**JURNAL SEGARA**
http://ejournal-balitbang.kkp.go.id/index.php/segara

ISSN : 1907-0659
e-ISSN : 2461-1166
DOI : 10.15578/segara.v20i2.15705

# TATA KELOLA SAMPAH DI ATAS KAPAL IKAN YANG BERPANGKALAN DI PELABUHAN PERIKANAN SAMUDERA BITUNG

## *WASTE MANAGEMENT ON FISHING VASSELS BASED AT BITUNG OCEANIC FISHING PORT*

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**Kata Kunci**: Kapal penangkap, Pelabuhan perikanan, Sampah, Tata kelola sampah

***Keywords***: *Garbage, Fishing Port, Fishing Vessel, Waste Management*

*Received: 24 Agustus 2025*
*Accepted: 9 November 2025*
*Published: 18 Desember 2025*

**ABSTRAK.** Aktifitas perikanan di Pelabuhan Perikanan Samudera (PPS) Bitung memiliki potensi pencemaran terutama akibat sampah yang dihasilkan dari armada perikanan. Sampah yang dihasilkan di atas kapal terbagi menjadi 2 kategori yaitu sampah organik dan an-organik. Informasi tentang pengelolaan sampah di atas kapal ikan yang berpangkalan di PPS Bitung masih minim dan sangat terbatas. Tujuan penelitian ini adalah mengkaji tata kelola sampah di atas kapal dan menganalisis strategi pengelolaan sampah di atas kapal ikan yang berpangkalan di PPS Bitung. Waktu penelitian mulai dari Agustus-November 2024 di PPS Bitung. Pengambilan data menggunakan metode survei dan wawancara dengan responden yang ditentukan dengan teknik *purposive sampling*. Analisis data menggunakan metode deskriptif dengan pendekatan kualitatif dan menentukan strategi pengelolaan sampah di atas kapal penangkap ikan dianalisis menggunakan analisis SWOT. Hasil yang diperoleh adalah kategori sampah yang dihasilkan kapal ikan di PPS Bitung yaitu sampah basah (makanan) yang langsung dibuang ke laut dan sampah kering seperti plastik, botol, kain, kaca, dan logam yang ditampung terlebih dahulu. Pengelolaan sampah kering dilakukan dengan dua cara, yakni tanpa penyortiran dan dengan penyortiran. Strategi pengelolaan sampah di atas kapal ikan di PPS Bitung dirancang untuk meningkatkan kesadaran lingkungan dan efisiensi pengelolaan limbah melalui pendekatan yang terintegrasi. Kombinasi edukasi, regulasi, dan kemitraan memberikan solusi komprehensif untuk meminimalkan dampak sampah terhadap lingkungan dan meningkatkan partisipasi aktif awak kapal dalam pengelolaan limbah. Implementasi yang konsisten dapat menjadi model pengelolaan sampah yang berkelanjutan di sektor perikanan.

***ABSTRACT.*** *Body scrub Fisheries activities at the Bitung Ocean Fishing Port (PPS) have the potential to cause pollution, particularly due to waste generated by fishing vessels. Waste generated on board is categorized into two types: organic and inorganic waste. Information on waste management aboard fishing vessels based at PPS Bitung is minimal and very limited. The aim is to study waste management aboard these vessels and analyze waste management strategies. The research was conducted from August to November 2024 at PPS Bitung. Data were collected using survey methods and interviews with respondents selected through purposive sampling. Data were collected using survey methods and interviews with respondents selected by purposive sampling. Data analysis used descriptive methods with a qualitative approach, and waste management strategies were analysed using SWOT analysis. The results showed that the categories of waste generated by fishing vessels include wet waste (food), which is directly dumped into the sea, and dry waste such as plastic, bottles, cloth, glass, and metal, which are collected first. Dry waste management is carried out in two ways, namely without sorting and with sorting. The waste management strategy on board fishing vessels in PPS Bitung is designed to increase environmental awareness and waste management efficiency through an integrated approach. The combination of education, regulation and partnership provides a comprehensive solution to minimize the environmental impact of waste and increase the active participation of crew members in waste management. Consistent implementation of this strategy can serve as a model for sustainable waste management in the fisheries sector.*

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## INTRODUCTION

Fishing ports are designated areas encompassing both land and water, functioning as centers for governmental and fishery-related business activities. These areas serve various functions such as vessel docking, anchoring, and loading-unloading of fishing vessels, and are equipped with facilities that support maritime safety and fishery operations (Regulation of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia No. PER.08/MEN/2012 concerning Fisheries Ports, 2012). The Bitung Oceanic Fishing Port (PPS Bitung) is classified as a Type A fishing port the largest operational type officially registered in Indonesia serving fishing activities in Indonesian waters, the Indonesian Exclusive Economic Zone (EEZ), and the high seas (Takaendengan, Pandey, and Rompis, 2019). Fishing vessels visiting PPS Bitung include hand line, pole and line, purse seine, long line, and collector vessels, ranging in size from ≤10 GT to ≥100 GT.

One of the main sources of environmental pollution in port areas originates from vessel activities (Putra & Fadilah, 2023). Several operations are conducted within fishing ports, including vessel docking, fish landing and distribution, loading of marine supplies, shipbuilding and maintenance, as well as gear servicing. According to Čulin and Bielić (2016), the primary types of waste produced by vessels include plastic, oil spills, and liquid waste. Vessel operations can generate household-like waste such as plastic, paper, metal, glass, food remnants, and other materials (Kuncowati, 2019). The increasing number of vessels contributes to a rise in waste production. Preliminary research conducted between November and December 2023 on waste characteristics from fishing fleets based at PPS Bitung including pole and line vessels, purse seiners, mini purse seiners, handliners, and collector boats showed that 70% of waste was plastic, 12% processed wood, 10% glass, 6% textiles/clothing, and 1% metal and rubber (Manohas et al., 2023).

Waste management at fishing ports has so far focused only on waste generated by port users. However, waste originating from fishing vessels must also be considered. Waste management policy in Indonesia, as regulated by the Waste Management Law (Republic of Indonesia, 2008), includes both waste reduction and waste handling. While waste handling in ports involves cleanliness programs, waste reduction efforts through 3R (Reduce, Reuse, Recycle) practices remain suboptimal. The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 Annex V) prohibits the disposal of plastic waste into the sea, including plastic bags, synthetic ropes, and nets. Food waste and other refuse must not be discarded into the sea within 12 nautical miles from land unless ground and passed through a mesh with openings no larger than 25 mm. The discharge of dunnage, lining, and floating packaging materials beyond 25 nautical miles is also prohibited. Despite these regulations, illegal dumping of waste by passengers and crew at sea continues to occur.

According to Wiyono (2016), a strategy is defined as a general guideline, path, and approach to achieving objectives, particularly in policy implementation, goal-setting, and determining methods for resource utilization. Waste management is considered a gateway to achieving sustainable development goals, as it is a cross-sectoral issue affecting various societal and economic aspects. Waste management is linked to issues such as public health, climate change, poverty reduction, food and resource security, and patterns of production and consumption (United Nations Environment Programme, 2015). The growing wave of environmental awareness and concern is encouraging port administrators to realize environmentally sustainable port operations.

Information regarding waste management on board fishing vessels based at PPS Bitung remains scarce and limited. Therefore, this study aims to examine the governance of onboard waste and analyze waste management strategies for fishing vessels based at PPS Bitung. The expected benefit of this research is to provide information and supporting data on onboard waste management at PPS Bitung and offer recommendations to the government and relevant stakeholders for improving waste management practices aboard fishing vessels.

## MATERIALS AND METHODS

The research was conducted at the Bitung Oceanic Fishing Port (Pelabuhan Perikanan Samudera – PPS) located in Aertembaga Satu Subdistrict, Aertembaga District, Bitung City, North Sulawesi Province. The study took place from August to November 2024. Data collection was carried out using survey and interview methods, with questionnaires serving as the primary instrument (Syahrizal and Jailani, 2023). The respondents interviewed were crew members of fishing vessels selected using purposive sampling techniques. The questions posed by the researcher during the interviews

were open-ended in nature. The collected data were analyzed using a descriptive method with a qualitative approach. A qualitative approach is a research method that uses interpretive procedures to generate descriptive data in the form of written or spoken words from observed individuals and behaviors. Through this approach, data were analyzed by describing or portraying the data as they were collected. Furthermore, to determine waste management strategies onboard fishing vessels, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis was employed. According to Rangkuti (2016), the SWOT matrix is used to formulate internal and external factors into various types of strategies, resulting in combinations of two internal and two external factors. The types of strategies derived from the SWOT matrix include:

1. SO (Strength–Opportunity) Strategy: strategies that emerge from combining internal strengths and external opportunities;
2. WO (Weakness–Opportunity) Strategy: strategies resulting from the combination of internal weaknesses and external opportunities;
3. ST (Strength–Threat) Strategy: strategies formulated by leveraging internal strengths to counter external threats;
4. WT (Weakness–Threat) Strategy: strategies that emerge from matching internal weaknesses with external threats.

## RESULTS

### Waste Management Onboard Fishing Vessels

The landed fish originate from local fishing vessels as well as from purse seine, hand line, long line vessels, collector boats, and transport vessels (Witomo and Wardono, 2012), as well as from pole and line fishing vessels (Mamarimbing, Kaparang, and Labaro, 2023). Based on the processed research data, three types of fishing gear were identified: 74% used purse seines, 22% used pole and line, and 4% used hand lines. Additionally, 68% of the vessels had a capacity greater than 61 GT, 20% had a capacity between 31–60 GT, and 12% had a capacity between 0–30 GT. Various waste management practices were identified onboard fishing vessels. According to Chen and Liu (2013), the method of waste handling on fishing vessels is influenced by the type or category of waste itself. The waste management practices carried out onboard during the research period are illustrated in Figure 1.

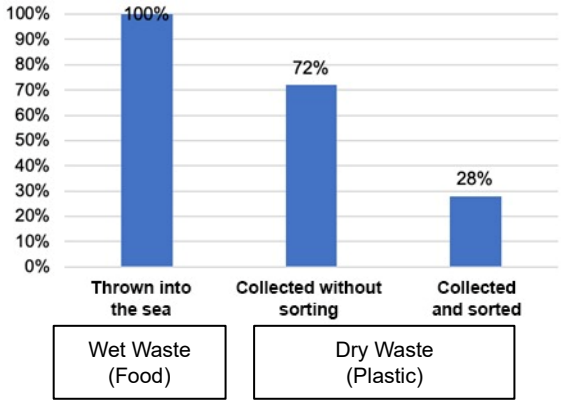


Figure 1. Forms of Waste Management Onboard Fishing Vessels

Based on the figure above, there are two categories of waste generated onboard: wet waste (food) and dry waste (plastic). This waste originates from the supplies brought by the crew for the fishing trip. These supplies include various necessities to support operational activities, such as fuel, ice, clean water, rice, oil or lubricants, salt, and other provisions including food materials (Fazri, Solihin, and Mustaruddin 2021; Fitriyashari, Rosyid, and Ayunita 2014). During fishing operations, waste is generated in the form of leftover food and other consumable materials (wet waste), as well as dry waste such as plastic bottles, cigarette butts, cleaning rags, and similar items (Katili et al. 2024). The research findings show that 100% of food waste is discarded into the sea. The crew believes that food leftovers and kitchen waste serve as food for marine life and, if stored for too long on the vessel, can produce an unpleasant odor. Food waste is wet and highly susceptible to microbial activity. Additionally, rapid auto-oxidation processes generate foul-smelling fatty acids. Enzymes present in plant-based fractions of food waste remain active, accelerating decomposition (Oreopoulou and Russ, 2007).

There is a lack of research analyzing food waste in marine environments. Food waste particles are heterogeneous and range in size from colloids to 25 mm. Ground food waste particles tend to clump together, forming dense, viscous sludge, making it difficult to distinguish between particle fractions (Wilewska-Bien, Granhag, and Andersson, 2016). Food waste is one of the major waste components generated onboard and is particularly challenging to manage due to its rapid spoilage, difficulty in storage, and handling issues. Therefore, such waste is typically discarded directly into the sea. If processing is required, it is generally limited to simple methods such as grinding before disposal

(Wilewska-Bien, Granhag, and Andersson, 2016). According to the Regulation for the Prevention of Pollution by Garbage from Ships in Annex V of MARPOL 73/78, the disposal of food waste into the sea is permitted if it has passed through a grinder or shredder and is discharged as far as practicable from the nearest land. However, discharge is prohibited within 3 nautical miles of the nearest land. Ground or shredded waste must be capable of passing through a screen with openings no greater than 25 mm. For dry waste such as plastic, bottles, cloth, glass, and metal, the waste is first stored onboard. Based on field observations, there are two identified practices in managing dry waste: 72% of respondents store it without sorting, while 28% store it with prior sorting.

Dry waste is stored in temporary storage containers onboard. The types of containers used for waste vary. Field observations indicate that waste is stored in sacks (70%), trash bins (20%), plastic bags (4%), used cardboard boxes (4%), and small buckets (2%). Interviews with respondents revealed that 86% of the crew consider the storage facilities adequate, while 14% view them as insufficient. Waste storage facilities are a critical component of waste management onboard, especially given the limited space on fishing vessels. Law No. 18 of 2008 states that waste storage facilities play a crucial role in the collection of waste, serving as both the endpoint of collected waste and the initial point before transportation to recycling or final processing sites. Waste storage facilities also serve as the first step in waste sorting particularly for plastic waste and promote healthier living behaviors (Setyowati and Mulasari, 2013). In addition, warning signs such as “No Littering” or “Keep Clean” have been installed on several vessels, typically on the deck or in the engine room. However, many vessels still lack such signage. These signs are important as educational tools, providing information, guidance, and reminders to the crew on the importance of cleanliness and proper waste handling. Moreover, they serve as an indication of compliance with MARPOL regulations. According to Regulation 9 of Annex V of MARPOL 1973/1978, every ship of 12 meters or more in length must display a placard to inform the crew and passengers of the requirements stated in Regulations 3 and 5 of this Annex.

Waste monitoring activities on board are carried out by the ship's captain (34%), the Bitung Fishery Port Authority (PPS Bitung) (22%), the company (12%), and in 32% of cases, no monitoring is conducted (Figure 2).

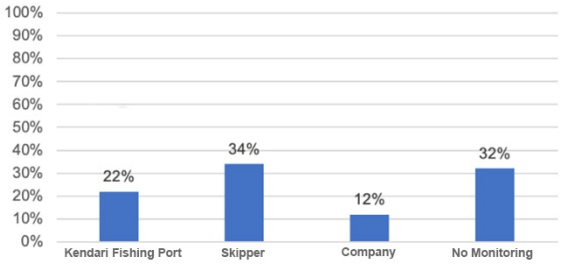


Figure 2. Waste Monitoring on Board.

The captain plays a crucial role in the implementation of waste management/handling, as they are directly responsible and hold the highest authority during fishing trips. In contrast, owners and managers can only oversee pollution prevention implementation from the port (Chen and Liu, 2013). Based on field observations, after the fishing vessels dock, waste management on land typically involves temporary storage facilities where waste is collected and later transported by sanitation workers (88%), while some is incinerated (12%). According to a study by Amir et al. (2024), 85% of crew members reported that the fishing port provides routine waste collection services offered by local authorities.

**Respondents' Basic Knowledge of Waste and Onboard Waste Management**

The respondents interviewed had the following characteristics: 6% were aged 10–18 years, 86% were aged 19–59 years, and 8% were aged over 61 years. Based on educational background, 36% of respondents held a senior high school or vocational school diploma, 26% held a bachelor's degree, 22% had completed junior high school, and 16% held a diploma degree. In terms of occupational roles, 44% were captains, 32% were crew members (ABK), 10% were chief engineers (KKM), 6% were helmsman, 4% were oilers, and 2% were deck officers and divers. The respondents' maritime experience varied: 42% had 0–5 years of experience, 30% had 6–10 years, 18% had over 21 years, 6% had 16–20 years, and 4% had 11–15 years of experience.

Respondents’ knowledge of marine debris was assessed through questions related to the definition of marine debris, types (organic and inorganic), sources, impacts, and ways to manage it. The findings revealed that 20% of respondents lacked basic knowledge of marine debris, while 80% had such knowledge. Additionally, 94% of respondents were aware of

the impacts of waste on board, while 6% were not. The fact that most respondents primarily fishermen were aware of the basic knowledge and impacts of marine pollution suggests a level of environmental awareness. The impacts of marine pollution include disruption to fish habitats and populations and the potential spread of diseases. When individuals perceive negative environmental changes, they may be motivated to take protective actions. However, in practice, many admit that waste management on fishing vessels is not a top priority, with personal safety and fishing activities taking precedence (Simmons and Fielding, 2019). Differences in individual knowledge levels may be influenced by factors such as education, age, environment, access to information, and experience, all of which ultimately affect attitudes and decision-making behavior (Ilma, Nuddin, and Majid, 2021). Basic knowledge, as an internal factor, significantly influences behavior and waste management practices on fishing vessels. In general, knowledge greatly affects action, especially in efforts to avoid environmental pollution (Gusti et al., 2015).

This study also assessed respondents' knowledge of waste management regulations and associated sanctions. About 62% of respondents were unaware of waste management regulations, while 38% were aware, although they did not know the specific names or articles of the laws governing waste management.

Regarding sanctions for dumping waste into the sea, 8% of respondents mentioned fines (most were unaware of the exact amount), 16% noted difficulties in obtaining permits (e.g., sailing approval letters), 36% mentioned verbal warnings, and 40% had no knowledge of applicable sanctions. These findings indicate that waste-related regulations have not been fully socialized among fishermen. Field observations revealed that 52% of respondents had participated in socialization sessions, while 48% had not. These socialization efforts serve as educational tools to help fishermen understand marine waste, its impacts, and existing waste management regulations for fishing vessels. The sessions were conducted by PPS, companies, and the Indonesian Tuna Longline Association (AP2HI), but they were irregular and usually held only during document inspections. The level of respondent participation in waste management activities revealed that 86% had never attended waste management training, while 14% had. Training, as referenced by fishermen, typically occurred during Basic Safety Training (BST), where one of the topics included pollution prevention on board.

Figure 3 shows that 64% of respondents were unfamiliar with the 3R waste management concept (Reduce, Reuse, Recycle), and 62% were unaware of the existence of waste banks. Meanwhile, 36% were familiar with the 3R concept, and 38% knew about waste banks. The Waste Management Law No. 18 of 2008, enacted by the government, serves as one of the legal foundations for regulating waste management. This law governs household waste management by applying the 3R principles: reducing the amount of waste (reduce), reusing materials (reuse), and recycling waste (recycle).

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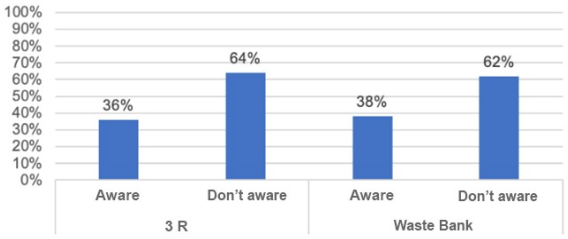


Figure 3. Knowledge of 3R Waste Management and Waste Banks

Government Regulation No. 81 of 2012 on Household Waste Management and Waste Similar to Household Waste emphasizes the need for a paradigm shift in waste management from a collect-transport-dispose system to a management system focused on waste reduction and treatment. This regulation is further supported by the Regulation of the Minister of Environment of the Republic of Indonesia No. 13 of 2012, which governs the implementation of the 3R (Reduce, Reuse, Recycle) principles through waste banks. A waste bank serves as a facility for sorting and collecting recyclable and/or reusable waste with economic value. All activities within the waste bank system are carried out by and for the community. Waste banks are part of a broader waste and environmental management program and community empowerment initiative for three primary reasons: first, waste management has yet to fully implement the 3R principles; second, waste management needs to be carried out comprehensively and integratively from upstream to downstream to provide economic, health, and environmental security benefits and to change public behavior; and third, it is the government's responsibility to increase public awareness of proper waste management (Ivakdalam and Far Far, 2022).

The public participates in waste banks by collecting, sorting, and storing inorganic waste with economic value, which is then sold to waste collectors. The proceeds from the sale are deposited into the community members' savings accounts according to the value of the waste, and individuals are responsible for collecting waste to be credited to their accounts. Each waste bank has different policies regarding the time frame, minimum waste amount, and waste pricing. Customers are entitled to withdraw money from their waste savings accounts (Ivakdalam and Far Far, 2022). Research findings indicate that respondents are not yet familiar with the concept and mechanism of waste banks. Interview results revealed that respondents were unaware of the economic value of waste materials such as bottles, cardboard, and plastic. Respondents also noted that they had not yet found waste collectors conducting buy-and-sell activities in Bitung City.

At PPS Bitung, trash bins have been installed at various strategic points such as the docks, fish auction sites, and administrative offices. Waste from fishing vessels is disposed of in the provided bins and, once full, is collected by sanitation workers using garbage trucks. According to interviews with several fishermen, PPS officials also inquire about the waste onboard when the vessel docks and reports its arrival. Additionally, interviews with port authorities revealed that PPS Bitung has established a waste bank as part of its support for the Ministry of Marine Affairs and Fisheries' (KKP) priority program to reduce plastic waste in the ocean. However, this program has not been optimally implemented, indicating a need for further research into the influencing factors.

## DISCUSSION

### Waste Management Strategy

Waste management strategies onboard fishing vessels were analyzed using a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats). According to Rangkuti (2019), the SWOT matrix is used to formulate internal and external factors into several strategic types, consisting of a combination of two internal and two external factors. The strategies derived from the SWOT matrix include SO (Strength-Opportunity), WO (Weakness-Opportunity), ST (Strength-Threat), and WT (Weakness-Threat) strategies, which involve combining or matching internal weaknesses with external threats.

Table 1. SWOT Matrix for Alternative Waste Management Strategies for Fishing Fleet

| Strengths (S) and Weaknesses (W)<br><br>Opportunities (O)<br>Threats (T) | Strengths (S)<br>1. The economic value of waste, which can serve as an additional income for one of the crew members.<br>2. The crew members have basic knowledge about waste and its environmental impact.<br>3. Monitoring activities conducted by the captain, the company, and the PPS in waste management on fishing vessels.<br>4. Waste disposal facilities both onboard and on land (at the port and company) are available and sufficiently adequate. | Weaknesses (W)<br>1. Waste collection activities are not considered important because they do not generate profit.<br>2. The waste bank at PPS has not been optimized yet. |
|---|---|---|
| Opportunities (O)<br>1. Regulations regarding waste and waste management are known by the crew.<br>2. The transportation of waste collected at temporary waste collection sites, both at ports and companies, by sanitation officers is categorized as smooth. | SO Strategy<br>1. Socializing regulations and educating the crew through regular waste management training activities.<br>2. Optimizing the economic waste separation system through the development of temporary waste collection sites at ports and companies.<br>3. Collaboration with private sectors in waste management.<br>4. Implementing a garbage record book.<br>5. A reward system for ships with the best waste management and sanctions for ships that do not manage waste properly. | WO Strategy<br>1. Educating the crew on the economic value of waste and providing training in waste management.<br>2. Building partnerships with waste banks and recycling entrepreneurs (third parties).<br>3. Improving waste bank infrastructure through an automatic waste sorting system. |
| Threats (T)<br>1. The implementation of waste management socialization on ships has not been fully implemented among the crew.<br>2. Knowledge regarding 3R waste management and the Waste Bank has not been fully known by the crew. | ST Strategy<br>1. Developing specific operational instructions for collecting and managing each category of waste. The document includes standard procedures, technical guidelines, and strict safety protocols to ensure that all aspects of waste management are covered.<br>2. Socializing regulations and educating the crew through regular waste management training activities. | WT Strategy<br>Optimizing the function of the waste bank by providing better facilities and an incentive system for the crew to participate in waste collection and sorting activities. |

Based on the SWOT matrix above, several strategies can be specified, including: (1) Socializing regulations and educating the economic value of waste to the crew through regular and periodic waste management training activities. (2) Optimizing the economic waste separation system through the development of temporary waste collection sites at ports and

companies. The analysis of the economic value of the waste produced is based on the waste prices from the Waste Bank. Inorganic waste, such as plastic bottles and cups, needs to be separated because it has a higher resale value in the recycling process compared to other types of plastic (Yusfi and Damanhuri, 2012). (3) Collaboration between the Waste Bank and recycling entrepreneurs in waste management. According to Amir et al. (2024), partnerships are important to ensure that all parties are responsible for maintaining cleanliness and preventing waste accumulation at fishing ports. (4) A reward system for ships with the best waste management and sanctions for ships that do not manage waste properly. According to Jumanah et al. (2022), appreciation provided by port management can increase fishermen's motivation to comply with regulations sustainably. (5) Optimizing the function of the Waste Bank by providing better facilities, such as an automatic waste sorting system, and offering incentives to the crew for participating in waste collection and sorting activities. The presence of the Waste Bank serves as an alternative solution applied by communities to manage waste (Khasanah et al., 2024). (6) Implementing a garbage record book and developing specific operational instructions for collecting and managing each category of waste. The document should include standard procedures, technical guidelines, and strict safety protocols to ensure that all aspects of waste management are covered. According to Sulistiyono, Setiawan, and Setyarso (2022); Novi (2020), each ship is required to have a waste logbook to document all activities related to waste management, from collection to disposal. All waste handling processes must be carried out according to the procedures set out in regulations. If waste is not handled properly, there is a high risk of improper waste disposal from the ship, wherever it may be, which can lead to marine pollution.

## CONCLUSION

The categories of waste generated by fishing vessels at PPS Bitung include wet waste (food) which is directly thrown into the sea, and dry waste such as plastic, bottles, cloth, glass, and metal, which are first collected. Dry waste management is carried out in two ways: without sorting and with sorting. The fishing fleet waste management strategy based on SWOT analysis includes: (1) socializing regulations and educating the economic value of waste for the crew through regular training, (2) optimizing economic waste separation by developing temporary collection sites at ports and companies, (3) collaborating with the Waste Bank and recycling entrepreneurs, (4) a reward system for ships that manage waste well and sanctions for those that do not, (5) improving the function of the Waste Bank through automatic sorting facilities and offering incentives to the crew, and (6) implementing the Garbage Record Book and developing specific operational guidelines for collecting and managing each waste category.

## ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Marine and Fisheries Human Resources Development and Extension Agency (BPPSDM) through BIMA KKP for the funding support provided for the activities during the research, preparation, and publication of this journal article.

## REFERENCES

Amir, Amriansyah, Febrianti Lestari, Khodijah Ismail, And Agung Dhamar Syakti. 2024. "Strategies For Preventing Fishing Vessel Debris Pollution In Tarempa's Coastal Fishing Port, Kepulauan Riau." *Jurnal Perikanan Dan Kelautan* 29(2): 283–90.

Chen, Chung-Ling, And Ta-Kang Liu. 2013. "Fill The Gap: Developing Management Strategies To Control Garbage Pollution From Fishing Vessels." *Marine Policy* 40: 34–40. Doi:Https://Doi.Org/10.1016/J.Marpol.2013.01.002.

Čulin, Jelena, And Toni Bielić. 2016. "Plastic Pollution From Ships." *Pomorski Zbornik* 51: 57–66.

Fazri, Kurniawan, Iin Solihin, And Mustaruddin. 2021. "Facilities And Operational Level For Fishing Port In South Aceh District, Aceh Province." *Albacore* 5(1): 7–16.

Fitriyashari, Amalia, Abdul Rosyid, And Dian Ayunita. 2014. "Analisis Kebutuhan Perbekalan Kapal Penangkap Ikan Di Pelabuhan Perikanan Pantai Tasikagung, Rembang." *Journal Of Fisheries Resources Utilization Management And Technology* 3(3): 122–30. Http://Www.Ejournal-S1.Undip.Ac.Id/Index.Php/Jfrumt.

Gusti, Aria, B Isyandi, Syaiful Bahri, And Dedi Afandi. 2015. "Hubungan Pengetahuan, Sikap Dan Intensi Perilaku Pengelolaan Sampah Pada Siswa Sekolah Dasar Di Kota Padang." *Dinamika Lingkungan Indonesia* 2(2): 100–107.

Ilma, Nurul, Andi Nuddin, And Makhrajani Majid. 2021. "Perilaku Warga Masyarakat Dalam Pengelolaan Sampah Rumah Tangga Di Zona Pesisir Kota Parepare." *Jurnal Ilmiah Manusia Dan Kesehatan* 4(1): 2614–3151. Http://Jurnal.Umpar.Ac.Id/Index.Php/Makes.

Ivakdalam, Lydia Maria, And Risyasrt Alberth Far Far. 2022. "Peningkatan Partisipasi Masyarakat Dalam Keberlanjutan Pengelolaan Sampah Melalui Bank Sampah." *Agrikan-Jurnal Agribisnis Perikanan* 15(1): 165–81. Doi:10.52046/Agrikan.V15i1.165-181.

Jumanah, Abdul Aziz, Atin Kartini, Anti Annisa Subhiyati, And Marlina. 2022. "Implementasi Program-Program Pemberdayaan Nelayan Tradisional." *Jurnal Ilmiah Niagara* Xiv(2): 270–80.

Katili, Lidya, Elsari Tanjung Putri, Jul Manohas, Silvester Simau, Jenny I Manengkey, Rudi Saranga, Franky A Darondo, Karyanto, And Imam Muddin. 2024. "Analisis Perbekalan Operasional Kapal Pole And Line Yang Berpangkalan Di Pelabuhan Perikanan Samudera (Pps) Bitung, Sulawesi Utara." *Manfish Journal: Marine, Environment And Fisheries* 5(1): 48–56. Https://Ejurnal.Polnep.Ac.Id/Index.Php/Manfish/Aboutkatilietal.,.

Khasanah, Rokhayatun, Syifa Silvana Puspita Rahayu, Ghina Farah Suangga, And Lilis Karwati. 2024. "Peran Bank Sampah Assopiah Dalam Pengelolaan Sampah Di Dusun Sukamaju." *Cendekia: Jurnal Pendidikan Dan Pemberdayaan Masyarakat* 1(4): 180–88.

Kuncowati, Kuncowati. 2019. "Analisis Pengelolaan Sampah Di Kapal Dan Peran Awak Kapal Terhadap Pencegahan Pencemaran Laut Dari Kapal Di Pelabuhan Tanjung Perak Surabaya." *Majalah Ilmiah Bahari Jogja* 17(1): 71–85. Doi:10.33489/Mibj.V17i1.200.

Mamarimbing, Yudistira J, Frangky E Kaparang, And Ivor L Labaro. 2023. "Produksi Dan Produktivitas Hasil Tangkapan Pole And Liner Yang Berpangkalan Di Pelabuhan Perikanan Samudera Bitung." *Jurnal Ilmiah Platax* 11(1): 88–94. Doi:10.35800/Jip.V10i2.44263.

Marine Pollution (Marpol) 73/78 Annex V. 1978. *Peraturan Tentang Pencegahan Polusi Sampah/Limbah Yang Berasal Dari Kapal*.

Novi, Bintang. 2020. "Analisis Pentingnya Pemahaman Garbage Management Plan Diatas Kapal Dalam Upaya Pencegahan Polusi Di Laut." *Jurnal Cakrawala Bahari* 3(1): 7–13. Http://Jurnal.Poltekpelsumbar.Ac.Id/Index.Php/Jcb.

Oreopoulou, Vasso, And Winfried Russ. 2007. *Utilization Of By-Products And Treatment Of Waste In The Food Industry*. Springer Science+Business Media, Llc.

Peraturan Menteri Kelautan Dan Perikanan Republik Indonesia Nomor Per.08/Men/2012 Tentang Kepelabuhan Perikanan. 2012. Kementerian Kelautan Dan Perikanan Republik Indonesia *Peraturan Menteri Kelautan Dan Perikanan Republik Indonesia Nomor Per.08/Men/2012 Tentang Kepelabuhan Perikanan*. Indonesia.

Rangkuti, Freddy. 2019. *Analisis Swot : Teknik Membedah Kasus Bisnis (Cara Perhitungan Bobot, Rating, Dan Ocai*. 25th Ed. Jakarta: Pt. Gramedia Pustaka Umum.

Setyowati, Ririn, And Surahma Asti Mulasari. 2013. "Pengetahuan Dan Perilaku Ibu Rumah Tangga Dalam Pengelolaan Sampah Plastik." *Jurnal Kesehatan Masyarakat Nasional* 7(12): 562–66.

Simmons, Erik C, And Kelly S Fielding. 2019. "Psychological Predictors Of Fishing And Waste Management Intentions In Indonesian Coastal Communities." *Journal Of Environmental Psychology* 65: 101324. Doi:Https://Doi.Org/10.1016/J.Jenvp.2019.101324.

Sulistiyono, Noor, Bambang Setiawan, And Fahreza Kautsar Setyarso. 2022. "Overview Of Garbage Management Plan On The Mt B Star." *Inland Waterways Journal* 4(1): 49–54.

Syahrizal, Hasan, And M. Syahran Jailani. 2023. "Jenis-Jenis Penelitian Dalam Penelitian

Kuantitatif Dan Kualitatif." *Qosim: Jurnal Pendidikan, Sosial Dan Humaniora* 1(1): 13–23.

Takaendengan, Julio, Sisca Pandey, And Samuel Y.R Rompis. 2019. "Evaluasi Kinerja Operasional Pelabuhan Perikanan Samudera Bitung." *Jurnal Tekno* 17(73): 154–58.

Undang-Undang Republik Indonesia. 2008. Republik Indonesia *Undang-Undang Republik Indonesia Nomor 18 Tahun 2008 Tentang Pengelolaan Sampah*.

United Nations Environment Programme. 2015. *Global Waste Management Outlook. (T. Cannon, Ed.) Austria: International Solid Waste Association*.

Wilewska-Bien, Magda, Lena Granhag, And Karin Andersson. 2016. "The Nutrient Load From Food Waste Generated Onboard Ships In The Baltic Sea." *Marine Pollution Bulletin* 105(1): 359–66. Doi:Https://Doi.Org/10.1016/J.Marpolbul.2016.03.002.

Witomo, Cornelia Mirwantini, And Budi Wardono. 2012. "Potret Perikanan Tangkap Tuna, Cakalang Dan Layang Di Kota Bitung." *Buletin Riset Sosek Kelautan Dan Perikanan* 7(1): 7–13.

Wiyono, S. 2016. *Manajemen Potensi Diri*. Jakarta: Pt. Grasindo.

Yusfi, Rosi Nuraeni, And Tri Padmi Damanhuri. 2012. "Studi Karakteristik Dan Potensi Daur Ulang Sampah Di Bantaran Sungai Cikapundung." *Jurnal Teknik Lingkungan* 18(2): 155–66.