ICEDES
International Conferences Engineering Design and Environmental **ISSN 3031-7320**
Volume 1, No. 1, December 2023

The Estimation of Potential Leaks and Brand of Marine Waste Products from Fishing Vessel Operations in Tegalsari Fishing Port

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Abstract. The issue of plastic marine pollution has attracted the most attention globally. Plastic waste has been found in the deepest ocean trenches and vast terrestrial ecosystems. Indonesia is one of the world's most significant contributors to plastic waste, with 17% of Indonesia's national waste in 2020 being plastic waste. Fishing and passenger vessel operations included 12,785 tonnes of waste. The study aimed to evaluate the potential of marine debris and product brands in estimating leakage and marine waste product brands in fishermen at the Tegalsari Fishing Port. This study used a descriptive quantitative technique with a survey and observation approach. This study observed 104 fishing boats docked at the wharf preparing for departure. The results of this study indicated that fishing boats PPP Tegalsari >30 GT produce 31.7 kg of plastic waste/trip, while fishing boats <30 GT produce 22.5 kg/trip of waste. 87.8% of plastic waste is disposed of into the sea, where beverage packaging contributes the most significant amount of plastic waste, namely 12.9 kg/trip from ships < 30 GT (67%) and 20.3 kg/trip from ships > 30 GT (69%), Product brands from plastic waste found were Adi and Prim-A brand mineral water, Sprite, Gudang Garam red cigarettes, Sedaap noodles, Masako flavoring, PT Tirta Adi Sejahtera, PT Coca Cola Bottling Indonesia, PT Wings Food, Indofood CBP Sukses Makmur, and others. Multinational companies such as Coca-Cola, Unilever, Otsuka, and Frisian Flag have a more direct role in line with the global target for waste reduction contributions following the provisions of Permen LHK No. 75/2019. In contrast, national companies, except Indofood, were not found to have concrete targets to support a plastic reduction in the pre-consumption and post-consumption stages.

Keywords: Leakage; product brand; marine debris; fishing port; tegalsari beach

1 Introduction

Marine debris has been recognized as a global phenomenon, along with other environmental problems such as climate change, ocean acidification, and biodiversity loss (Sutherland et al., 2021). Plastic waste, the main component of marine debris, has received particular attention worldwide because it is abundant, durable, and consistent (Gall & Thompson, 2015). Plastic waste in the sea has received significant attention in recent years, as seen from various meetings of the UN, G7, and G20 organizations, UN, APEC, and national and local governments, as well as non-governmental organizations in various parts of the world launching programs to contribute to handling plastic waste.

Plastic waste of varying sizes in the oceans has been found in remote locations in the world's oceans, on most coastlines, and in terrestrial ecosystems (Thompson et al., 2009; Vince & Stoett, 2018). Around 14 million tons of plastic leak into the sea yearly, mainly in areas close to tourist areas and densely populated areas (IUCN, 2021). About ¾ of the world's marine debris is plastic waste that pollutes the north and south poles to the equator and from coastlines to the deep sea (Barnes et al., 2009).

Indonesia is one of the countries that contribute significantly to the leakage of plastic waste into the sea. The Indonesian Ministry of Environment and Forestry in Aditya (2020) stated that the total national waste generation in 2020 reached 67.8 million tons, with 17% contributed by

plastic waste. There has been an increase in plastic waste generation in Indonesia over the last decade, namely by 6%, which was caused by an increase in plastic production in the food and beverage sector. The total waste entering the Indonesian seas in 2020 was estimated to be around 521,540 tons, of which around 12,785 tons come from marine activities obtained from the sum of the operations of passenger ships and fishing vessels (Hendiarti in Sucahyo, 2021). Based on these calculations, it can be concluded that marine debris only contributes to around 2.45% of plastic waste leakage into the sea. Related parties claim this assessment still requires further research because it does not consider broader factors. Therefore, a more comprehensive study is needed that specifically examines the potential for waste leakage into the sea from fishing vessel activities in Indonesia to obtain improved data.

Marine debris negatively impacts the economy, environment, marine biota, and ecosystems. Plastics in the sea are harmful to commercial shipping and fishing vessels, aid in the transmission of organic and inorganic waste, and threaten marine species and humans (Barnes et al., 2009). Marine ecosystems such as mangroves, seagrass beds, and coral reefs, according to Assuyuti et al. (2018), have also been polluted by waste, both in the form of solid waste and liquid waste originating from community activities on land. The same research stated that plastic waste had been found in coral reef ecosystems on Pramuka Island, Panggang Island, and Air Island in the Seribu Islands Jakarta with an average hard coral cover of > 30%, where the number of waste increases along with the cover of hard and dead corals at a depth three meters. Putra et al. (2021) further reported that plastic waste was also found in coral reef ecosystems on Dua Island, Harapan Island, and Kelapa Island, which are in the same archipelago, namely the Seribu Islands.

Measuring the estimation of marine debris from fishing activities in the sea, accompanied by an assessment of the brand of supplies, is still challenging to find in Indonesia. Two previous studies from Abdurrahman (2021) and Kholipah Rahman (2021) at the Ocean Fisheries Port and the Cilacap Ocean Fisheries Port provided an overview of waste generation from consumable supplies for human consumption and non-human consumption for machines and fishing, especially on Gill Net Vessels. However, these two studies did not assess the brand of fishing supplies, so that specific information on the type of plastic packaging that leaked into the sea was not obtained. The absence of such information does not provide strong evidence that producers are obliged to take part in social and environmental responsibility (corporate social responsibility/CSR) of Limited Liability Companies following Government Regulation no. 47/2012 and social and environmental responsibility of State-Owned Enterprises following the provisions of the Minister of BUMN Per-05/MBU/04/2021) regarding the problem of plastic waste in the sea. The Break Free Plastic program has carried out routine brand audits in various countries, including Indonesia (Greenpeace USA, 2018). However, because this program adopted the clean-up movement concept with the main focus on evaluating waste in coastal areas and beaches, the Break Free Plastic program has not been able to answer the problem of plastic waste from fishermen's supply brand products in fishing operations in Indonesian seas. Therefore, research on estimating the leakage of waste into the sea coupled with an assessment of the brand of supplies from fishing boat activities is needed so that the trend of plastic waste entering the sea from direct disposal by fishermen during fishing operations can be known.

2 Materials And Methods

2.1 Time and Location of Research

This study on the potential for marine debris from fishing vessel operations in Indonesia was conducted at one of the largest fishing ports in Central Java Province, namely the Tegalsari Fshing Port (PPP Tegalsari_ located in Tegalsari Village, West Tegal District, Tegal City, Central Java Province. This study was conducted in the capture fisheries industrial area in Block E, which consists of the Jongor Fish Auction site, mooring docks, supply and ship repair docks, and fishing boats. This activity will be held for three days, March 15 - 18, 2022.

 ISSN 3031-7320

Figure 1. Tegalsari Fishing Port (PPP Tegalsari)

2.2 Research Design

This study applied a descriptive quantitative method with a survey approach. Descriptive quantitative methods were used because they can specifically explain social and natural events to provide an overview of more complex study results (Punaji, 2010). The descriptive method, through interrelated variables, tries to clarify social phenomena in society (Widodo & Mukhtar, 2000). Assessing the potential for waste from fishermen's supplies from fishing activities required a detailed description so that conclusions can be drawn on an ongoing basis from the study results. Descriptive methods develop a foundation for finding new facts and provide a knowledge base that can become parameters for further quantitative analysis, most of which are guided by one or more research questions and often do not follow a structured research hypothesis (Travers, 1978). This study was a follow-up study of the Quick Assessment activity carried out in June 2021. It was used to develop research questions in the questionnaire used. This study is then believed to provide new and detailed data and information regarding the leakage of plastic waste from fishing ports, especially Type C Fishing Ports in Indonesia, which can be adopted at other fishing ports in Indonesia in the future.

2.2 Population and Sampling Technique

The population in this study included 958 fishing vessels operating and based at the Tegalsari Fishing Port. Sampling was carried out in a classy manner (stratified random sampling). This technique selected a cross-sectional sample better than an unstratified population and provided a reasonable justification for estimating population characteristics. The sample group studied in this study was divided into ships with sizes < 30 Gross Tonnage (GT) and ships with sizes > 30 GT. There were 515 vessels < 30 GT and 443 vessels > 30 GT (UPT PPP Tegalsari, 2020). Based on the sample size calculation, it was found that the number of samples for ships < 30 GT was 21 ships, and for ships > 30 GT was 83 total ships.

2.3 Research Instruments

The study on the potential assessment of marine debris and product brands from Indonesian fishing vessel operations does not develop hypotheses. It will only understand the weight/volume of waste and product brands of plastic packaging waste from fishing activities in the sea. The survey approach in this study aimed to identify supplies and procedures for handling fishermen's waste on fishing boats using a questionnaire to conclude the estimated weight/volume of waste and product brands that enter the sea from fishing activities. The questionnaire was a closed question to collect detailed information about fishermen's supplies based on product groups to minimize confounding factors affecting the final result of the marine waste calculation.

3 Results And Discussion

3.1 Generation and Composition of Plastic Waste

Plastic waste generation is the weight or volume of plastic waste generated at a location. Waste generation is obtained from the division between the weight of the waste measured (kg) by the number of waste generating units (ships). The calculation of plastic waste generation on the PPP Tegalsari fishing boat illustrates a large amount of remaining plastic packaging supplies that have the potential to enter the sea from fishing vessels without proper handling. The waste generated by fishing vessels >30 GT and fishing vessels <30 GT have very different weights, so a separate calculation is required to determine the average ($\bar{x}$) waste of a specific size. Waste generation from fishing vessels <30 GT is divided by 21, while waste generation from fishing vessels >30 GT is divided by 83 according to the composition of the respondents. There is a total of 54.2 kg of plastic waste generated in each PPP Tegalsari. Each ship > 30 GT produces a total of 31.7 kg of plastic waste, or 59.2% of the total plastic waste on board, while the rest is contributed by small ships.

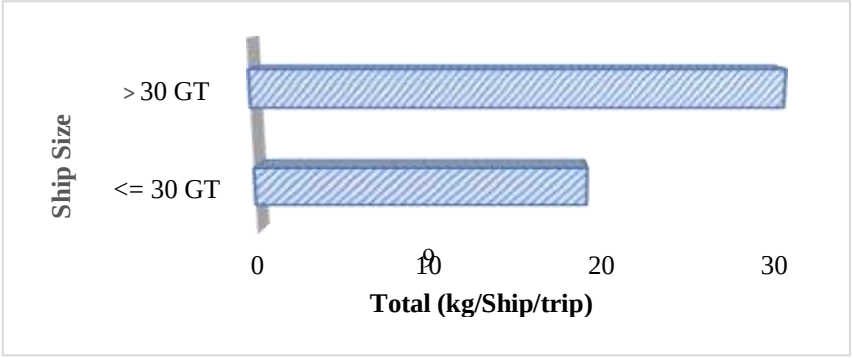

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Fig. 2. Generation and composition of plastic waste on the PPP Tegalsari

Those waste generation is only obtained from the remaining packaging of human supplies, namely food, drinks, and personal equipment, but does not include the remaining consumption of ships. It is difficult to obtain data from 104 captains and ship agents/managers due to low awareness and the sensitive issue of specific questions resulting in the absence of information regarding the composition of API and ABPI on marine debris. Fish plastic is usually stored in sacks and bought in kilograms, so the crew and ship agents/managers lack information about the number of plastic fish sheets they carry. It hinders the calculation of the weight of plastic fish waste per item. Then, concerning nets and ropes, not all fishermen are willing to provide information about the number of API and ABPI because the fishing gear is a sensitive issue that should be avoided as much as possible. Another limitation is that the ship's agent/management and the captain are unwilling to provide receipts or supply shopping lists because these are company secrets. Observation of nets and sembar ropes is also challenging to carry out because of the accumulation of large numbers of items in one place. Because of the conditions above, this study only describes the problem of waste from human consumption supplies without discussing ship consumption supplies.

The grouping of fishing supplies into three classes compared to five classes according to the conceptual framework is driven by the complexity of obtaining data related to API and ABPI. Only a few of the fishermen know, and only a few of the ship's agents want to provide information about the number of supplies of nets, fishing lines, plastic fish, oil, and other ship equipment brought to sea. This information was also challenging to obtain through observation because the ropes and nets are generally piled up and difficult to count manually. Besides, fish plastic has also been put in sacks and cannot be opened. Oil is generally stored at the bottom of the ship, so calculations are also tricky. Then, other equipment, such as medicines, are not included in the supplies provided by the ship's management. Recording the number of supplies required requires interviews and observations with each fishing boat crew. It is not adequate to do because it requires more time and resources. Waste from fishermen's toiletries does not have a significant amount, so combining toiletries and other equipment into fishermen's supplies is better. The number of supplies and plastic waste from API/ABPI in this study was not found, so a particular follow-up study to calculate related waste needs to be carried out.

The composition of plastic waste is obtained from the division between the amount of waste per category (food/drink/personal equipment) per ship class and the total plastic waste generated on board. The total waste generated on board from all types of waste, including organic waste, iron, glass, and B3 waste, is not included in the calculation because the main focus of this study is on plastic waste. Then it encourages calculating plastic waste composition in the fishermen's food, beverage, and personal equipment clusters. The amount of plastic waste generated in each PPP Tegalsari fishing vessel based on the size of the vessel is directly proportional to the composition of the plastic waste. Beverage supplies contribute the most significant amount of plastic waste on board, with a percentage of >65% on fishing vessels <30 GT and >30 GT. Food supplies are the second largest contributor of plastic waste on ships, with a percentage of 2x more significant than personal supplies on ships >30 GT and 1.5 more significant than personal equipment on ships <30 GT.

Supplies that have the potential to generate sea-based plastic waste are divided into three categories: food, beverages, and personal equipment. The products that produce plastic waste in the food supplies category include snacks, flavorings, salt, sugar, soy sauce, sauces/chili sauce, flour, tofu, tempeh, instant noodles, seasonings, cooking oil, powdered coconut milk, sacks, and jerry cans. Types of products in the personal equipment category known to produce plastic waste are soap, detergent, shampoo, toothpaste, toothbrush, and medicine. The products that are then assessed to produce plastic waste in the beverage supplies category are mineral water, coffee, tea, milk, and soft drinks. The five types of products that contribute most to plastic waste after mineral water during the fishing period for large and small vessels are soft drinks with an average weight of 8.5 kg, instant noodles with 4.3 kg, jerry cans with 2.8 kg, cigarettes with 2.8 kg and 2.5 kg of instant noodle seasoning. Outside of the five products above or 26

other products, weighing in less than <2 kg. Mineral water packaging occupies the first position as the type of plastic mainly produced on fishing vessels, with a total weight of 19.6 kg.
In comparison, tempeh and medicine packages occupy the last position with a weight of 0.62 kg each. The level of contribution of a type of packaging to the composition of plastic waste on ships is not significantly influenced by the product's quantity but by the product's density. For example, sachets with a much more significant amount than bottles do not have a large composition because of the low density and vice versa. Graph 1 illustrates waste generation and the composition of plastic waste produced on fishing boats at the PPP Tegalsari.

Table 1. The six types of products that contribute the most to plastic waste on fishing vessels

Rank	Category	Product type	Waste generation	
			<30 GT	>30 GT
I	Drinks	Mineral water	8.2	11.4
II	Drinks	Soft drink	3.4	5.1
III	Food	Instant Noodle	1.8	2.5
IV	Food	Ketchup / sauce / oil jerry cans	0.7	2.0
V	Personal equipment	Cigarette	1.3	1.4
VI	Food	Instant noodle seasoning	1.1	1.4

Large ships produce more than large ships, which is motivated by the number of crew members and the duration of the trip. The greater the number of crew members and the longer the fishing period, the greater the number of supplies that need to be carried. However, the number of supplies carried by fishing boats should not be excessive because it will require a large budget. Therefore, rationing is done. The rationing of supplies at PPP Tegalsari is considered before departure and during the ship's operational period to anticipate a shortage of supplies until the end of the operational fishing trip. To ensure that food consumption is sufficient for fishermen's needs, cooks divide food supplies into certain portions for daily consumption. In order to save on the consumption of drinks and personal equipment, agents/ship handlers prepare products in small forms, such as glass sachets and bottles, to save the use of limited resources on board. However, suppose the supplies brought cannot meet the fishermen's needs until the trip's end. In that case, the captain generally communicates with other ship captains so that the requested product is provided and will be replaced when returning to the port.
This study did not detect the potential for new waste to arise from requests for several supplies from other fishing vessels due to the uncertainty of product demand and quantities. In addition, other plastic wastes used to package B3 waste, such as oil and nylon plastic from nets, are also not considered. For this reason, the plastic waste generation found is still lower than the actual plastic waste on fishing boats. Nonetheless, the figures obtained are enough to prove that the fisheries sector also has the potential to contribute significant amounts of marine plastic waste to WPPNRI and the high seas if there is no handling of waste on fishing vessels during fishing.

3.2 Potential Leakage of Plastic Waste

Information regarding the leakage of plastic waste into the sea from fishing vessels was obtained from interviews with ship captains who directly relate to waste handling. Estimates of leakage of plastic waste in each fishing vessel <30 GT and >30 GT are obtained by dividing the weight of waste dumped into the sea by the number of waste-producing units (ships). An assessment of the leakage of plastic waste into the sea provides an overview of the contribution of fishing boats to the entry of pollutants or plastic waste into the sea in fishing operations. Garbage disposed of by fishing vessels <30 GT and fishing vessels >30 GT have different weights, so a separate calculation is required to determine the average ($\bar{x}$) of waste wasted. Waste generation from fishing vessels <30 GT is reduced by waste leakage, according to fishermen's statements, divided by 21, while fishing boat waste generation >30 GT is reduced by waste leakage, according to fishermen's statements, divided by 83, according to the composition of the respondents. Furthermore, because no clear information was found related to the amount of waste brought ashore (bags/kg), the calculation was carried out according to fishermen's statements regarding the percentage of waste leakage from certain types of packaging.
Of the 54.2 kg of plastic waste generated on fishing boats on each trip, 90% was disposed of intentionally into the sea, and the rest was returned to land for further processing (Graph 2). All packages of flavorings, salt, sugar, soy sauce, flour, tofu, tempeh, oil, coconut milk, tea, milk, toothpaste, and medicine contaminated the routes that PPP Tegalsari fishing vessels pass. Toothbrush and jerry can waste, the two most common types of waste a little were discharged into the sea with a percentage of 58.9% and 58.6%, respectively. Other than the above types, snack packs, instant noodles, instant seasonings, drinking water, coffee, soft drinks, soap,

 ISSN 3031-7320

detergents, shampoo, and cigarettes > 80% were also dumped into the sea during the PPP Tegalsari fishing vessel fishing period. The graph below shows the handling status of plastic waste generated on board by being discharged into the sea or returned to the port.
Looking at the size of the ship, fishing vessels > 30 GT contributed 30 kg or 61.1% of the total leakage of plastic waste into the sea during fishing at sea, while fishing vessels < 30 GT contribute as much as 19 kg of plastic waste to the sea, with the highest composition owned by beverage supplies with a respective percentage of 41.4% and 26.6%. Fishermen's supplies contributed to the lowest composition of plastic waste leakage into the sea, with the percentage on small boats at 2.7% and on large vessels at 3%.

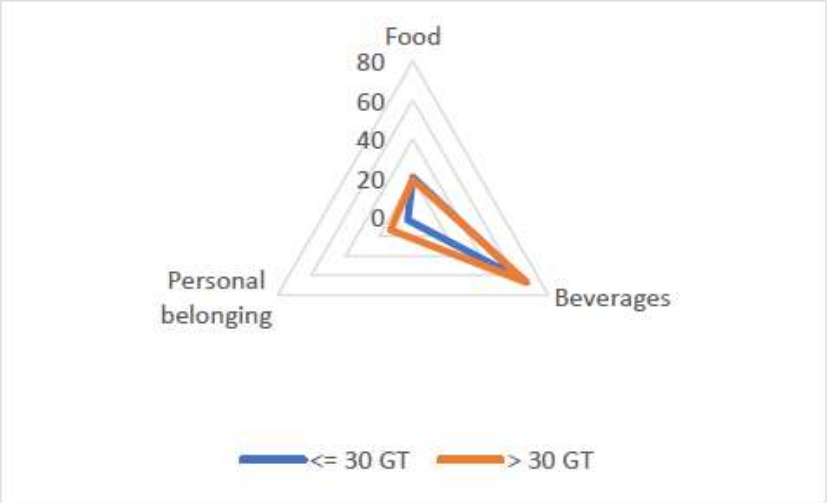

Fig. 3. Generation and Composition of Leakage of Plastic Waste into the Sea from the PPP Tegalsari

On average, PPP Tegalsari fishing vessels carry out fishing operations four times a year. Extrapolating data on plastic waste leakage in a year shows that vessels > 30 GT dispose of 120 kg of waste, while small ships dispose of 76 kg of waste. A total of 23,075 kg of plastic waste was generated by 958 fishing vessels in 2020, with large vessels contributing 58% of the total leakage of plastic waste. Data from the Ministry of Environment and Forestry in Katadata (2020) stated that waste in the Indonesian seas reached 5.75 tons, with plastic as the primary contributor to marine waste, 627.8 grams/m2. About 70% of the waste comes from land, while the rest comes from the sea. The TKN-PSL in the Kemenkomarves (2020) said that 12,784 tons of waste that entered the sea came from activities at sea (did not specify the amount of plastic). This follow-up study emphasized that although waste originating from the sea only contributes to 30% of total marine waste, plastic waste dumped into the sea during fishing, for example, harms the carrying capacity of the marine environment (marine environmental carrying capacity). The MECCC is the acceptable threshold for the marine environment without exceeding water quality. It is essential to support water pollution management (Liao et al., 2013). The amount of plastic waste in the sea impacts the limitations of fish catches due to the death of species from entanglement, interaction, and consumption of plastic.
The estimated leakage of plastic waste into the sea is directly related to the amount of waste generated on board. The higher the waste generation on fishing vessels, the higher the amount of waste leaking into the sea. Most fishing vessels throw mineral water containers into the sea in terms of weight, which is 16 kg/trip or equivalent to 81.8% of the total mineral water packages on board due to the high waste generation from the start, which is influenced by the density of the product. It is the same as the generation of waste packaging for soft drinks, instant noodles, cigarettes, and instant spices as the second to fifth most significant contributors of plastic waste to the sea. One difference is that coffee packaging replaces used jerry cans as the most significant pollutant into the sea from the supplies of PPP Tegalsari fishermen at 2 kg.

Table 2. Six types of products contribute to the leakage of plastic waste into the sea

Rank	Category	Product Types	Waste Generation		%
			<30 GT	>30 GT	
I	Drinks	Mineral water	7.8	8.2	81.8
II	Drinks	Soft Drink	3.1	4.9	93.7
III	Food	Instant Noodle	1.6	2.4	92.2

 ISSN 3031-7320

IV	Personal Equipment	Cigarette	1.2	1.4	95.1
V	Food	Instant Noodle Seasoning	0.9	1.4	92.2
VI	Drinks	Coffee	0.6	1.3	94.4

Many fishermen's supplies that enter the sea are plastic with aluminum, as many as 6,212 packs/trip, consisting of snack wrappers, flavorings, soy sauce, chili sauce, instant noodle seasoning, coffee, soft drinks, detergents, shampoo, and toothpaste. Cigarette packs occupy the second position as the most effective form of plastic waste polluting the marine environment, namely 2,375 packs/trip (17%). Sachets of instant noodle seasoning, chili sauce/sauce, and plastic noodles are most thrown into the sea by fishermen, consisting of 2,396 packs and 2,317 packs/trip. Drug strips and buckets are the two forms of waste that pollute the marine environment the least from fishing activities in the sea, namely 15 and 23 packs/trip. The graph below provides a detailed illustration of the composition of plastic packaging that enters the sea from the PPP Tegalsari fishing vessel.

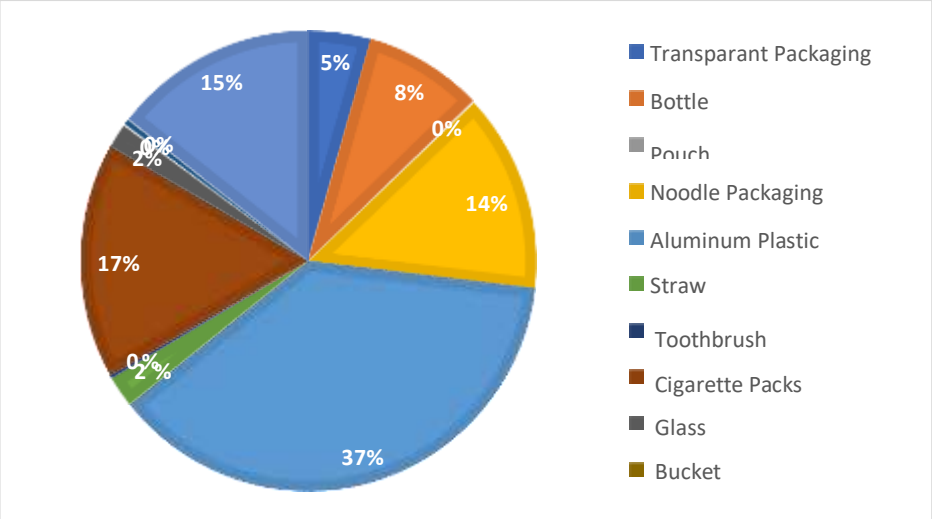

Fig. 4. Forms of Plastic Waste Packaging Leaking into the Sea

This study described the potential for leakage of sea-based waste from fishing vessels to catch fishermen's consumption in kilograms, similar to studies from Kholipah Rahman et al. (2021) and Abdurrahman (2021). However, the difference was that this study focused on plastic waste, while the other two studies explained waste broadly. This study, however, yielded more accurate figures that could justify the leakage of marine-based debris into the sea. It was because the weight of the waste differs according to the product brand, and the type of packaging (sachets, bottles, cups, and others) was included as a determining factor for the high or low weight of waste entering the sea. Another difference is that this study discusses the brand of fishing supplies that enter the sea, while the two related studies do not. Other studies report brands of marine plastic waste in Indonesia, but only 10 brands/companies were known to contribute to marine pollution. Compared to the initial study of the Rapid Assessment of Solid Waste Management and Waste Management at PPP Tegalsari, this follow-up study was more structured, explaining the types of plastic waste from fishermen's supply packages that enter the sea, and the amount of each package (kg/pcs). The initial study provided the foundation for designing questions in the follow-up questionnaire, from open-ended questions to gather as much information as possible to closed questions to find out the details of each question.

3.3 Brand Audit of Plastic Waste from Fishing Supplies

Brands of fisherman and boat consumption supplies vary. Several products, such as flour, oil, flavoring, and chili sauce, have the same brand. There were no particular rules from the Ship Agent in choosing the brand of supplies to be carried. Ship agents/handlers bought according to the availability of products at retail customers. The Ship Agent directly accepted the product provided by the seller without considering the price if the product choices are limited. It was also called a forced choice decision related to opportunity cost. Generally, the brands widely used in fishing operations at sea were products familiar to fishermen's daily lives, classified as fast-moving consumer goods (FMCG). FMCG has low prices in order to reach a broad target market. FMCG has a low shelf life because related products are quickly sold in large quantities daily.

There were approximately 166 product brands from 106 producers used by fishermen on board the Tegalsari Beach Fishery Port, of which around 90% of the products were produced by Limited Liability Companies (PT), and the rest were produced by Commanditaire Vennootschap (CV) and Trading Enterprises (UD). Seven types of fishermen's supply products did not have brands or were often called bulk products, such as snacks, salt, tempeh, tofu, flour and sugar, soy sauce, and chili sauce. Unbranded products are generally produced on a household scale that pays little attention to labeling. It resulted in no information regarding the manufacturer found. The product categories most used by PPP Tegalsari fishermen were mineral water, instant noodles, soft drinks, cigarettes, and instant coffee.

In contrast, the sequence of products that Indonesian residents widely use, according to Kantar Indonesia (2021), are instant noodles, biscuits, instant coffee, detergents, and flavorings. Related reports showed that *Indomie* instant noodles were the primary choice of consumers, while the results of this study showed that *Sedaap* noodles were the main choice of fishermen. Masako flavoring and Economy cream soap were used more at the port than Royco flavoring and So Klin detergent. This study also found that Frisian Flag milk was not in the first position as a widely consumed dairy product at the port, but Indomilk milk. Roma Coconut Biscuits and Vegetable Biscuits were not the primary food consumption for fishermen, but kilo snacks without a brand. Kapal Api Coffee occupied the sixth position as the product that fishermen were most interested in compared to other beverage categories or were not in the first position per a survey conducted by Kantar Indonesia.

Table 3. Comparison of Brand Audit / Footprint Results from DFW Indonesia and Kantar Indonesia

Product	Rank	Brand Audit By DFW Indonesia	Brand Footprint by Kantar Indonesia
Food	1	Sedaap Noodle	Indomie Noodle
	2	Masako	Sedaap Noodle
	3	Supermi Noodle	Royco
	4	Royco	Roma
	5	Gulaku	Masako
Drinks	1	Adi Mineral water	Kapal Api Good Day Luwak
	2	Prim-A	Top Coffee Aqua
	3	Sprite Mineral water	
	4	Coca-Cola	
	5	Fanta	
Milk Product	1	Indomilk Frisian Flag Enak	Frisian Flag Indomilk Dancow Aice
	2	Bear Brand Omela	Bear Brand
	3		
	4		
	5		
Personal Care	1	Pepsodent Formula Clear	Lifebuoy Pepsodent Giv
	2	Ciptadent Pantene	Nuvo Pantene
	3		
	4		
	5		
Home Care	1	Cream Ekonomi Daia	So Klin Sunlight Daia Downy
	2	Rinso So Klin Wings	Rinso
	3		
	4		
	5		

Source: kantar Indonesia (2021)

PT Tirta Adi Sejahtera, PT Coca-Cola Bottling Indonesia, Wings Group, PT Sinar Sosro, PT Unilever Indonesia, PT Gudang Garam, PT Indofood CBP Sukses Makmur, PT Santos Jaya Abadi, PT Gunung Madu Plantations and PT Otsuka Indonesia were the ten companies that

contribute to waste the giant marine plastic from the capture fisheries sector at the PPP Tegalsari based on waste weight.

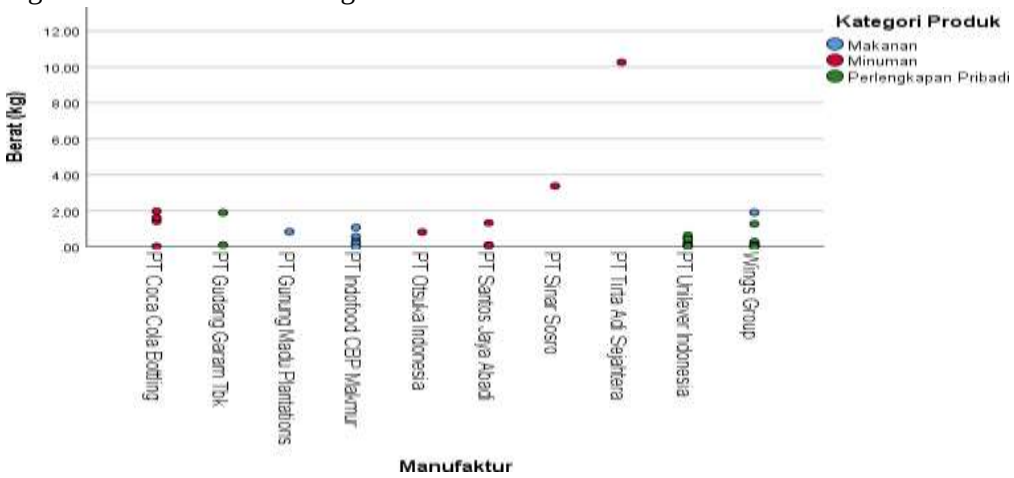

Fig. 5. Weight of Plastic Waste Based on Manufacturing of Fisherman's Supply Products

Figure 5 above shows that five out of ten manufacturers contribute plastic beverage packaging waste to the sea; two companies each put food packaging and personal equipment into the sea, and one company donates food, beverage packaging, and personal equipment. PT Coca-Cola Bottling and PT Otsuka Indonesia contributed to soft drink bottle waste, PT Santos Jaya Abadi for coffee sachets and packets, PT Tirta Adi Sejahtera, and PT Sinar Sosro for mineral water bottles and glasses. PT Gunung Madu Plantations and PT Indofood CBP Sukses Makmur produced marine plastic waste from food packaging, sugar wrappers, instant noodles, flour, and soy sauce. PT Unilever Indonesia produced waste from food packaging and personal equipment from packets of flavorings, soy sauce, soap, shampoo, toothbrushes, toothpaste, and detergents. Wings Group produces waste from food and beverage packaging and fishermen's equipment, such as packets of instant noodles, cream soap, soy sauce, soft drinks, detergents, toothpaste, soap, and shampoo. Then, the top ten product brands contributing to the entry of plastic waste into the sea are Gudang Garam Merah Cigarettes, Sedaap Noodle, Masako Flavoring, Kapal Api Coffee, Adi Mineral Water, Supermi noodle, Surya Cigarettes, Indomilk Milk, Royco Flavoring and Frisian Flag milk. Cigarettes from PT Gudang Garam produced the most plastic waste into the sea, reaching 1,905 packs/trip. This quantity was far above other products, which range from less than 1,200 packs/trip. A total of 1,125 packages of Sedaap noodles were found to contaminate the ocean from each ship per trip. Kapal Api Coffee to Mie Supermi donated more than 600 plastic wraps to the sea. In one trip, each PPP Tegalsari fishing boat put 512 packs of Surya cigarettes and 508 sachets of Indomilk milk into the sea. Royco Flavoring and Frisian Flag Milk were ranked ninth and tenth as manufacturers that contribute the most significant plastic waste to the sea, consisting of 438 packs/trip and 441 packs/trip.

Five brands of plastic waste that contribute to marine litter by weight also have a high quantity of products, such as Gudang Garam Merah Cigarettes, Sedaap Noodle, Kapal Api Coffee, Supermi Noodle, and Adi Mineral water. However, product weight is known to have no significant relationship with product quantity. In other words, products with a significant weight do not always have a high quantity and vice versa. This condition is shown in Graph 7. Adi mineral water, which contributes to the most significant marine debris in terms of weight, occupies the fifth position in quantity. Gudang Garam Cigarettes are in sixth place in terms of weight but have the highest product quantity. Supermi noodle packaging ranks fifth in quantity but last in weight due to its low density. Sedaap noodle is not in a much different position regarding quantity and weight. Seven of the ten most significant contributors to the weight of plastic packaging also contribute to the entry of high quantities of plastic waste into the sea, including PT Gudang Garam, Wings Group, PT Indofood CBP Sukses Makmur, PT Unilever Indonesia, PT Santos Jaya Abadi, PT Tirta Adi Sejahtera, and PT Sinar Sosro. Three other companies that have significant quantities of waste in the sea are produced PT Ajinomoto Indonesia, PT Indolakto, and PT Frisian Flag Indonesia.

Gudang Garam Merah and Surya cigarettes from PT Gudang Garam contributed to the most significant entry of plastic packages into the sea from fishing vessels, 2,417 packs/trip. Wings Group, then PT Indofood CBP Sukses Makmur followed right below it with around 1200 packs/trip of plastic dumped into the sea. PT Sayap Mas Utama produced the most waste from Wings Group manufacturing in the form of Sedaap Noodle packaging, Sedaap Kecap, Isoplus

 ISSN 3031-7320

soft drinks, Economy cream soap, and Daia detergent. In contrast, PT Indofood CBP Sukses Makmur produced marine waste from Supermi Noodle, Sarimi Noodle, Indomie, Blue Triangle Wheat, and Indofood Soy plastic packaging Sauce. Product packaging from PT Unilever Indonesia, PT Ajinomoto Indonesia, and PT Santos Jaya Abadi occupied the fourth to sixth position as contributors of marine plastic packaging from fishermen's supplies PPP Tegalsari with a total of 875 packs/trip, 790 packs/trip, and 757 packs/trip.

Products from PT Unilever that were found dumped into the sea during the fishing activities of the PPP Tegalsari fishing vessel included Pepsodent, Royco toothpaste and toothbrushes, Lifebuoy soap and shampoo, Bango soy sauce, Rinso detergent, Clear and Sunsilk shampoos. Plastic packaging for Masako and Ajinomoto Flavoring from PT Ajinomoto Indonesia and plastic packaging for Kapal Api Coffee, ABC Coffee, and Good Day from PT Santos Jaya Abadi is the brands of waste found entering the sea on the shipping and fishing routes of PPP Tegalsari fishing vessels. Furthermore, PT Indolakto contributed 127 fewer plastic packs to the sea than PT Tirta Adi Sejahtera but 75 more packs than PT Frisian Flag. PT Indolakto and PT Frisian Flag Indonesia each produced beverage waste from milk packaging. The product packaging from PT Sinar Sosro that entered the sea was 226 bottles and cups/trip from one product brand, such as PT Tirta Adi Sejahtera.

Although only from two products, PT Gudang Garam beat Wings Group, PT Unilever Indonesia, and PT Indofood CBP Sukses Makmur, with more than five types of products, as the main contributors to marine plastic waste from the PPP Tegalsari ship. It was motivated by the high need for cigarettes during the fishing season of fishermen every day. Cigarettes were claimed to be a primary need for fishermen that cannot be postponed compared to other needs, which are consuming at least one pack per day per person. Although food and drink are consumed daily, the frequency of smoking is higher for fishermen, especially while waiting for the net to be lifted, relaxing/ chatting, driving, repairing/ emulsifying boat engines, and others. Apart from that, other consumption supplies such as soap, shampoo, and detergent are claimed not to be used daily but once every three days or once a week. The two things above made the amount of waste from food, drink, and personal care supplies to fishermen lower than cigarettes. This results in plastic waste entering the sea from the three categories of supplies being lower than the plastic packaging from cigarettes, mainly in quantity.

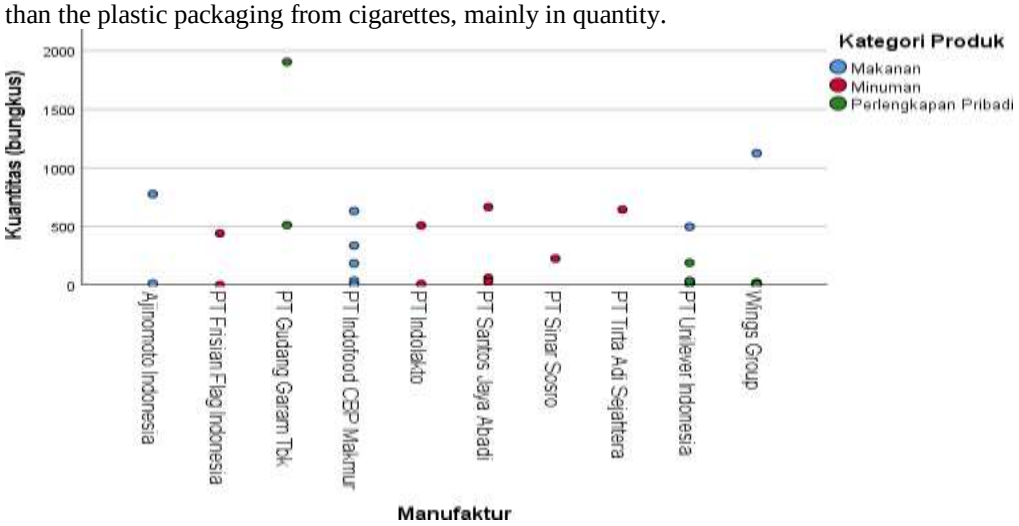

Fig. 6. Quantity of Waste Based on Manufacturing of Fisherman's Supply Products

PT Indolakto, PT Frisian Flag, and PT Ajinomoto Indonesia are three manufacturers not included in the most prominent plastic waste contributor companies based on waste weight but in the ten largest plastic waste contributor companies based on product quantity. In contrast, PT Coca-Cola Bottling Indonesia, PT Gunung Madu Plantations, and PT Otsuka Indonesia have fewer products. However, due to their high product density, they contributed to the weight of the waste that enters the sea. There were differences in manufacturing and the amount of plastic waste between the 2018 brand audit and this brand audit. Branded Report 2018 from Greenpeace USA (2018), showed that PT Danone Indonesia, PT Indofood CBP Sukses Makmur, PT Unilever Indonesia, Tudung Group, PT Procter & Gamble, PT Coca-Cola Bottling Indonesia, PT Mayora Indah, PT Heinz ABC Indonesia, PT Pepsi Indobeverages and Nestlé were the ten most significant contributors of plastic waste to the sea. Except for PT Unilever Indonesia, PT Indofood CBP Sukses Makmur, and Mayora Indah, other companies contribute plastic waste to

the sea in smaller amounts. PT P&G donated 23 plastic bottles of Mizone and Aqua and 94 sachets of Pantene and Head & Shoulders shampoo to the sea from one ship on each trip, while Nestlé Indonesia, with its Bear Brand products, put 14 packs of plastic waste per trip. PPP Tegalsari fishermen did not use products from Tudung Group, Kraft Heiz, and Pepsi during the fishing period, so no plastic waste was found dumped into the sea.

Table 4. Differences in results between the 2022 DFW Indonesia Brand Audit and the 2018 Brand Audit

Rank	Brand Audit DFW Indonesia		Brand Audit Reference 2018	
	Manufacture	Σ (pack/trip)	Manufacture	Total (Packs)
1	PT Gudang Garam	2.417	PT Danone Indonesia	563
2	PT Indofood CBP Sukses Makmur	1.208	PT Indofood CBP Sukses Makmur	384
3	Wings Group	1.206	PT Unilever Indonesia	335
4	PT Unilever Indonesia	855	Tudung Group	106
5	PT Santos Jaya Abadi	808	PT P&G	105
6	PT Ajinomoto Indonesia	790	PT Coca Cola Bottling Indonesia	98
7	PT Tirta Adi Sejahtera	664	PT Mayora Indah	94
8	PT Indolakto	517	PT Heinz ABC Indonesia	52
9	PT Frisian Flag Indonesia	441	PT Pepsi Indobeverages	40
10	PT Coca Cola Bottling Indonesia	237	Nestlé Indonesia	19

Source: Greenpeace USA (2018)

The brands, quantities, and ratings of manufacturers contributing to marine plastic waste varied in the two studies due to different data collection techniques, locations, and target audiences. Brand audits carried out at ports collect comprehensive information on all brands, manufacturers, and the amount of plastic waste that has the potential to enter the sea from fishermen's supplies for a trip duration of 20 to > 90 days with a crew of 14 people to 40 people, while brand audits carried out in areas Coastal areas in Indonesia collect information partially from waste drifting in from unknown sources of waste. Related studies could not see the broader side that one company could contribute more than 10 products if it did not find product variations in one manufacturer. Brand audits at ports also had limitations in that they could only identify less than 30% of FMCG brands at 166.

3.4 Waste Management on Fishing Vessels

Efforts to reuse waste or reuse were carried out by a small number of fishing boats at the Tegalsari Beach Fishing Port, with a composition of only <30%. Apart from the limited implementation of waste reduction, the lack of waste handling on board has also contributed to the increase in plastic waste in the Indonesian seas. The results of this study indicated that the PPP Tegalsari capture fisheries industry is more focused on fulfilling economic aspects and ignoring environmental aspects during fishing. In other words, fishermen did not pay more attention to other things besides achieving economic profit/value, including the importance of providing facilities to support the management of waste handling on board. Almost all agents /ship handlers did not include trash bins on the shopping list because the captains did not order them. It has implications for the absence of pockets on all PPP Tegalsari fishing vessels. The related parties answered that plastic fish and sacks are usually used to replace the function of garbage collection, so purchasing separate bins/garbage bags was unnecessary. Responding to this, DFW Indonesia saw that fishing boat crews had a more significant disadvantage by using fish plastic to store waste. Because plastic fish prices are higher, excessive use can lead to long-term scarcity of commodities at sea to accommodate fish packaging needs. Sacks are a suitable option for minimizing plastic use on ships, so DFW Indonesia supports the program to run on more ships in the future.

Cases of using plastic fish and sacks, however, were rarely found (20.2%) because, in general, the Tegalsari PPP fishing boats did not have waste container facilities. The absence of trash cans resulted in the non-implementation of waste containers and segregation efforts on board. Less than ¼ of ships < 30 GT have a waste storage facility, and only 4.8% provide segregated waste bins. Ships > 30 GT have more significant problems than ships < 30 GT. Only about 14.5% of

 ISSN 3031-7320

the larger fishing vessels have temporary waste storage containers, and only 4.4% use segregated waste bins.

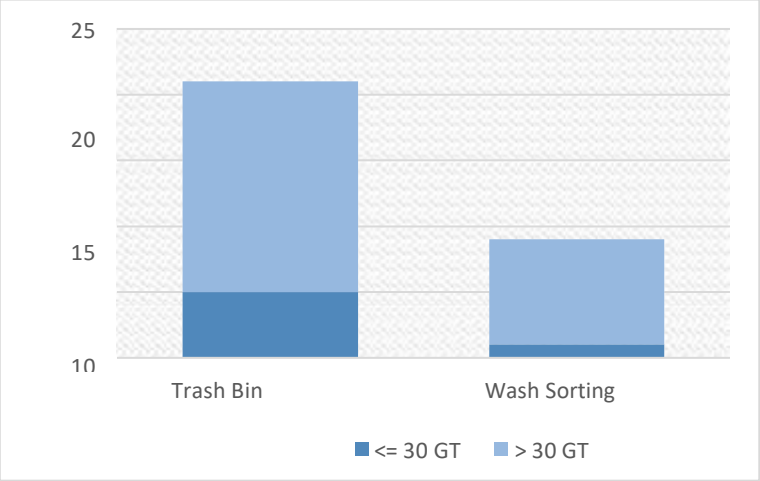

Fig.7. Container and Segregation of Waste on the PPP Tegalsari Fishing Boat

Ships > 30 GT have two to more than five bins, while ships < 30 GT use one to more than five bins. Most trash cans on large ships were on the ship's deck (13.2%), while the trash bins on small ships were on the deck and stern of the ship (3.8%). Each ship of a different class has a trash bin in the bridge area. The waste collection had not been carried out effectively on the PPP Tegalsari fishing boat due to the non-optimal implementation of waste collection and segregation at the port. The results of the data analysis show that only 11.6% or 6.4 kg of plastic waste is returned for further handling/processing at the port.

3.5 Implementation of Waste Reduction Map by Producers

Multinational companies such as Coca-Cola Bottling, Unilever, Otsuka, Ajinomoto, and Frisian Flag clearly commit to reducing plastic waste. Only one company, namely PT Indofood CBP Sukses Makmur, is committed to reducing plastic waste in both the pre-consumption and post-consumption stages. This difference is driven by the global target of reducing plastic as raw material and post-consumer plastic waste for multinational companies, while for national companies, the target for reducing plastic waste is still lacking. Local companies have a more complex situation in that it is infrequent for manufacturers to pay attention to reducing single-use plastics or waste that can be recycled and reused.

The five multinational companies above commit to using 100% recyclable plastic packaging for all products marketed globally in 2025 for Coca-Cola Bottling (Coca Cola Amatil Indonesia, 2021) and Frisian Flag (Rindrawati, 2021), in 2030 for Unilever (Unilever) and Otsuka (Otsuka). Coca-Cola Bottling and Unilever emphasize reducing the use of virgin plastic from non-renewable sources, which is the first company, by 3 million cumulative metric tons in 2025 (Coca-Cola Amatil Indonesia, 2021) and the second company by > 100,000 tons in 2045 (Unilever). Coca-Cola Bottling and Unilever also emphasized their commitment to waste collection and processing (Coca-Cola Amatil Indonesia, 2021). A company operating globally since 1993 (Unilever) has an ambitious target of collecting and processing more plastic than is sold in 2045 (Sayekti, 2022). Otsuka and Ajinomoto are committed to replacing single-use plastic packaging with recycled plastic packaging, vegetable materials (Otsuka), and paper (Ajinomoto, 2022).

Judging from the achievements of the multinational companies' targets above, only Unilever and Ajinomoto provided statistical information. PT Unilever Indonesia claimed to have collected and processed more than 45,900 tons of plastic waste in 2021 by collecting more than 24,500 tons of plastic waste from a network of waste banks and successfully processing more than 21,400 tons of waste through RDF technology (Sayekti, 2022). PT Ajinomoto Indonesia then modified plastic packaging with paper, thereby reducing plastic use by up to 30% for Ajinomoto products, 8.4% for Masako, and 9.5% for Sajiku (Ajinomoto, 2022). Coca-Cola Bottling Indonesia stated that they changed colored bottles to transparent PET (which has high economic value), designed recycled bottles, implemented Affordable Small Sparkling Package (ASSP) technology, and succeeded in improving waste collection and recycling infrastructure (Coca-Cola Amatil Indonesia, 2021). PT Frisian Flag Indonesia claimed to have succeeded in reducing the use of plastic by replacing it with paper straws, in which straws were attached to

the primary product packaging to reduce the amount of waste that goes to the landfill (Rindrawati, 2021). Unlike the four related multinational companies, PT Otsuka Indonesia did not provide an update regarding the achievement of the plastic waste reduction target at the national level, both statistically and non-statistically.

National companies such as Indofood did not statistically explain the commitment to reduce plastic waste that they want to carry out but provided detailed information on the achievements of reducing plastic waste that has been successfully carried out. PT Indofood CBP Sukses Makmur Indonesia claimed to use more efficient materials for plastic beverage bottle packaging, which is 30% lighter and has succeeded in reducing the thickness of beverage bottle packaging. The related company also succeeded in reducing 76% of post-production plastic waste (more than 9,000 tons) in collaboration with waste collectors through the Waste Bank, Green Warmindo, to be sent to the recycling industry, and the rest (more than 2,800 tons) was recycled internally at the Division Flexible Packaging (Indofood, 2021). Other large companies, such as Wings Group and Gudang Garam, did not have explicit commitments to supporting waste reduction by producers, as seen from the absence of related information on the website or in other sources from the literature studies conducted. It is the same with other national companies such as GMP, Santos Jaya Abadi, and Indolakto, as well as a local company in Tegal City, namely Tirta Adi Sejahtera, which were not found to have contributed to Permen LHK No. 75/2019.

4 Conclusion

The conclusions that can be drawn from the study "Estimating Potential Leaks and Brands of Marine Garbage Products from Fishing Vessel Operations at the Tegalsari Fishing Port" are as follows:

1. Each PPP Tegalsari fishing boat produces 54.2 kg of plastic waste in one fishing trip. Ships > 30 GT produce a total of 31.7 kg of plastic waste, or the equivalent of 59.2% of the total plastic waste on board, with the most significant component of plastic waste contributed by drinking supplies (26.6%) and the smallest composition from fishermen's equipment (40%).
2. Around 88.7% of the plastic waste generated on fishing boats is dumped into the sea by fishermen to WPPNRI. Fishing vessels > 30 GT accounted for 60.1% of the total leakage of plastic waste into the sea, with beverage packaging as the primary contributor to marine plastic waste (26.2%) and fishermen's equipment packaging as the lowest contributor (41.4%).
3. In terms of weight, Adi's mineral water bottles and glasses from a local producer, PT Tirta Adi Sejahtera, contributed the most significant amount of plastic waste to the sea from PPP Tegalsari fishermen's supplies, namely 10.3 kg/trip. Prim-A mineral water from PT Sinar Sosro occupies the second position as the most significant marine plastic waste product, 3.4 kg/trip. Sedaap noodles from Wings Group, Sprite, Coca Cola and Fanta from PT Coca-Cola Bottling Indonesia, Gudang Garam Merah cigarettes from PT Gudang Garam, Kapal Api coffee from PT Santos Jaya Abadi, GMP sugar from PT Gunung Madu Plantations and Supermi noodles from PT Indofood CBP Sukses Makmur contribute plastic waste weighing <2 kg/trip each. In terms of quantity, Gudang Garam Merah cigarette packaging contributed the most plastic waste to the sea, 1,905 packs/trip, followed by Sedaap noodle packages, 1,125 packs/trip. Masako flavoring from PT Ajinomoto Indonesia, Kapal Api coffee, Adi mineral water, Supermi noodles, Surya cigarettes from PT Gudang Garam, Indomik milk from PT Indolakto, Royco flavoring from PT Unilever Indonesia and Frisian Flag milk from PT Frisian Flag Indonesia donated as much as > 400 plastic packages per fishing vessel trip duration.
4. Only 21 out of 104 vessels (20.2%) of the PPP Tegalsari fishing vessels carried out waste collection during the fishing operations at sea. This number has decreased to only 9 ships (9%) that sort waste on daily, and monthly fishing boat trips at sea. It resulted in the amount of plastic waste that leaked into the sea being higher than the amount that returned to land at 6.7 kg (12.1%).
5. Multinational companies (Coca-Cola Bottling Indonesia, Unilever, Otsuka, Ajinomoto, and Frisian Flag) have more specific commitments and achievements in reducing waste by producers compared to national companies (except Indofood) and local companies in Tegal City. It is because there is a global target which is a reference for multinational companies to reduce the use of plastic in pre-consumption and post-consumption.

5 Acknowledgments

This research was fully supported by the Project "Rethinking Plastics - Circular Economy Solutions to Marine Debris," of the European Union (EU) and the German Federal Ministry for Economic Co-operation and Development (BMZ) with executors Deut- sche Gesellschaft für Internationale Zusam- menarbeit (GIZ), Expertise France (EF) and Destructive Fishing Watch Indonesia. We would like to express our gratitude to the research team who helpedus collect the samples. The authors declare no conflicts of interest, and all co-authors have seen and approved the manuscript's contents without any financial interest to report.

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