Strategies for Preventing Fishing Vessel Debris Pollution in Tarempa's Coastal Fishing Port, Kepulauan Riau

Strategi Pencegahan Pencemaran Sampah Kapal Penangkap Ikan di Pelabuhan Perikanan Pantai (PPP) Tarempa Kepulauan Riau

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Abstract

Research has been conducted on the prevention strategy of fishing vessel waste pollution carried out in April 2024 with the location at Tarempa Coastal Fishing Port. This research aims to formulate a plan for preventing fishing vessel waste at Tarempa Coastal Fishing Port. This research used a survey method with a purposive sampling technique. The data taken in this study are the type and amount of waste from ship activities during mooring, ship maintenance and repair, and maintenance and repair of fishing gear at the Tarempa PPP. The results of observations in the field found that the management done before was only in the form of burning, disposing of garbage in trash cans, hoarding garbage, and some throwing garbage into the sea. Based on the results of the analysis of waste prevention strategies, ten management alternatives were found, including port management needs to establish partnerships with crew members and the community to prevent waste generation at PPP Tarempa, apply rewards for crew members who manage waste well, improve cleaning and waste management facilities at PPP Tarempa, increase routine supervision to prevent waste generation at PPP Tarempa, apply punishment for crew members who pollute the environment, provide counseling and K3 training for crew members at PPP Tarempa, optimize the function of cleaning and waste management facilities at PPP Tarempa.

Keywords: Ships, Ports, Management, Waste, Tarempa

Abstrak

Telah dilakukan penelitian tentang strategi pencegahan pencemaran sampah kapal penangkap ikan yang dilaksanakan pada bulan April 2024 dengan lokasi pada Pelabuhan Perikanan Pantai Tarempa. Adapun tujuan dari penelitian ini yaitu untuk merumuskan strategi pencegahan sampah kapal penangkap ikan di Pelabuhan Perikanan Pantai Tarempa. Penelitian ini menggunakan metode survey dengan teknik pengambilan data secara *purposive sampling*. Data yang diambil dalam penelitian ini berupa jenis dan jumlah limbah aktivitas kapal pada saat tambat kapal, perawatan dan perbaikan kapal, perawatan dan perbaikan alat tangkap di PPP Tarempa. Hasil pengamatan di lapangan diketahui pengelohan yang telah dilakukan sebelumnya hanya berupa pembakaran, pembuangan sampah pada tempat sampah, menimbun sampah dan ada yang membuang sampah ke laut. Berdasarkan hasil analisis strategi pencegahan sampah ditemukan 10 alternatif pengelolaan, diantaranya: pengelola pelabuhan perlu menjalin kemitraan dengan awak kapal dan masyarakat untuk pencegahan timbulan sampah di PPP Tarempa, menerapkan *reward* untuk awak kapal yang mengelola sampah dengan baik, meningkatkan fasilitas kebersihan dan pengelolaan sampah di PPP Tarempa, meningkatkan

pengawasan rutin untuk pencegahan timbulan sampah di PPP Tarempa, menerapkan punishment untuk awak kapal yang mencemari lingkungan, memberikan penyuluhan dan pelatihan K3 untuk awak kapal di PPP Tarempa, mengoptimalkan fungsi fasilitas kebersihan dan pengelolaan sampah di PPP Tarempa, mengoptimalkan tugas petugas kebersihan di PPP Tarempa, mengevaluasi fungsi fasilitas kebersihan dan pengelolaan sampah atau limbah di PPP Tarempa, dan memperketat peraturan pencegahan timbulan sampah di PPP Tarempa.

Kata kunci: Ship, Port, Waste Management**,** Tarempa

1. Introduction

Law Number 32 of 2009 concerning Environmental Protection and Management states that pollution prevention is an activity that is seeking early, planned, integrated, and measurable so that the activities of fishing port users in the fishing port area do not cause environmental pollution (Wahyudi et al., 2018). Garbage entering the sea comes from boat shipping, recreation, coastal tourism, and fishing (Rahman, 2021). When the amount of waste increases without effective management, it will result in environmental damage and pollution. Negative impacts on the environment also affect the marine sector (Firdayanti et al., 2021).

The activities of fishermen and fishing boat crews at fishing ports produce environmental pollution, including waste. Waste management and handling requires the participation of fishermen, not just the government. The amount of waste continues to increase every year in line with the shift in people's lifestyles, which tend to be consumptive, along with increasing activities accompanied by the advancement of science and technology (Sahil et al., 2016). Based on previous research, waste generated at PPI Paotere Makassar comes from various fisheries activities such as lifting fish, anchoring and docking ships, selling fish, and so on, which causes solid and liquid waste (Erna, 2023).

So far, waste management at the fishing port has only focused on waste originating from port users without considering waste originating from the fishing fleet. Port managers must know the amount, type, and volume of waste from the fishing boat fleet so that waste handling and management at the fishing port can run effectively and efficiently (Rahman, 2021). Ship waste management can be improved by optimizing existing facilities, personnel, and regulations by applying stricter sanctions and better supervision (Riyanto et al., 2021).

As in the previous study, the Coastal Fishing Port experienced several obstacles. One of the constraints faced is the lack of awareness of fisheries stakeholders in the PPP towards existing regulations. In addition, WWTP facilities are not yet correctly available, and drainage channels are poorly organized. Waste-handling facilities are also unavailable (Mahottama & Soemarmi, 2017). Based on this description, this study aims to formulate a strategy for preventing fishing vessel waste in the Tarempa Coastal Fishing Port.

2. Material and Method

2.1. Time and Place

This research was conducted in April 2024. The study was conducted at Tarempa Coastal Fishing Port, Anambas Islands Regency, Kepulauan Riau.
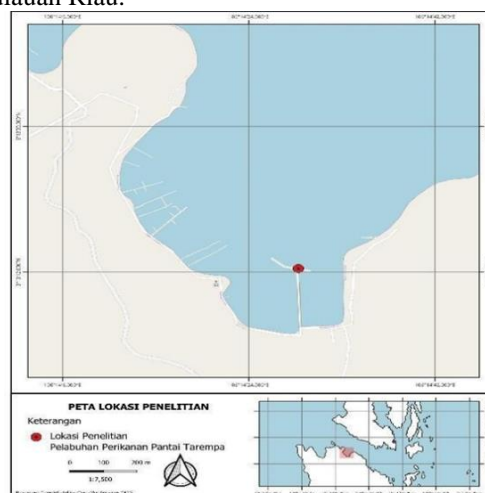

Figure 1. Research location map

2.2. Methods

This research uses a survey method with a purposive sampling technique. Data in this study were obtained from census interviews with respondents of fishermen/boats anchored and docked according to the data needed to be collected. The total respondents were 300 people, representing each fishing vessel. If the data collected from a sample in a population has obtained a particular trend, then sampling is stopped for samples from that population (Asrulla et al., 2023).

Strategy formulation was conducted through questionnaires and in-depth interviews with experts. The criteria for experts are those who understand or are involved in waste management in Tarempa PPP. The respondents consisted of local government parties who have authority in waste management. There were four respondents, namely the Head of Tarempa Timur Village, the Head of Tarempa Coastal Fishing Port, the Head of the Anambas Islands Regency Environment Agency, and the Head of the Anambas Islands Regency Agriculture and Food Fisheries Agency.

2.3. Data Analysis

The approach used in this research is a quantitative descriptive approach with the method of determining the formulation of waste pollution prevention strategies using SWOT analysis (Strength, Weakness, Opportunity, Threat). SWOT analysis is a method used to systematically identify various factors in formulating a plan. The SWOT matrix describes an external opportunity and threat faced and can be adjusted to the internal strengths and weaknesses (Nugraheni et al., 2013). Strengths and weaknesses are internal, while opportunities and threats are external factors (Rangkuti, 2002).

3. Result and Discussion

3.1. Characteristics of Respondents

The assessment of current conditions for the prevention of waste pollution in fishing ports can be seen from the waste control carried out by the crew of fishing vessels. Waste control can be identified by how the fishing boat crew manages plastic waste, how they manage waste when the boat is operating, how to manage waste when the ship is docked, and how to dispose of plastic waste garbage in the trash can. The number of vessels entering the fishing port in April 2024 and their tonnage weight are listed in Figure 2.
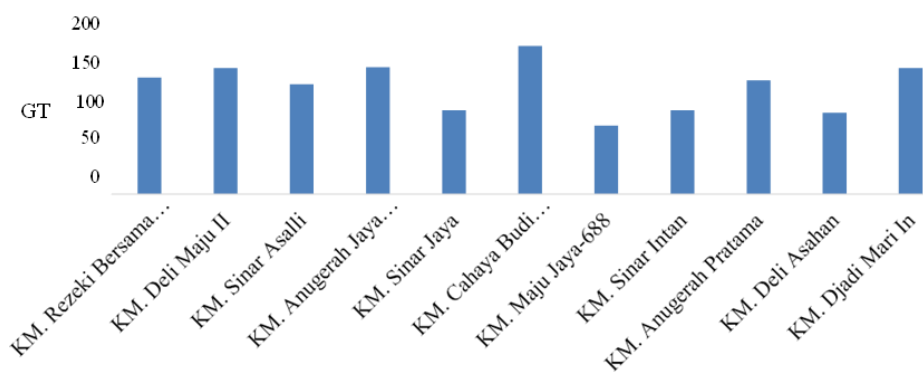

Figure 2. Ship name and tonnage at Tarempa coastal fishing port
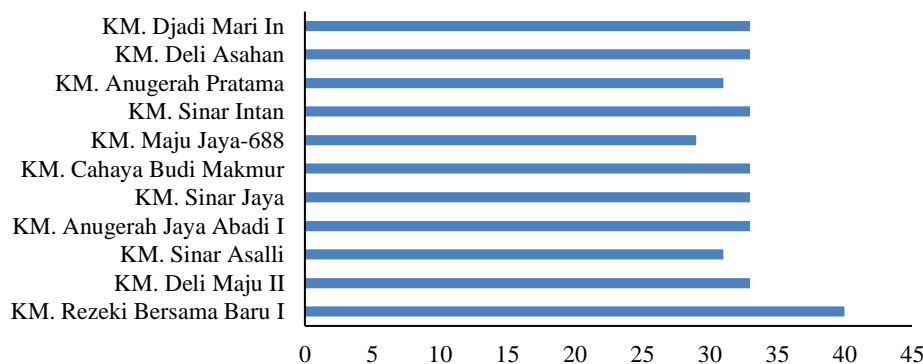

Figure 3. Ship name and number of crew at Tarempa Coastal Fishing Port

The results of this study explain that the weight of marine debris at Kualo Coastal, Bengkulu City, is in the form of organic waste 37.94% and inorganic marine debris with a percentage value of 62.06%, dominated mainly by plastic. The research results on marine debris found in all waters in the world reveal that plastic waste is the most common type and has the most severe impact on aquatic organisms (NOAA, 2016). According to Jamika

(2023), plastic marine debris is considered to have the most significant potential to alter the environment and negatively impact biota and humans, as it floats on the surface, is heavily transported by ocean currents, persists in the environment for years, and is not easily digested when consumed.

When the vessel operates at sea, the crew community uses two methods to manage waste. The method

The most common practice is to collect and dispose of almost all waste in bins or dumps (88%). The other method was to throw almost all waste overboard (12%). The behavior of fishing vessel crew members who throw garbage overboard must be eliminated because it will cause the fishery to become a nuisance Pollution. When the vessel docks at the fishing port, all crew members agree to collect and dispose of almost all waste in the garbage bins or dumps at the fishing port (100%). The prevention of garbage pollution in fishing ports by the crew of fishing vessels can be seen from their awareness of disposing of garbage in the trash. The research questionnaire asked how far the crew would walk to dispose of the ship's garbage to the trash can or disposal site. The results of the questionnaire can be seen in Figure 4.
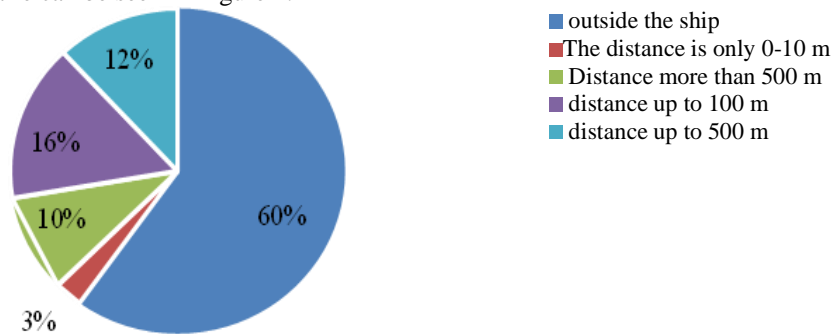

Figure 4. Fishing boat crew awareness of disposing of garbage at the dump

The questionnaire results show that 60% of fishing vessel crew members are willing to walk outside the vessel to dispose of garbage at the disposal site. 16% of the crew members were willing to walk to the dumping site up to 100 m away, 12% were willing to walk to the dumping site 500 m away, and 10% were willing to walk to the dumping site 500 m away. Meanwhile, the remaining 3% were willing to walk to a dumpsite that was only 0-10 meters away.

3.2. Conditions of Waste Pollution Prevention in Tarempa Anambas Fishing Port

Prevention of garbage pollution in fishing ports must be carried out according to good practices to be sustainable. The prevention of garbage pollution in the harbor can be done by knowing the perception of the fishing boat crew about garbage in the waters of the fishing harbor. Starting from the fishermen's knowledge about the prevention of garbage in the waters of fishing ports and the current conditions that have been carried out for garbage control, follow-up can be done to prevent garbage pollution in fishing ports in the future.

A total of 97% of fishing vessel crew members stated that a temporary waste disposal site was on board. The remaining 3% of crew members noted that the vessel had no temporary waste disposal site. Temporary waste disposal sites should be available on the vessel's premises as vessels produce waste from fishing operations, and it should be disposed of in a waste bin to prevent contamination of the environment.

The fishing port environment must also be considered for waste control, especially from fishing vessels. 85% of fishing vessel crew members stated that the fishing port provides regular waste collection services the village or agency offers. 8% of crew members stated that the fishing port does not provide regular garbage collection services provided by the village or agency, and another 7% indicated that they did not know about the facility. The port environment provides an appeal not to litter, according to 95% of fishing vessel crew, while according to the other 5%, the port does not offer such an appeal. According to Hamzah & Rahmawati (2021), trash bins are one of the facilities that must be available for environmental control. Based on ISO 14001 regarding ecological management, waste bins must be accompanied by waste handling so that the bins provided are not only 1 type. The bins provided must function as a temporary waste storage area and a place for waste control.

Currently, there are regulations on waste management in fishing ports and villages, but most fishing boat crews are not aware of these regulations. 78% stated they were unaware of waste management regulations in the port and village environment, while only 22% knew the laws. 98% of fishing vessel crews consider waste management a problem in the vessel environment. According to 99% of respondents, the plastic waste problem found on the Coastal or sea is a crucial concern to address. 92% stated that plastic waste would affect marine degradation, compared to waste from fishing gear (8%). When plastic waste is collected, fishing boat crews will take it to a landfill (32%), throw it in the trash (41%), and recycle it into other plastic products (24%). However, fishing crew members still do not know what they will do with the collected plastic waste (3%). Therefore, efforts can be made to reduce and control the amount of plastic in the environment by applying the 3Rs (reduce, reuse, recycle) and substituting environmentally friendly raw materials (Firmansyah et al., 2021).

Plastic waste directly or indirectly affects marine organisms, humans, and the environment. According to 38% of fishing boat crews, fish and other marine animals eat plastic waste. Meanwhile, 55% said fish and other marine animals do not eat plastic waste, and 7% of respondents did not know. According to 98% of fishing vessel crew, plastic waste will hurt the environment, but 2% said it will have a positive impact. Most crew members (97%) stated that burning waste, including plastic waste, will affect humans. These effects include making people sick, making it difficult to breathe, causing coughing, and causing air pollution. However, another 3% of respondents did not know the impact of burning waste on humans, so further education is needed. The observations in this study are supported by the results of research by Firmansyah et al. (2021), which states that the presence of plastics is found in the environment, such as in food, wastewater installations, clean water, and drinking water, including in micro and nano sizes. The presence and dangers of plastics on human health are found in cells, which are the smallest unit in the human body, so that they can trigger cancer.

All fishing boat crew respondents stated that waste found on land or land would end up at the coast or sea. They argued that this plastic waste could come from other villages, fishing vessels, boats, their community or neighborhoods, other countries, other islands, or even tourists and travelers (Figure 5).
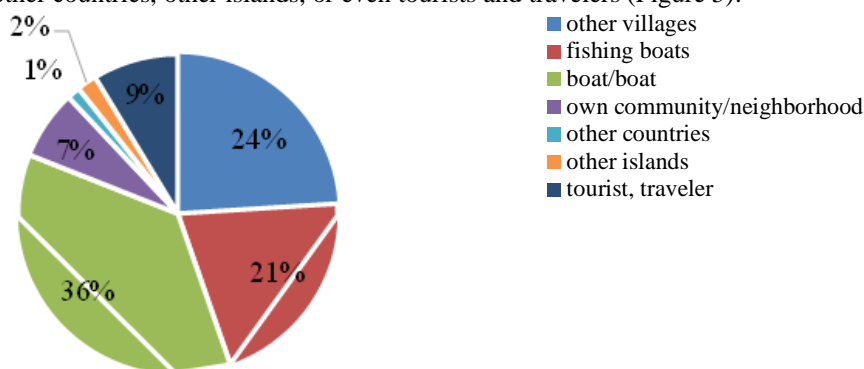

Figure 5. Source of plastic waste in the ocean

3.3. Formulation of Strategies for Preventing Solid Waste Generation in Tarempa Coastal Fishing Port Environment

Based on Government Regulation No. 27 of 2021 concerning the implementation of the marine and fisheries sector, the management of the fishing port environment is the responsibility of the fishing port manager. Therefore, strategies to prevent solid waste generation in the fishing port environment are being developed to manage the Tarempa PPP. The plan was formulated using a SWOT (Strength, Weakness, Opportunity, Threat) analysis. SWOT analysis was conducted on solid waste prevention's internal and external factors for fishing vessels at PPP Tarempa.

Strategy formulation refers to Table 3, which creates an internal factor analysis summary (IFAS) and external factor analysis summary (EFAS) matrix. Expert respondents in the Tarempa PPP environment determined the weight and rating values during discussions with researchers. The weight, rating, and score of internal and external factors can be seen in Table 1.

Table 1. Internal Factor Analysis Summary (IFAS) matrix

No.	SWOT Elements	Weight	Rating	Score
	Power			
1	Availability of cleaning facilities at PPP Tarempa	0,10	3	0,30
2	Availability of waste management regulations in Tarempa PPP and villages	0,13	4	0,53
3	There is an appeal not to litter at PPPs Tarempa	0,10	3	0,30
4	The existence of cleaning staff	0,07	2	0,13
5	Awareness of fishing boat crew to dispose of garbage in its place	0,13	4	0,53
	Total Strength			1,80
	Weaknesses			
1	Insufficient number of cleaning and waste control facilities in PPP Tarempa	0,07	2	0,13
2	There are no strict sanctions on boats that dump garbage carelessly	0,10	3	0,30
3	Lack of waste management supervision for fishing vessels	0,10	3	0,30
4	lack of cleaning staff	0,07	2	0,13
5	lack of waste counseling/education for fishing boat crews	0,13	4	0,53
	Total Weaknesses			1,40
	Total internal factors			3,20

Based on the results of the Internal Factor Analysis Summary (IFAS) matrix in Table 2, it can be seen that the prevention of solid waste in the Tarempa Coastal Fishing Port environment has a total score of 3.20. This condition means that the internal conditions originating from within the system still have the strength to deal with the problems. The External Factor Analysis Summary (EFAS) matrix results in Table 2 show that the prevention of

solid waste generation in the Tarempa Coastal Fishing Port environment has a score of 3.22. This condition means that threats outside the system can still be overcome by maximizing existing opportunities. This conclusion follows David's (2003) statement that a total average score below 2.5 is characteristic of an internally weak organization, while a number far above 2.5 indicates a stronger internal position. Determination of alternative strategies to prevent waste generation at PPP Tarempa based on the SWOT component factors analyzed with the SWOT matrix in Table 3.

Table 2. External Factor Analysis Summary (EFAS) Matrix

No.	SWOT Elements	Weight	Rating	Score
	Opportunities			
1	Great potential for waste management development in PPP Tarempa	0,11	2	0,22
2	The existence of waste management assistance/programs from the government	0,11	2	0,22
3	The enthusiasm of fishing boat crews to learn the management of trash	0,22	4	0,89
	Total Opportunity			1,33
	Threat			
1	Amount of waste generated from fishing units	0,22	4	0,89
2	Increased number of fishing units at PPP Tarempa	0,17	3	0,50
3	Environmental pollution from waste generated by other sources	0,17	3	0,50
	Total Threat			1,89
	Total external factors			3,22

Table 3. SWOT Matrix for the prevention of waste generation at PPP Tarempa

Internal environment / External environment	Strength - S	Weakness - W
	1. Availability of cleaning facilities at PPP Tarempa (S1) 2. Availability of waste management regulations in Tarempa PPP and village (S2) 3. There is an appeal not to litter at PPP Tarempa (S3) 4. The presence of cleaning staff (S4) 5. Awareness of fishing boat crew to dispose of garbage in its place (S5)	1. Lack of cleaning and waste control facilities at PPP Tarempa (W1) 2. No strict sanctions on vessels that litter (W2) 3. Lack of waste management supervision for fishing vessels (W3) 4. lack of cleaning staff (W4) 5. lack of waste counseling/education for fishing boat crews (W5)
Opportunity - O 1. The potential for waste management development in Tarempa PPP (O1) 2. The existence of waste management assistance/programs from the government (O2) 3. The enthusiasm of fishing boat crews to learn waste management (O3)	**Strategy - SO** 1. Establish partnerships with boat crews and communities to prevent waste generation at PPP Tarempa (S2, S3, S4, S5, O3) 2. Implement *rewards* for crew members who manage waste well (S1, S2, O1, O2)	**Strategy - WO** 1. Improve cleaning facilities and waste management at PPP Tarempa (W1, W4, O1, O2) 2. Increase routine monitoring to prevent waste generation at PPP Tarempa (W3, O1, O2) 3. Implement *punishment* for crew members who pollute the environment (W2, O1) 4. Provided OHS counseling and training for crew members on board ships PPP Tarempa (W5, O1, O2, O3)
Threat - T 1. Amount of waste generated from fishing units (T1) 2. Increased number of fishing units at PPP Tarempa (T2) 3. Environmental pollution from waste produced by other sources (T3)	**Strategy - ST** 1. Optimizing the function of cleaning and waste management facilities at PPP Tarempa (S1, S3, S4, S5, T1, T2) 2. Optimizing the duties of cleaning staff at PPP Tarempa (S2, T3)	**Strategy - WT** 1. Evaluate the function of cleaning and waste management facilities at PPP Tarempa (W1, W4, S5, T1, T2, T3) 2. Tighten regulations on the prevention of waste generation at PPP Tarempa (W2, W3, T1, T2, T3)

The SWOT analysis resulted in 10 strategies grouped into SO, WO, ST, and WT. SO strategy results from a combination of strength and opportunity owned by PPP Tarempa in preventing waste generation. WO strategy combines weakness and opportunity based on the research results. ST strategy is a combination of strengths and threats, while WT strategy is a combination of weaknesses and threats to the prevention of waste generation at PPP Tarempa.

The strength opportunity (SO) strategy obtained from the SWOT analysis results is that the fishing port management establishes a partnership with the crew and the community to prevent waste generation at PPP Tarempa. This partnership is important so all parties are responsible for maintaining cleanliness and preventing waste generation at the fishing port. The following strategy is for the management of the fishing port to implement

rewards for crew members who manage waste well. Appreciation given by the port management can increase the motivation for fishermen to comply with regulations sustainably (Jumanah et al., 2022).

There are four recommendations for the weakness opportunity (WO) strategy. These strategies are improving cleaning and waste management facilities at PPP Tarempa, increasing routine supervision to prevent waste generation at PPP Tarempa, implementing punishment for crew members who pollute the environment, and providing K3 counseling and training for crew members at PPP Tarempa. Facilities at PPP Tarempa are good, but additional waste management facilities such as trash bins, temporary landfills, and wastewater treatment plants need to be added. The port also needs to conduct routine supervision of fishermen and community activities to prevent environmental pollution and provide punishment for violators. Counseling and training on hygiene, health, and safety (K3) also need to be carried out so that the port community is educated and more aware of the importance of environmental management. Fishermen who already understand the importance of implementing OHS in the port environment will be more careful in handling fish so that the quality and quality of fish are considered before fishing to marketing (Aulia et al., 2023).

The strength threats (ST) strategy offered is that the port optimizes the function of cleaning and waste management facilities at PPP Tarempa. The facilities already exist, but their function is not optimal, so there needs to be improvement. Besides, the cleaning staff must also be optimized to clean at PPP Tarempa. Based on research by Fazri et al. (2021), operational activities can show the performance of a fishing port. So, fishing ports need to be supported by the availability of facilities according to the needs of fishermen while still paying attention to the environment to improve performance.

Two weakness opportunity (WO) strategies result from the SWOT analysis. The first strategy is to evaluate the function of cleaning and waste management facilities at PPP Tarempa. Regular evaluations need to be carried out by the port to check whether the cleaning and waste management facilities are still functioning correctly. This evaluation can be done every period, such as once a month, once every six months, or once a year. The second strategy is to tighten regulations to prevent waste generation at PPP Tarempa. Existing regulations must be implemented and tightened so that all port users obey them and waste generation in the Tarempa PPP environment can be prevented. These two strategies follow Wahyudi et al.'s (2023) research, which states that waste management facility evaluation must be done at the port. The government has issued several regulations to reduce environmental pollution in ports by requiring every public port and special port in Indonesia to provide waste collection and storage facilities originating from ship activities. The regulations concerning Waste Management in Ports are listed in the Minister of Environment Regulation No. 5 of 2009.

4. Conclusions

Waste generation or fishing vessel waste in Tarempa Coastal Fishing Port can be prevented through 10 alternative strategies. These strategies are that the port management needs to: 1) establish partnerships with crew members and the community to prevent waste generation at PPP Tarempa, 2) apply rewards for crew members who manage waste well, 3) improve cleaning and waste management facilities at PPP Tarempa 4) increase routine supervision to prevent waste generation at PPP Tarempa, 5) apply punishment for crew members who pollute the environment, 6) provide counseling and OHS training for crew members at PPP Tarempa, 7) optimize the function of cleaning and waste management facilities at PPP Tarempa, 8) optimize the duties of cleaning staff at PPP Tarempa, 9) evaluate the function of cleaning and waste management facilities at PPP Tarempa, and 10) tighten regulations to prevent waste generation at PPP Tarempa.

5. Suggestion

Tarempa Coastal Fishing Port can implement alternative strategies based on the results of this study. The implementation of the strategy must be done with the cooperation and willingness of all fisheries stakeholders in the Tarempa Coastal Fishing Port.

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