons of garbage per day flows from rivers in Jakarta, Tangerang, Bogor and Bekasi. Each river in Jakarta contributes one tonne of waste, while the rivers in Tangerang and Bekasi each contribute 7-8 tonnes of waste every day [13]. Efforts to pull of marine debris have been carried out by various environmental organizations such as the organization 4ocean, which from 2017 until now has pulled out more than 10 million pounds or around 4.5 million kg of marine debris.

Rivers, especially in big cities with urban communities who mostly live on the banks of rivers, have the potential to become the main channel that sends waste from the land to the ocean. Besides the Citarum River, four rivers in Indonesia are also included in the 20 dirtiest rivers in the world, namely the Brantas, Bengawan Solo, Serayu, and Progo rivers [14]. Efforts to close waste taps into the ocean can be carried out, for example in 2019, the Government uses the River Cleaning up System (RCS) technology, which is an effort to clean up waste in rivers using an interceptor boat that will catch trash from the river and lift it out of the river before it can flow to the ocean. In addition, it is also very necessary to install the trash rack at each river estuary before entering the ocean so that trash can be trapped and carried by the trash rack before entering the ocean. There are also many waste taps from the mainland from marine tourism sites where many tourists around beach and coastal tourist sites carry and leave trash at these tourist sites, especially single-use plastic waste from food and beverage packaging. Therefore, we need to manage waste at marine tourism sites so that it is not entering into the ocean.

The community’s commitment also needs to be followed by the government’s commitment to formulating regulations that support waste management on land so that it does not enter the ocean. In the implementation of waste management, each region has the authority to manage their own regional waste. According to Law Number 18 of 2008 concerning Waste Management and its implementing regulations, most of the authority for regulating waste management rests with the central government, however, the authority to implement it lies almost entirely in the regions. Local governments need to establish applied policies in accordance with the conditions and problems of waste in each region, especially for areas traversed by watersheds, need to add waste management so that land waste is not entering into rivers. In accordance with the mandate of Presidential Decree Number 97 of 2017 concerning Policies and National Strategies for the Management of Household Waste and Waste Similar to Household Waste, each region needs to formulate regional strategic policies regarding waste management. Here, local government commitment is required so that their waste management policies take into account the possibility of untreated waste leaking into the river flow. This commitment also needs to be considered by local governments so that waste management is also a priority in the regional development plan.

Handling marine waste also needs to be strengthened by more aggressive and massive technological interventions to manage the increasing amount of waste. The government from 2019 - 2020 plans to operate 12 Waste Power Plants throughout Indonesia. In addition, the government has also operated an Integrated Waste Management using refuse-derived fuel (RDF) in Cilacap, which is a new milestone in waste management in Indonesia. Apart from the above innovations, the use of pyrolysis technology can also be done to break down plastic waste into diesel, gasoline and kerosene types of fuel. With this pyrolysis, plastic waste can produce three components of fuel oil, namely 60 percent diesel, 25 percent gasoline, and 15 percent kerosene. However, waste handling with a high-temperature approach poses a negative risk to health and the surrounding environment due to the residue and combustion emissions produced. A cleaner and healthier waste management can be conducted using a low-temperature approach, that is using anaerobic digestion assisted by microbes in organic waste management, because household waste is still dominated by organic waste. However, this low-temperature approach requires more time and a stronger commitment by the whole community.
4. Conclusion
With the baseline marine debris at 0.49 - 0.86 million tonnes/year, it requires serious efforts to reduce marine debris by 70% by 2025. With more and more waste flowing into the sea, the heavier the environmental risk and economy that had to be recovered. Handling marine debris is the obligation of all parties, and must be carried out starting when the waste is still on land, upstream of rivers, in river flows, and when the waste is already in the ocean. To achieve the target of handling marine debris in 2025, some efforts need to be implemented firmly such as people's mindsets and habits change of waste disposal, commitments to take single-use plastics by producers, strengthening government regulations, and appropriate technological interventions.

References
[1] World Economic Forum 2016 The New Plastics Economy Rethinking the future of plastics
[2] Jambeck J R et al 2015 Plastic waste inputs from land into the ocean Science Vol 347 Issue 6223 pp 768–71
[3] International Union for Conservation of Nature 2018 Marine Plastic IUCN Issues Brief
[4] Center for International Environmental Law 2019 Plastic & Climate: The Hidden Costs of a Plastic Planet
[5] United Nations Convention On Biological Diversity 2016 Report Of The Conference Of The Parties To The Convention On Biological Diversity
[6] United Nations 2016 UN report finds marine debris is harming more than 800 species, costing countries millions
[7] World Bank Group 2018 Hotspot Sampah Laut Indonesia, Laporan Sintesis
[8] Sistem Informasi Pengelolaan Sampah Nasional (SPSN) http://sipsn.menlhk.go.id/ accessed 24 Juni 2020
[9] Directorate of Pollution and Coastal Damage Control and the Directorate General of Environmental Control and Damage, Ministry of Environment and Forestry 2017 Pemantauan Sampah Laut Indonesia Tahun 2017
[10] Pusat Penelitian Oseanografi 2019 Naskah Akademik: Inisiasi Data Sampah Laut Indonesia Untuk Melengkapi Rencana Aksi Nasional Penanganan Sampah Laut Sesuai Peraturan Presiden RI No.83 Tahun 2018 Lembaga Ilmu Pengetahuan Indonesia
[11] National Plastic Action Plan 2020 Mengurangi Polusi Plastik Secara Radikal di Indonesia Rencana Aksi Multipemangku Kepentingan World Economic Forum
[12] Secretariat of the National Action Plan for Marine Debris Management 2019 Laporan Tim Pelaksana Rencana Aksi Nasional Penanganan Sampah Laut Tahun 2019
[13] Arumingtyas L 2018 Menagih Peran Para Pihak Tangani Sampah Plastik di Laut Mongabay Indonesia https://www.mongabay.co.id/2018/12/29/menagih-peran-para-pihak-tangani-sampah-plastik-di-laut/ accessed 19 Juni 2020
[14] Lebreton L C M 2017 River plastic emissions to the world’s oceans Nature Communications