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A RAPID ASSESSMENT OF WASTE MANAGEMENT AT THE TEGALSARI COASTAL FISHING PORT, TEGAL REGENCY

Beni Sabdo Nugroho[1*], Atrasina Adlina[2], Nur Rizki Hajar[3], Moh Abdi Suhufan[3], Hartono[3], Alin Fithor[4]
[1] Faculty of Fisheries and Marine Sciences, Pancasakti University, Indonesia
[2] Graduate Program, Environmental Policy Group (ENP), Wageningen University, Netherlands
[3] Researcher DFW Indonesia TCC Batavia Office Tower, Jakarta, Indonesia
[4] Research Center for Hydrodynamics Technology, National Research and Innovation Agency (BRIN), Surabaya, 60112, Indonesia
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ABSTRACT

Waste has become a primary environmental concern at Tegalsari Coastal Fishing Port, one of the largest fishing ports in Central Java. The port area exhibits slum-like conditions, as indicated by the significant accumulation of waste around its main intersections. To evaluate the current situation, a rapid assessment was conducted to examine the status of waste generation, handling, and management within the port area. Primary data were collected through field observations, questionnaires, waste measurement surveys, and in-depth interviews using structured interview guides, while secondary data were obtained from relevant agency reports, scientific publications, and government documents. The assessment, conducted from June 14 to 19, 2021, revealed that waste generation in the port area reaches approximately 2,240 kg per day during low vessel activity. The fish and fillet processing industry was identified as the most significant contributor to waste (652.3 kg/day), while the wharf area generated the least (287 kg/day). Plastic waste from fishing vessels is managed mainly through direct disposal into the sea or return to the port, indicating that sustainable practices are still limited. Overall, the study concludes that waste management implementation is hindered in the early stages due to inadequate infrastructure, limited human resource capacity, and weak institutional and regulatory frameworks. Therefore, strengthening waste management infrastructure, capacity building, institutional development, and policy enforcement is essential to establish an integrated and sustainable waste management system that minimizes marine pollution and supports environmentally responsible port operations.

Keywords: fishing port; marine enviromental; Tegalsari beach; waste conditions; waste management

INTRODUCTION

Waste is a major environmental issue in one of Central Java's greatest fishing ports. Tegalsari Coastal fishing port is reported to be a slum, as evidenced by the large amount of waste accumulated at the port's main points. The principal cause of the enormous amount of rubbish distributed in this port is a poor waste management system, which has resulted in a large amount of waste being dumped on the wharf area on occasion, then carried by the wind and leaking into the harbour pool. Based on the report from the Tegal City Environment Service (2020), the waste generation in Tegal City reaches 250 tons/day. However, only 10% of the waste is handled, while the rest is transported to the landfill. The population of Tegal City in 2020 was 250,600 people. Compared with the average waste generation in Indonesia, which is 0.7 kg/person/day (Afayat, 2021) the daily waste generation by the City of Tegal far exceeds the average daily waste generation limit of 42%. Waste management that could be more optimal has resulted in piles of waste found at various points.

The Indonesian Fishermen Association of Tegal City, in several electronic media (Suara Semarang, 2021), stated that it earned the nickname as one of the dirtiest ports in Indonesia because of the large amount of waste scattered at strategic points in the port. The accumulation of plastic waste in harbour pools has implications for siltation, making it difficult for ships to enter/land at the port during low tide. Waste in the temporary dump disturbs aesthetics. It creates an odour that spreads to nearby industries/

correspondence author:
e-mail: benisabda@gmail.com
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fish processing units, offices, food stalls, and road users because it is located next to a busy road. The waste piled up near the fish auction facility Jongor Fishing Base itself also disrupts the activities of the people who come to buy fish because the waste creates an unpleasant odour.

Musa *et al*. (2013) stated that plastic waste not processed or at the final processing site poses a significant environmental burden on resources because it takes 40 to 1000 years to decompose (Bashir, 2019). The United Nations Environment Program (2014) explained that plastic waste causes economic losses to marine ecosystems of USD 17.3 billion/per year. Therefore, plastic waste must be dealt with immediately because it not only harms the environment both on land and at sea but also causes economic losses. In addition, what is often not realized due to the accumulation of waste is the negative impact on public health. Plastic waste can cause digestive tract infections if not managed because it provides a breeding ground for disease vectors such as flies and mosquitoes (Suprapto, 2005). Plastic waste in the form of fractions in the sea, which marine animals consume by following the final food chain in humans, causes accumulation of plastic in fat tissue, thereby disrupting the work of endocrine hormones, which are closely related to the nervous system and lowering the human immune system (Hasibuan, 2016)

Even though various parties are aware of the negative impact of using plastic, particularly single-use plastic, on the environment, some parties (assumed to have low waste awareness and education), such as fishermen, need to be made aware of the dangers of these plastic bags. As a result, numerous programs, such as promoting the hazards and economic benefits of trash management and developing and implementing policies linked to integrated and holistic waste management, are urgently required to address waste problems sustainably. According to initial observations at Tegalsari Coastal Fishing Port (CFP), the most common trash in the fishing port region includes plastic fish wrapping, plastic food/beverage packing, single-use plastic bags, old mooring ropes, and fishing nets.

MATERIALS AND METHODS

Time and Location of Research

The rapid assessment activity was conducted in Tegalsari Village, West Tegal District, Tegal City, Central Java Province (Figure 1). The location of the rapid assessment activities covers non-residential areas within its area, including the wharf area, offices, fish market, and industrial area within the port. The rapid assessment as an initial project activity was carried out for six days, from Monday, June 14, to Saturday, June 19 2024. One of the largest coastal fishing ports in Central Java Province, which is a parameter of other inshore fishing ports in Indonesia. It plays a vital role in the economy of the city of Tegal with the slogan Kota Bahari. The port area has 14,953 workers who work in the commercial and industrial sectors (UPT PPP Tegalsari, 2023). Most work in fillet and fish packing units (52.3%) and in Fishing/ fisherman (43.7%). The port area is 109^0 10' 0" East Longitude and 07^0 01' 00" South Latitude in Tegal City, Central Java Province. The Java Sea borders the Tegalsari Coastal Fishing Port (CFP) to the north, West Tegal District to the south, Jongor Street, Tegalsari Village, West Tegal District to the east, and RW II Tegalsari Village, West Tegal District to the west. The Sibelis river flows westward with a length of + 5 km. The Sibelis River has its headwaters in Tegal Regency, Pepedan Village, and then flows south of Tegal City to the north in the Java Sea. Its primary use is for agricultural activities, ponds, and fishing boat moorings (Environmental Agency of Tegal City, 2020).

The management and development are equipped with facilities and infrastructure with a land area of 17.20 Ha, of which 15.96 Ha is utilized for the benefit of the fishing industry, cold storage, workshops, offices, banking, and shops, as well as various facilities and security. Of the land area of 17.2 Ha, around 12.5 Ha is owned by the Tegal City Government, and the Central Java Provincial Government owns 4.7 Ha of reclamation land and buildings, except for Jongor Fishing Base, with an area of 784 m^2. Based on Autonomy Law No. 4/2011 concerning the Repeal of Central Java Provincial Regulation No. 16/2002, the management of Jongor Fishing Base was taken over by the City Government of Tegal through an auction system. Because of the different ownership, each authority oversees its affairs. According to the joint agreement between the Central Java Provincial Government and the Tegal City Government, it is 16.3 Ha. Land use for functional facilities, government buildings, and public interests is 13.3 Ha, and commercial land use is 3 Ha. The land is prioritized for the modern fishing industry. A utility facility has been built to serve the needs of service users, namely, a Fisherman's Fuel Filling Station (SPBN), which provides subsidized fuel for ships <30 GT, with the management carried out by the Karya Mina Joint Business Group and Aneka Kimia Raya Tbk. For GT ships > 30, Non-subsidized fuel supplied by various companies is used.

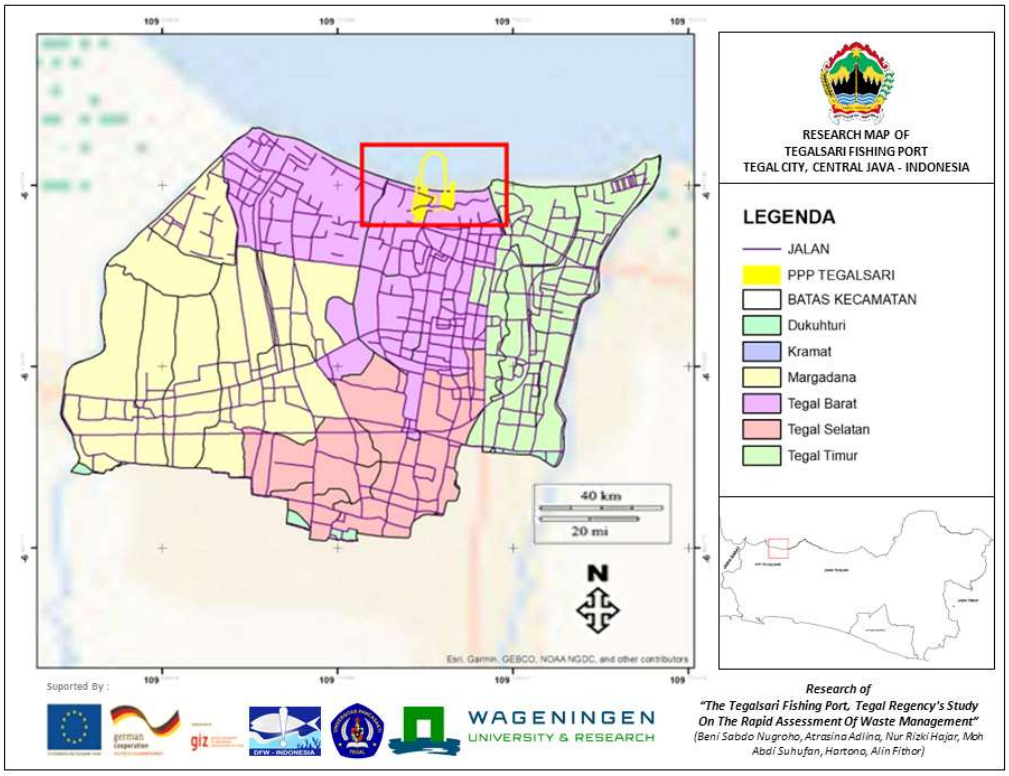

Figure 1. Quick assessment locations at the Tegalsari Coastal Fishing Port

The Scope of Research

The scope of study of this activity includes two things: the waste management system and waste conditions. The assessment of the waste management system includes three indicators: (1) supporting infrastructure/facilities for handling waste, (2) human resources, and (3) waste management policies. Meanwhile, the assessment of waste conditions includes two indicators: mapping waste source activities and measuring the amount and composition of waste generation and the number of fishing vessels operating.

Data Collection

Data collection in this activity was carried out directly for primary data and indirectly for secondary data. Primary data was collected using observation, interviews, and land and sea waste generation surveys. The observation method included mapping port waste management facilities and infrastructure, and mapping activities at the port. Then, the interview method used in this activity was a structured interview in which the researcher prepared the questions listed in the guide and provided information at the beginning of the interview as a guide for conducting the interview. The interview guide contained questions about waste management and parties supporting efforts to reduce and handle waste in the area. The interview questions consisted of the following: (1) waste conditions, waste management, and parties involved, (2) the waste management policy implemented by Tegalsari Coastal Fishing Port (3) the education related to waste management in the area, and (4) the payment of cleaning fees. The following method of surveying the generation and composition of land and sea waste was used to determine the quantity and characteristics of land waste produced by each waste-producing unit and marine waste from supplies carried by fishing vessels operating in the Tegalsari Coastal Fishing Port area. Waste generation survey activities must be conducted to determine the selection of technology to be applied (PLPBM, 2020).

Meanwhile, secondary data collection helped researchers to spend little time collecting primary data. Secondary data was collected in this activity through studies and visits to related agencies. Secondary data sources used in this activity came from journal articles, the official website of the Tegal City Environmental Service, and various valid website sources used as the basis for activities, government regulations, legislation, presidential regulations regarding plastic waste reduction, waste management, and others. They then collected secondary data from institutions such as Tegalsari Coastal Fishing Port, Jongor Fishing Base, the Fish

Processing Unit (FPU), Small, and Medium Enterprises (MSMEs) the Tegal City Environment Service, Tegal City Fisheries and Maritime Affairs Mintaragen Integrated Waste Processing Site 3R Waste Processing Site, and Dewi Sinta Waste Bank.

Data Analysis

The Rapid Appraisal activity used a quantitative approach, with findings in the form of data from activity locations and from existing sources that are descriptive. The results of these findings were related to a theory of solid waste management in the area, with the active participation of various parties. The Statistical Package for Social Sciences (SPSS) is the data analysis software used. Descriptive data analysis in this activity produced informative data related to survey results, guiding the program to achieve goals. Data processing was from observations, interviews, and surveys of land waste generation, and a descriptive comparability analysis was carried out according to the assessment indicators with applicable standards following government regulations or regional regulations. In other words, the facilities, infrastructure, and waste systems were compared with the standard facilities, infrastructure, and waste systems in regional/urban waste management. Figure 2 shows the framework for the Rapid Assessment of Waste Problems and Waste Management activities.

RESULTS AND DISCUSSION

Results

Mapping of Waste-Generating Activities

Activity mapping collects data and information from activity descriptions and observations of the object under study. In this case, the object refers to activities that generate waste. Activity mapping is carried out to determine all activities contributing to waste generation in the area and identify possible activities that cause marine debris-based waste leakage. Based on the results of observations and interviews with various waste-producing units, it was found that sources of generating activities and the waste generated within the area include ship loading and unloading, ship berthing, sailing and fishing, cleaning by packing fish, commercial, offices, and in and out of the port activities.

Ship loading and unloading activities consist of departure preparation and ship return activities from sailing. Waste generated from departure preparation activities is ship cleaning waste from the rest of the sea which is not unloaded when the ship is unloading, including ship wood/ sawdust waste, plastic beverage packaging waste such as drinking bottles, trash bags, and LDPE plastic fish wrapping (as material for food chains that is keeping the quality of fish caught), sacks and cardboard. Ship unloading activities in which the catch and the rest of the supplies are removed from the ship, resulting in inorganic and hazardous and toxic materials (B3) waste, including fish wrapping waste, fishing line, damaged fishing gears, sacks, used oil, cardboard, cooking oil, cigarette butts, drinking water bottles/glass. Ship berthing activity is where the ship waits for departure until the Sailing Approval Letter (SPB) is issued. Vessel waiting time varies both daily and weekly. During this period, the ship's crew performed activities, such as relaxing and cleaning the ship, and related parties performed ship repairs. Generally, the waste generated by fishermen from their leisure activities is in the form of leftover organic waste, plastic food and beverage packaging, and cigarette butts, which based on the results of observations of this waste, are directly disposed of into bodies of water near docked boats, namely in mooring ponds and repair ponds as well as

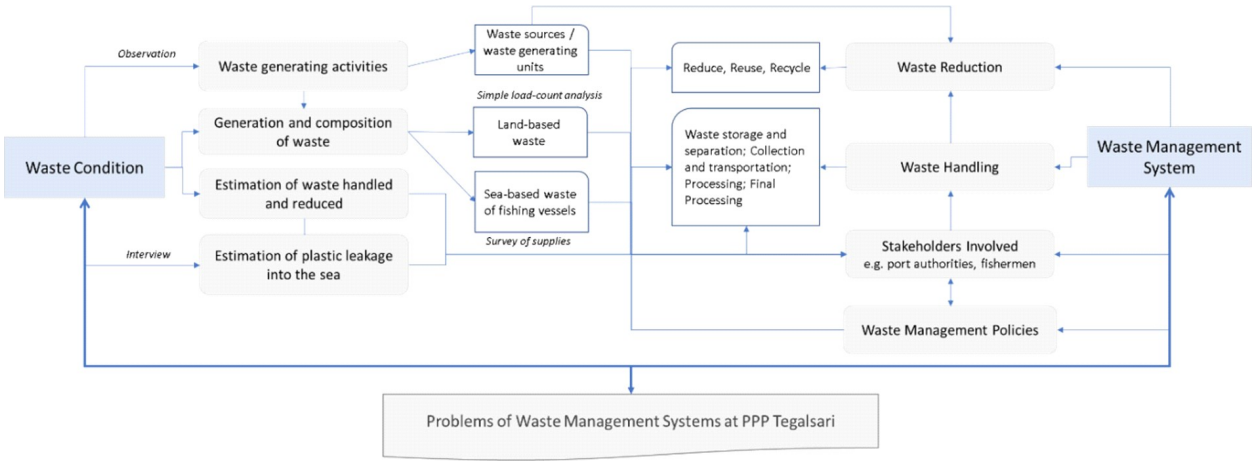

Figure 2. Rapid assessment activity framework

on the river near the harbour such as disposal plastic waste into rivers ill cause river siltation (Qomariah & Nursaid, 2020) and blockage of river flow, which can cause flooding (Sari et al., 2021). Gregory et al., (2025) stated that plastic could trap marine life and clog the digestive tract, leading to death. In addition, B3 waste, such as oil and grease, was also observed in ship repair ponds. Research conducted by (Tutut et al., 2020) showed that the oil layer could affect the life of organisms directly and indirectly. Indirect effects arise from the lethal nature of the oil, carbon monoxide, and other toxic materials that cause mass death in marine organisms and seabirds.

In contrast, the indirect effects can be seen from the destruction of habitat, the reduction of oxygen in the sea, and rising water temperatures. Marine biota exposed to oil spills will also smell, which causes a decrease in quality in the market (Fakhruddin, 2004). The accumulation of fat and protein compounds occurs through the food chain from one organism to another, so if consumed by humans in the long term, it will cause chronic effects on human health, as well as plastic drinking water and other inorganic waste.

Sailing activity, defined by Big Indonesian Dictionary (KBBI), is crossing the sea or travelling by ship. Fishing activity refers to taking fishery catches, which include fish, mollusks, crustaceans, and other animals, residues, and aquatic plants, for commercial and industrial purposes by involving fishermen, boats, fishing gear, and fishing aids operating in inland areas, on the coast, offshore and high seas (*Glossary: Fishery Products*, 2024). Both activities produce the same type of waste from human and ship consumption. Waste left over from fishermen's supplies includes: 1) organic waste (egg shells, rice and fish bones, cardboard, leftover vegetables, and fruits), 2) inorganic waste (coffee plastic, cooking oil, instant noodles, drinking bottles, snacks, food flavourings, cigarette wrappers, shampoo, soap, and cardboard), and 3) B3 waste (oil, grease, and cigarette butts).

Ship trash in the form of fishing gear (API), such as damaged, abandoned, and wasted nets, and fishing aid equipment, such as fishing lines and plastic ropes. Disposal of waste into the sea from sailing and fishing activities is commonly carried out by fishermen along fishing routes, regardless of the provisions on disposal of waste from ships in MARPOL 73/78. The regulation states that all vessels during sailing cannot dispose of organic waste at a distance of less than 12 nautical miles or 500 meters from the nearest platform. Waileruny (2019) stated that plastic waste disrupts fishing activities, such as fishing with gill nets, which results in the loss of productivity value of fishing grounds in coastal areas and reduces fishermen's income. Economic value from damage to nets and machines also arises from repair and maintenance costs of around IDR 3.5 million/month.

The activities that generate waste at Tegalsari Coastal Fishing Port are fish cleaning and packaging activities. Both activities are not limited to this but also include crustaceans (shrimp) and mollusks (squid). Cleaning activities include washing the catch and cleaning fish scales, stomachs, and shrimp heads, while packaging activities include sealing, sterilizing, cooling, and final checking. Most waste from the fish cleaning process is organic waste, such as heads, intestines, bones, fish scales, and fish-washing liquid waste. In contrast, most waste generated from fish packaging includes cardboard, rope, and plastic waste from damaged fish packaging. Specific fish processing industries continue to abandon the idea of clean manufacturing, exposing waste fish fillets to the sun and giving rise to a foul odour area and the surrounding areas (Wibowo & Yulianto, 2013).

Figure 3 shows fish processing activities and the types of waste generated at the modern FPU area, namely at UD Isti and PT Prima Samudera Premium. Based on interviews with the area manager, information was obtained that the Integrated wastewater treatment plant (WWTP) in the area had not been used for a long time since 2012. The reason was that during the WWTP construction phase, there was no consideration regarding the height of the water body, so the Integrated WWTP flow was built lower than the water level, so that the water could not flow into the water bodies. The results of interviews with five of the seven FPU Modern managers showed that four FPU Moderns (80%) were actively handling waste by collecting and transporting the waste they produced directly to garbage dump using cars, where each company usually has at least one trash cart, which is located in the production area of FPU Modern. The community's efforts to clean up, collect and transport waste follow Tegal City Regional Regulation No. 4/ 2019. Payment of user fees by FPU Modern to the Provincial Government of Central Java and the City Government of Tegal mainly uses containers and transports waste from garbage dump to final waste disposal site.

Commercial activities include exchanging or selling/buying goods or services to gain economic benefits, including all supporting activities (Sungguh, 1992). Fish auctions at Jongor Fishing Base, buying and selling food and beverages at MSME kiosks, and others produce plastic packaging waste for shopping

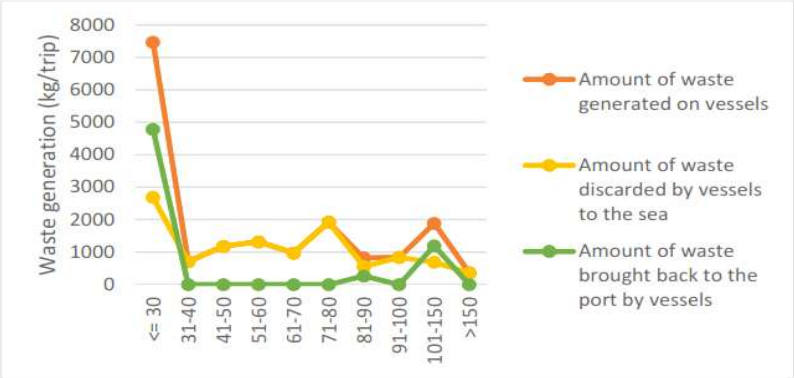

Figure 3. Total waste generation and handling of plastic waste on ships

products and plastic food and beverage packaging. When shopping, people usually do not separate shopping baskets but instead use disposable plastic, which can produce plastic waste. In addition, food consumption, especially in restaurants, produces food waste such as fish heads, fish bones, and rice. Collins Dictionary defines *office activities* as work carried out in an office. Office activities at Tegalsari Costal Fishing Port, Port Health Office of Tegalsari, and various other offices produce organic waste from food and drink leftovers, paper, tissue, and yard waste, and also produce inorganic waste such as shopping plastic, drinking water cups/bottles, plastic cutlery, plastic stationery, B3 residues, and waste such as cigarette butts. These findings align with Wisma (2016), who state that office areas generate food waste, paper, residue, and plastic bottles. The movement of workers inside the port and the public from outside the port to the port for specific purposes usually disposes of the waste directly on the road, drainage, and vacant land. The most common waste is plastic for food and beverage packaging and plastic shopping bags. Plastic scattered on the road contaminates the soil, disrupts the environmental aesthetics, and can become an intermediary for developing disease vectors such as flies and mosquitoes if not treated immediately (Riswan, 2011).

Waste Generation and Composition

This rapid assessment activity measured waste generation and composition in commercial areas, including markets, stalls, offices, industrial areas, FPU, and other industries. This rapid assessment also measured water generation from the sea from ship activities registered at Tegalsari Coastal Fishing Port using units of kg for waste weight, and % for waste composition. In more detail, residential and commercial areas are measured in kg/person/day, industries in litres of waste/product/day, and roads in litres/road length. The size of waste weight is generally based on the weight in tons or kg and volume in litres or m^3.

The amount of waste generated at Tegalsari Coastal Fishing Port during the two measurement days (13-14 June 2021), using the simple load-count analysis method, was 2,240 kg/day (Figure 4), where the fillet fish processing industry was the most

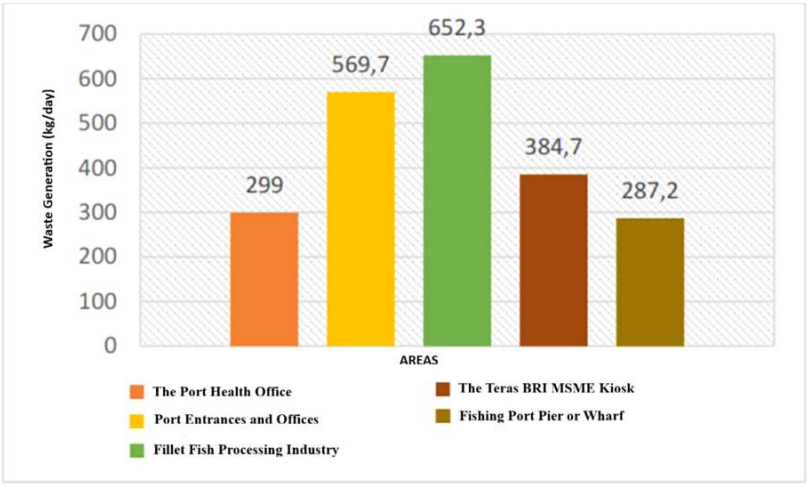

Figure 4. Landfill waste generation on the Port

significant contributor to waste, which is 652.3 kg/day, while the wharf became the area that contributes the lowest waste weight is 287.2 kg/day. Other areas, such as port entrances and offices, are ranked second as this port's most significant waste producer, at 569.7 kg. The high amount of waste is caused by the collection of organic waste from leaves, grass, and trees, which is transported along with the soil. In addition, on this road and office, many lands still need to be built, so it has the potential to become a waste disposal site for parties active in the port area. The scope of cleaning in this area is broad because it includes roads and ditches/gutches, where water-containing types of waste were found, contributing to the high amount of waste in the in and out areas and offices at Tegalsari Coastal Fishing Port.

Furthermore, for other areas inside the port, namely the road leading to the old Fishing Base and kiosks 40 and 60, shophouses and offices, including the Teras BRI MSME kiosk and the Port Health Office, each contributed 384 kg and 299 kg to waste generation at the port. In these two areas, much waste comes from cleaning by the cleaners, followed by the results of individual indirect collection. Waste measurement for two days instead of eight days was carried out with a simple load count analysis driven by port conditions, which were similar to one week of measurement, because there was not much activity during the fishing season for ships. Another thing is that for the construction of the Integrated temporary dump, the measurement of waste generation can be done at least two days on holidays (Saturday-Sunday) and working days (Monday-Friday). Sumantri (2022) stated that, besides population, one factor influencing the amount of waste generated in an area is the season. It is estimated that the waste generated in this port will be higher during the high season, especially when ships arrive to load and unload catches. The measurement is compared to during the low season for ships / when measurements are taken (June 2021). When many ships return to land/land and the wharf, fish processing activities, buying and selling of fish by the community from inside/outside the port, and industrial and commercial activities from capture fisheries in port will work fine.

The jetty area has a larger plastic waste composition (42%) than organic waste (36.5%). The main factor that drives this is that the loading and unloading activities at the wharf do not generate much organic waste. Most of the waste brought back to land by the fishing fleet is plastic waste, while organic waste is directly dumped into the sea on the routes passed by the ships. Organic waste brought back to land cannot be disposed of because the ship has already been docked at the port. Other rubbish in the wharf area was waste used for cleaning ships. The majority of plastic waste found at the wharf was HDPE plastic waste used to wrap fish, PET plastic drinking bottles, used PVC shampoo and soap plastic, plastic food packaging (snacks and instant noodles), spices, coffee, cooking oil, PP straws, and LDPE plastic bag waste. Then, for other waste found in all areas within the area, namely rubber, patchwork, glass, and can waste.

Based on the estimated marine debris generation measurement results, the total waste generation for 958 ships operating was 133,704 kg or equivalent to 139.56 kg/trip/ship, for trip durations ranging from 20 to 90 days with an entire crew of 10 to 25 people. Ships weighing 151 - 200 Gross Tonnes (GT) have the most significant waste generation, 255 kg/trip/ship with a crew of 22-25 people and a fishing trip duration of 90 days. They are followed by ships with a weight size of 101-150 GT, which is 249 kg/trip/ship, while ships with a weight size < 30 GT have the lowest waste generation, which is 105.2 kg/trip/ship.

NOAA (2017) reports that most waste that enters the sea is land-based. Land waste that enters the sea generated in this port area comes from direct disposal from loading and unloading ships and fishermen's relaxing activities on boats when ships dock. Land trash that enters the sea from the pier is caused by poor waste handling by the cleaners responsible for cleaning the pier. Plastic that enters the sea is mainly caused by the collection and transportation of waste that needs to be carried out quickly and correctly, so the wind can easily carry that waste into harbour pools and water bodies. The findings above confirm the NOAA report (2017), which claims that land trash can enter the sea through intentional dumping into the sea, poor waste management, and rain sweeping. Organic waste is the most common waste generated by fishing vessels operating (80%) in food waste, egg shells, cardboard, and paper. Plastic waste is the second largest contributor to organic waste (Figure 5), 17,528 kg/trip for 958 ships or 18.3 kg/trip/ship. Most of the waste on ships is PP-type packaging/wrapping waste.

Based on the results of observations and interviews with related parties (Figure 6), marine-based waste mainly comes from fishing vessel activities in the sea. Almost all ships with different weights and fishing gear throw the resulting plastic waste directly into the sea on the sailing and fishing lanes they pass. Fishermen specifically dispose of waste generated on board both intentionally and unintentionally (damaged or lost fishing gear). It is caused by neglect of waste

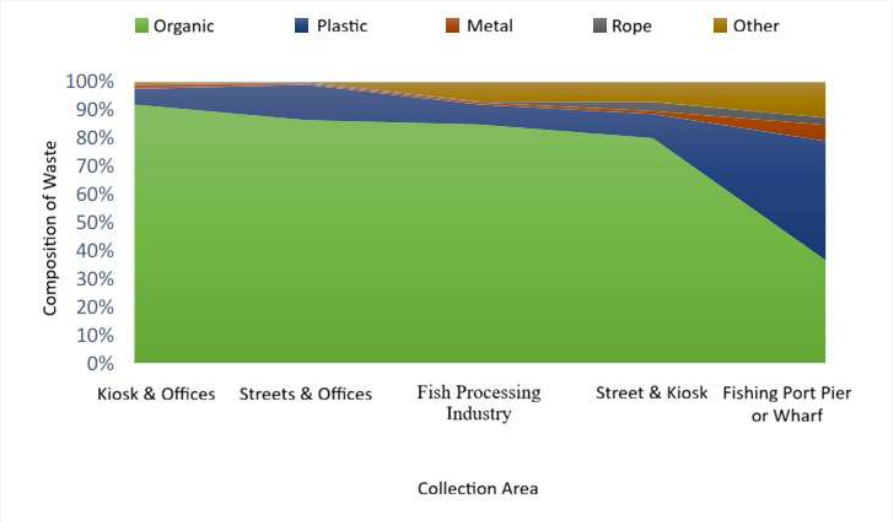

Figure 5. Composition of waste in Tegalsari Coastal Fishing Port

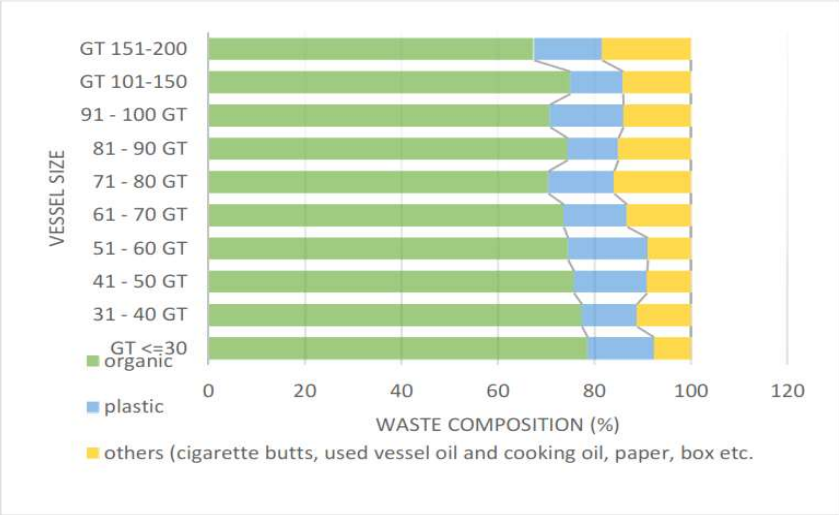

Figure 6. Composition of marine debris

container facilities on fishing vessels, lack of supervision, and low awareness and knowledge regarding handling plastic waste on board. Therefore, the higher the GT weight of the ship, the more waste is generated by the ship, and vice versa. These findings are supported by research from Kholipah (2021), which states that the number of crew members and the duration of the trip are directly proportional to the size of the ship, in which the larger the ship, the longer the duration of the trip and the number of crew members. Even so, based on the results of calculations by multiplying waste generation by the number of ships operating, data was obtained that ships weighing <30 GT contribute the highest waste due to the ratio of ships weighing <30 GT to >150 GT, namely 515:10. In other words, ships with a low GT weight exceed the amount of ship waste generated with a high weight because the amount is 51.5% larger.

Based on Tegalsari Coastal Fishing Port, the percentage of waste reduction at the Tegalsari Fishery Port was 30% or 672 kg/day, with the category of processed waste, including fish waste and plastic packaging. This estimate is based on the amount of waste collected by individuals and groups of scavengers from within and outside the Tegalsari area. However, these percentages were only estimated without actual calculations. Because of this, the figures cannot be used to determine the amount of waste effectively reduced in this port, where the proportion of waste handled could be higher or lower. However, these figures explain that water processing is carried out daily to help dispose of the waste generated in this port.

In contrast to the percentage of Tegalsari Coastal Fishing Port waste successfully reduced, Tegalsari

Coastal Fishing Port did not include an estimate of the amount of waste successfully handled in its working area. The cleaning staff admitted that port areas could not be cleaned of waste, even though they have been classified into five groups for port cleanliness: commercial, industrial, and office zones. This statement implies that waste management can be considered fully adequate. There is no daily documentation of the amount of waste managed successfully in this port because the port authority prioritizes program implementation over the planning and evaluation stage, where they have to collect data, coordinate/cooperate with related parties, record reports for the condition database and waste management for the status of the Tegalsari Coastal Fishing Port.

Waste Governance Management

Tegalsari Coastal Fishing Port implements a linear economic waste management system, emphasizing the take-transport-dispose principle. The decrease in natural resources due to unlimited demand and loss of material value from waste in landfills negatively impacts a linear economic system in waste management (Banerjee & Roy, 2024). Waste management using the take-transport-dispose principle has resulted in high waste generation (Sariatli, 2017) at garbage dump Tegalsari and final waste disposal site Sarong. This section will explain efforts to reduce and handle waste with the principles of the linear economy, regional waste management policies, and the role and cooperation of internal and external port stakeholders in managing waste in this port.

The principle of reducing waste, which emphasizes reducing waste or limiting waste generation, reuse of waste, and recycling of waste (MMAF, 2018), does not run optimally in commercial and industrial areas in the Tegalsari Coastal Fishing Port because there is no effort to limit the generation of waste from good sources. It is indicated by the absence of a call from the area manager to reduce waste generation from sources. In addition, there is no record or target for reducing waste generation set by regional waste managers. Based on the results of interviews with the Tegal City Environmental Service, it is known that the Tegal City Government should have included the Tegalsari Coastal Fishing Port as one of the waste reduction target areas due to differences in authority. The Provincial Government of Central Java is responsible for the cleanliness of this port, except for the Jongor Fishing Base area, which is under the authority of the Tegal City Government. In the absence of the environmental service intervention, regional waste managers should be more active in recording to determine waste reduction targets for a specific period. The waste processing technology is not available in the port area, even though the waste generated at the port during the off-season is more than two tons per day. Especially during the high season for ships, it is estimated that the waste generated will increase, along with the many industrial and commercial activities that resume after stopping when there is a shortage of raw materials during the low season for ships.

The second and third interviews with integrated waste disposal site of Panggung and Dewi Sinta Waste Bank revealed that the two waste processors operate in the same way, buying certain types of waste from scavenger groups, or “customers,” and then selling the waste that has been cleaned/separated from residual waste to third-party interested parties. The purchase price of waste, the technology used in waste processing, and the number of workers vary between the stages of the garbage dump and the relevant Waste Bank. The Dewi Sinta Waste Bank offers higher prices for waste from its customers. Also, it provides customer savings books that can be exchanged for gold at a predetermined amount in collaboration with the Tegal City Pawnshop.

In addition to recycling, various parties in Tegalsari Coastal Fishing Port, such as fishermen and business actors, also try to reuse it. In contrast to recycling and reuse, waste reduction through reduction is not carried out by waste-producing units in this area, which results in a large amount of waste generation with plastic packaging for fish, food, beverages, and other types of packaging. Waste reduction within the area is also constrained because only a waste handling mechanism needs to be aligned with waste recycling facilities. Land and limited waste handling infrastructure inhibit achieving this port’s vision as a clean port. Waste handling includes collection, transportation, and final processing of waste. Based on the Regional Regulation of the City of Tegal No. 4/ 2019, waste handling must consist of five activities: sorting, collection, transportation, processing, and final disposal. Coastal Fishing Port and Jongor Fishing Base have good waste management facilities and infrastructure. In handling waste, the port authority must provide segregated waste bins in its control area, participate in waste collection and transportation, and disseminate waste management rules to all parties at the port. With this comparison, waste handling in the area must run optimally because it only carries out three instead of five handling efforts.

The waste transportation method applied at Tegalsari Coastal Fishing Port is the stationary

container system (SCS), a manually loaded collection system. Waste is collected using a container that is not carried around or remains with manual work by the relevant cleaning staff. This system is usually used in residential and commercial areas, so it is appropriate to apply it in this port. The SCS started with a Tegal City Environment Service dump truck emptying the container at the port garbage dump and transporting the waste to the fixed truck container, transporting the waste in one iteration for approximately one hour. The waste transportation equipment provided by Tegalsari Coastal Fishing Port is a wooden cart, while the waste transportation equipment provided by Jongor Fishing base is a Tossa/ three-wheeled motorized cart. Consider using wooden carts compared to Tossa/three-wheeled motorized carts to last longer because they are resistant to seawater corrosion. The wooden cart also has the drawbacks of being impractical, heavy, and having to be pushed or pulled to collect waste, making it difficult to use in large waste service coverage areas such as Tegalsari Coastal Fishing Port and requiring more than one person to push the cart. At the same time, Tossa is easier to use because it is a motorized vehicle that no longer requires much human power. Tegalsari port still has various operational constraints, namely the limited garbage collection fleet and human resources to optimize the solid waste system in an area measuring 17.2 hectares.

The waste collection method carried out by Tegalsari Coastal Fishing Port is an indirect individual pattern and a sweeping street pattern (Figure 7). In contrast, the collection method carried out by Tegalsari Coastal Fishing Port is an indirect individual pattern and an indirect communal pattern. The indirect individual collection pattern was carried out by Tegalsari Coastal Fishing Port and Jongor Fishing Base, taking into account the characteristics of the community who are passive in waste management, land for transfer locations is available, the topography is flat, the collection equipment can reach directly, and the collection equipment can traverse road conditions without disturbing other road users. There was no segregation during the waste collection and transportation stages at Tegalsari Coastal Fishing Port and Jongor Fishing Base. The cleaners only load mixed waste into the waste collection fleet, which needs more space to sort waste by type. There is no schedule for transporting waste to garbage dump, depending on the type of waste.

Based on the results of interviews from Tegalsari Coastal Fishing Port, it is known that some individuals and groups collect waste outside the waste management system implemented at the port. It causes data regarding this port's total input, processed, and residual waste to be unavailable. The port authority also paid less attention to waste data collection because it places more emphasis on service implementation. Therefore, it is difficult to determine the achievement of waste management performance in the port area because important assessment indicators need to be included in the system. City

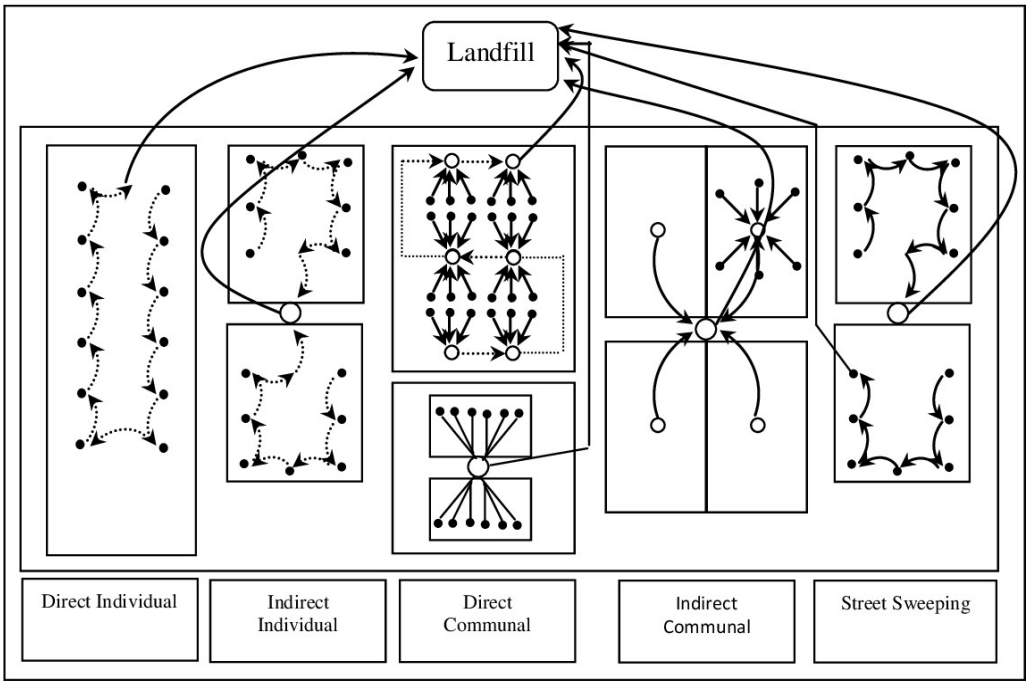

Figure 7.Garbage collection pattern (Source: SNI 19-2454-2002)

Environment Service carries out the final waste processing at the Temporary landfill Tegal City, which is 6.7 km from the port area, with an open dumping landfill system. Open dumping is Indonesia's most widely applied waste disposal system (90%); the rest is operated in controlled and sanitary landfills. No final waste is processed at the garbage dump Tegal City, either by composting or 3R. Also, there is no waste segregation at the landfill, exacerbated by the absence of segregation at all garbage dump in Tegal City. The City Environment Service waste truck directly disposes of waste to the garbage dump after collecting and transporting waste from garbage dump in Tegal City from port areas, offices, hotels, settlements, and others. Leachate management still needs to be maximally implemented in the landfill.

The stakeholders involved in waste management at Tegalsari Coastal Fishing Port include internal stakeholders/organisations or institutions in the port area and external stakeholders/organisations or institutions outside the port. Stakeholders who play a role in waste management at the port, both in reducing and handling waste, include port management authorities, modern industry / FPU, traditional/micro industries such as the fish fillet industry, plastic waste collectors groups, fish organic waste processing industry, fishermen and MSMEs. Stakeholders outside the port who participate in reducing and handling waste at Tegalsari Coastal Fishing Port are City Environment Service, the Cardboard Waste Collection Group, and the fishing nets.

CONCLUSION

The rapid assessment of waste management practices at Tegalsari Coastal Fishing Port indicates that the current system remains in a developing phase. The evaluation of waste handling infrastructure, human resources, management policies, waste source activities, and overall waste conditions shows that the port generates approximately 2,240 kg of waste per day during periods of low vessel and port activity. The fish and fillet processing industry contributes the largest share of waste, around 652.3 kg/day, while the wharf area produces the smallest amount, approximately 287 kg/day.

Plastic waste management aboard fishing vessels primarily occurs through two methods: direct disposal into the sea and returning waste to the port. This finding highlights the limited adoption of sustainable waste practices. Overall, the implementation of waste handling and reduction strategies is still in its initial stages due to gaps in infrastructure, institutional capacity, and regulatory enforcement.

To advance sustainable waste management at Tegalsari Coastal Fishing Port, it is essential to enhance infrastructure facilities, strengthen institutional frameworks, build human resource capacity, and develop comprehensive regulations. These efforts will support the establishment of an integrated and sustainable waste management system, reducing the risk of marine waste leakage and promoting environmentally responsible port operations.

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