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Coastal Waste Management Strategies to Preserve the Sea and Strengthen Fishing Family Economies in Tapanuli Tengah

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***Abstract*— The potential of marine, fisheries, and tourism resources in Tapanuli Tengah Regency is increasingly threatened by the growing accumulation of unmanaged waste. Piled-up waste in coastal settlements, mangrove forest areas, and marine waters has caused severe degradation of coastal ecosystems and a decline in environmental quality. This study aims to identify the types of waste found in the coastal and marine areas of Tapanuli Tengah Regency and to formulate relevant waste management strategies to preserve the marine environment while improving the economy of fishing households. This research employs a case study method with qualitative descriptive analysis and SWOT analysis. The findings indicate that inorganic waste—particularly plastic—dominates the coastal and marine areas, followed by styrofoam, baby diapers, and fabric waste. These types of waste were found accumulating at the research locations: Mela I Village, Pondok Batu Village, Hajoran Village, and Jago-Jago Village. Based on the SWOT analysis, several recommended waste management strategies include environmental awareness and education programs for coastal communities, the development of facilities for sorting organic and inorganic waste, the establishment of Waste Banks at the village or sub-district level, the development of handicrafts made from plastic waste, composting of organic waste, and regular community-led "clean and waste-free sea" activities initiated by the local government and residents. These strategies are expected to support marine conservation and strengthen the economic resilience of fishing families.**

Keywords— *Coastal Areas; Economic Improvement; Fisherfolk; Marine Conservation; Waste Management*

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I. INTRODUCTION

Waste is material that comes from production residues and various human activities as active living beings, both those who live in coastal areas and non-coastal areas. The problem of waste accumulation, which has disrupted environmental cleanliness, poses a threat to coastal and marine communities, particularly in the coastal areas of Tapanuli Tengah Regency, Sumatera Utara. The waste problem is not only occurring on land in coastal areas, but waste has also spread directly to the sea, which ultimately threatens marine ecosystems and disrupts fishermen's catches, both of which have a direct impact on the economy of fishing families.

The waste found and accumulated in coastal and marine communities is usually caused by the bad habits of the people in these areas, one of which is the habit of littering. Some coastal communities in Tapanuli Tengah Regency admit that they often throw waste directly into the sea. Therefore, efforts are needed to educate coastal communities that littering is prohibited [1].

Tapanuli Tengah Regency is one of the regions in Indonesia with great marine and fishery resources [2]. The potential of this region is actually threatened by the increasing amount of waste that is not being properly managed. In fact, waste has accumulated in the residential areas of the coastal communities of Tapanuli Tengah Regency and into the sea, with non-organic waste dominating. Most of the coastal communities in Tapanuli Tengah Regency are well aware of the waste that has accumulated in the sea, and in the future, this will pose a serious threat to the lives of these coastal communities [3].

Communities in coastal areas have made efforts to address the issue of waste, but these efforts have not been effective in solving the problem. This problem occurs due to a lack of public knowledge and minimal infrastructure in coastal areas [4]. The impact of waste in coastal areas and the sea also has a negative effect on the future of fishing families. It is no surprise that plastic waste, which dominates the ocean waters, can damage fishing nets, thereby directly impacting the productivity of fishermen. Plastic bags are the type of waste most commonly complained about by fishermen, as more than half of gillnet fishing activities involve waste that contaminates the nets [5].

The waters of Tapanuli Tengah are currently threatened by the high amount of accumulated and polluting waste, especially plastic waste. This condition not only endangers the sustainability of coastal and marine ecosystems, but also risks destroying the livelihoods of fishermen. The most effective way to

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reduce the waste problem is to reduce the amount and toxicity of waste produced. However, with the increasing desire for a better standard of living, humans have higher consumption levels and, as a result, produce more waste [6].

Figure 1. Research Location Map, Pondok Batu Village, Sarudik Subdistrict, Tapanuli Tengah Regency

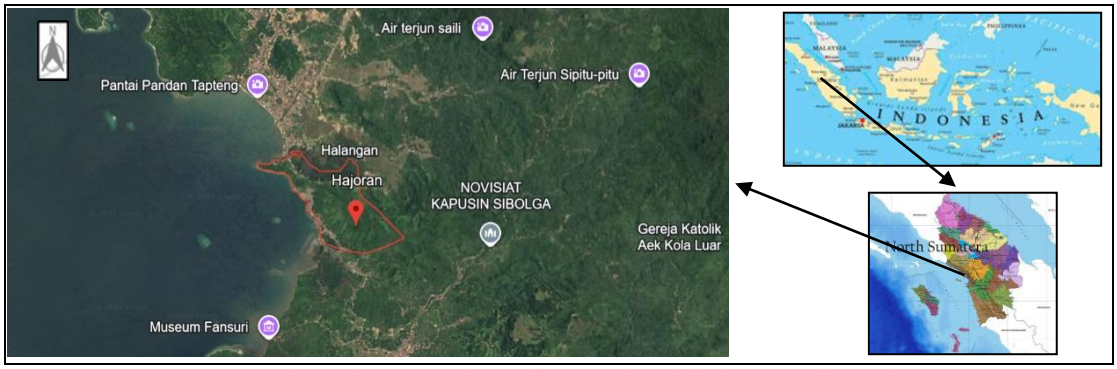

Figure 2. Research Location Map, Hajoran Village, Pandan Subdistrict, Tapanuli Tengah Regency

Figure 3. Research Location Map, Jago-jago Village, Badiri Subdistrict, Tapanuli Tengah Regency

Figure 4. Research Location Map, Mela I Village, Tapian Nauli Subdistrict, Tapanuli Tengah Regency

Waste management is the responsibility of all parties and is mandated by law. Waste managed according to regulations consists of household waste, waste similar to household waste, and specific waste. Household waste as referred to above originates from daily activities in the household, excluding feces and specific waste [7].

Efforts or measures that can be taken to reduce the spread and accumulation of waste in the coastal and

marine areas of Tapanuli Tengah include developing a waste management strategy for these coastal areas. It is hoped that this will become an effective waste management strategy that will have a direct impact on marine conservation efforts and enable waste to become a new source of economic growth for fishing families.

Based on the above background, two research questions were formulated, namely: what types of waste are found in the coastal and marine areas of Tapanuli Tengah Regency, and what is the waste management strategy in the coastal areas of Tapanuli Tengah Regency as an effort to preserve the marine environment and improve the economy of fishing families?

II. METHOD

A. Research Methods

The research method used in this study is a case study research method using descriptive, analytical, and comparative approaches. Research data was obtained from interviews with informants using a prepared questionnaire, and research data was also collected from focus group discussions (FGD) with stakeholders.

The emphasis of the case study is on depth and detail, namely in-depth interviews, detailed descriptions, and problem disclosure. A case study is defined as an exploration of a bound system or a variety of cases that become problems from time to time through in-depth data collection and involving various strong sources of information on a problem [8].

B. Research Location

This study was conducted in the coastal area of Tapanuli Tengah Regency, including Pandan Subdistrict, Badiri Subdistrict, Sarudik Subdistrict, and Tapian Nauli Subdistrict, with each research location in each subdistrict consisting of one village. The research locations were deliberately chosen considering that the four districts are coastal areas and the majority of the population in these districts work as fishermen.

C. Research Informant

Informants in the study are subjects who understand the issues and information related to the research object, either as direct actors or other parties who understand the research object [9]. The population in this study is the entire coastal community in the research location. The population in this study is more specifically fishermen and their families.

The informants in this study consist of several stakeholder groups directly relevant to coastal environmental conditions and waste management in Tapanuli Tengah Regency. First, the Heads of Villages/Urban Wards from the four research locations, who represent local government authorities and possess contextual knowledge of social and environmental conditions. Second, community leaders from each village/urban ward, who provide community perspectives on local practices and behaviors related to coastal waste management. Third, the Head of the Environmental and Sanitation Agency of Tapanuli Tengah Regency, responsible for formulating policies and implementing regional waste management programs. Fourth, the Head of the Marine and Fisheries Office of Tapanuli Tengah Regency, who offers insights into the impacts of waste on coastal ecosystems and fisheries activities. Fifth, the Head of the PLN (State Electricity Company) Branch, as a supporting institution involved in operational activities within coastal areas. Lastly, environmental activists and practitioners in Tapanuli Tengah Regency, who contribute knowledge on ecological issues and community-based environmental initiatives.

D. Data Collection

Research data collection is a procedural series that is important for obtaining the data needed in research. Simply put, data collection techniques are the methods used by researchers to obtain information and research data that are relevant to the research method [10].

Primary data and secondary data are the data that will be collected in the research. Primary data is obtained from direct interviews and in-depth interviews, as well as focus group discussions with informants based on questionnaires or research guidelines that have been prepared. Meanwhile, secondary data is obtained from relevant agencies in Tapanuli Tengah Regency, such as the Environment and Sanitation Agency, the Marine and Fisheries Agency, and the Regional Statistics Agency, which provide data to complement the research results.

E. Data Analysis

Analyzing data is a very important activity in research, because through analysis, researchers will be able to solve research problems, and analysis has a strategic position in research [11].

Data analysis is also defined as an activity carried out by researchers to refine data into a form that is easier to read and interpret. The primary and secondary data obtained will then be processed into tables, diagrams, graphs, and images, and will be compiled into a research report. To answer the first research objective regarding the types of waste found in the coastal and marine areas of Tapanuli Tengah Regency, qualitative descriptive analysis was used, with data sourced from interviews with informants, observations, and direct identification at the research site.

Next, to answer the second research objective regarding waste management strategies in the coastal areas of Tapanuli Tengah Regency as an effort to preserve the sea and improve the economy of fishing families, a SWOT analysis was conducted using data sources from in-depth interviews with all informants and focus group discussions (FGD) based on prepared questions/research guidelines. SWOT analysis is the systematic identification of various factors to formulate a strategy. This analysis is based on logic that can maximize strengths and opportunities, but in the process can also minimize weaknesses and threats [12].

III. RESULTS AND DISCUSSION

A. Overview of Research Location

Mella I Village

Mela I Village is an administrative area within the Tapian Nauli subdistrict in Tapanuli Tengah Regency,

Sumatera Utara Province. Mella I Village consists of four hamlets with a total area of 2.39 km². The distance between Mella I Village and the Tapian Nauli Subdistrict Office is approximately 7 km. The distance between this village and the Tapanuli Tengah Regency Office is approximately 15 km. Mela I Village has a sloping topography with an elevation of 6 meters above sea level. The village is directly adjacent to the Indian Ocean, so the majority of the community works as fishermen.

TABLE 1.
AGE OF RESEARCH INFORMANTS

Category (Years)	Frequency
34-40	3
41-50	5
51-65	4
Amount	12

TABLE 2.
GENDER OF RESEARCH INFORMANTS

Category (Gender)	Frequency
Male	11
Female	1
Amount	12

TABLE 3.
ADDRESSES OF RESEARCH INFORMANTS

Category (Address)	Frequency
Tapian Nauli Subdistrict	2
Sarudik Subdistrict	2
Badiri Subdistrict	2
Pandan Subdistrict	6
Amount	12

TABLE 4.
OCCUPATIONS OF RESEARCH INFORMANTS

Category (Occupation)	Frequency
Village head/sub-district head	4
Fisherman/Community Leader	4
State-owned enterprise (PLN) employee	1
Civil Service	3
Amount	12

Pondok Batu Village

This Village is part of Saudik Subdistrict, Tapanuli Tengah Regency, which consists of 5 neighborhoods/hamlets with an area of 3.1 km². The distance from Pondok Batu Village to the Sarudik Subdistrict Office is approximately 0.11 km. The distance between this village and the Tapanuli Tengah Regency Office is approximately 7.7 km. This village has a lowland and coastal topography with an elevation of 6 meters above sea level. The research area is directly adjacent to the Indian Ocean, so the majority of the people in this area work as fishermen.

Hajoran Village

This Village is located in Pandan Subdistrict Tapanuli Tengah Regency, Sumatera Utara Province. It consists of four neighborhoods/hamlets with an area of 1.5 km². The distance between this Village and the Pandan Subdistrict Office is approximately 5 km. The distance from this village to the Tapanuli Tengah Regency Office is approximately 7 km. This village has a lowland and coastal topography with an elevation of 11 meters above sea level. This Village area borders directly on the waters of the Indian Ocean so that the majority of people in this village work as fishermen, especially fishermen who use *bagan tancap* (lift net) fishing gear [13].

Jago-jago Village

Jago-jago Village is located in Badiri Subdistrict, Tapanuli Tengah Regency, which consists of 4 hamlets with an area of 22.83 km². The distance from Jago-Jago Village to the Badiri Subdistrict Office is approximately 3 km. The distance between this village and the Tapanuli Tengah Regency Office is approximately 14 km. Jago-jago Village has a sloping topography with an elevation of 6 meters above sea level. The village area is directly adjacent to the Indian Ocean, so the economic activities and livelihoods of the villagers are heavily dependent on marine resources.

B. Informant Characteristics

The characteristics of the informants in this study show a diverse composition and represent stakeholders in the coastal area of Tapanuli Tengah Regency. Of the total 12 informants, the majority were in the productive and mature age range, namely five people aged 41–50 years, followed by four people aged 51–65 years, and three people aged 34–40 years (Table 1). The informants were predominantly male (11), while only one informant was female, reflecting the strong role of men in the marine sector and local leadership (Table 2). Based on place of residence, most informants came from Pandan District (six people), two from Tapian Nauli District, two from Sarudik District, and two from Badiri District (Table 3). In terms of occupation, the informants

consisted of four village heads/lurah, four fishermen or coastal community leaders, one state-owned enterprise (BUMN) employee (PLN), and three civil servants/PNS, reflecting a mix of perspectives from the government, coastal communities, and supporting institutions (Table 4).

TABLE 5.
TYPES OF WASTE BASED ON DIRECT OBSERVATION RESULTS BASED ON THE MOST PREVALENT LEVELS

Waste Categories	Ranking
Plastic	1
Foam/Styrofoam	2
Baby diapers	3
Fabric	4

C. Types of Waste Found in Coastal Areas and Seas of Tapanuli Tengah Regency

Waste is a collection of particles produced from the consumption of living creatures, including humans. Waste found in the coastal and marine areas of Tapanuli Tengah Regency is currently in a critical phase, meaning that it is damaging the marine ecosystem and causing environmental unhealthiness in coastal areas.

Based on the results of identification and observation at the research site, it was found that the category of inorganic waste, namely plastic waste, is the most abundant or dominant type of waste in the coastal and marine areas of Tapanuli Tengah Regency, followed by foam/styrofoam waste, diapers/baby diapers, and fabric waste. All of this waste was found piled up on the beach and in the sea at the research site (Table 5).

Figure 5. Various types of waste dominating the beaches in the study area

Based on various studies conducted in Indonesia, plastic waste dominates the composition of macro waste. Large waste dominates the research site. Plastic waste has the highest quantity and weight composition [14]. Furthermore, based on the results of research conducted by Isdianto et al, it was concluded that plastic and rubber waste dominate the composition of waste in Wonorejo Mangrove Ecotourism. Plastic is the largest type of waste, contributing up to 95.33% of the total waste in September, which indicates that single-use plastics are still a major problem in waste management in this area. Rubber also showed a significant increase in May, which may have been caused by certain activities in the area [15].

D. Waste Management Strategy in the Coastal Area of Tapanuli Tengah Regency as an Effort to Preserve the Sea and Improve the Economy of Fishing Families

In fact, waste management specifically in the coastal and marine areas of Tapanuli Tengah Regency must begin upstream. Good and sustainable waste management must start from the ground up because, based on field observations, it has been found that the coastal areas and marine ecosystems affected by waste are downstream of the existing waste problem.

The government must play a strong role in waste management, such as by creating regulations or policies related to household waste management and being directly involved in various educational programs or training for waste processors that directly target communities in coastal areas.

Several waste management strategies in the Coastal Area of Tapanuli Tengah Regency (Research locations: Mela I Village, Pondok Batu Village, Hajoran Village, and Jago-Jago Village) that can be applied with the aim of preserving the sea and improving the economy of fishing families include active socialization to coastal communities as part of education on the importance of protecting the coastal environment and keeping the sea free of waste, Construction of waste disposal sites for organic and inorganic waste, creation of village/subdistrict-level waste banks directly managed by the local government, production of handicrafts from plastic waste, composting of organic waste, and implementation of monthly community service activities to promote love for the sea and a waste-free

environment, which are also initiated by the local government together with the community.

Internal / **Eksternal**	Strengths (S) 1. The desire of the coastal communities in Tapanuli Tengah Regency to change. 2. Organic and non-organic waste provides considerable economic benefits. 3. The coastal area of Tapanuli Tengah is a tourist destination. 4. The friendly nature of the local coastal communities in Tapanuli Tengah. 5. Many people in the coastal area take advantage of the natural beauty and the existence of the coastal area and beaches to start businesses.	Weaknesses (W) 1. Lack of socialization related to waste management to coastal communities by the government 2. Lack of socialization related to the economic value of waste (waste has considerable economic value) 3. Retribution (quotation above) for waste management in Tapanuli Tengah is not comprehensive 4. Non-organic and organic waste disposal sites in the coastal area of Tapanuli Tengah are not functioning properly and are not equitable
Opportunities (O) 1. Tapanuli Tengah Regency Government policies and support for good and sustainable waste management, particularly in coastal areas. 2. Waste management MSME activities carried out by some local coastal communities in Tapanuli Tengah have a significant impact on improving family incomes. 3. Access to direct learning related to waste management is very open. 4. Tourists from outside the region continue to visit tourist destinations in the coastal and marine areas of Tapanuli Tengah.	Strategy (SO) 1. Development of MSMEs with the concept of utilizing organic and non-organic waste (S1, S2, S3, S4, O1, O2, and O3) 2. Creating new economic opportunities for fishing families (S1, S2, O1, O2, O3, and O4)	Strategy (WO) 1. Increased active outreach to coastal communities as part of education on the importance of protecting the coastal environment and keeping the sea free of waste (W1, O1, O2, and O3) 2. Construction of waste disposal sites for organic and inorganic waste (W3, W4, O1, O2, and O4)
Threats (T) 1. Waste that is piling up day by day and is difficult to manage in the coastal and marine areas of Tapanuli Tengah Regency. 2. Waste damages fishing gear, boats, and even the marine and coastal ecosystems of Tapanuli Tengah Regency. 3. Limited access to capital for fishing families to engage in waste management activities. 4. Climate change and an unstable and unpredictable economy.	Strategy (ST) 1. Establishment of Village/Sub-district Waste Banks directly managed by Local Governments (S1, S2, S3, S4, T1, T2, and T3) 2. Creation of handicrafts from plastic waste and Composting of organic waste (S1, S3, S4, and T1)	Strategy (WT) 1. Active dissemination of information on proper and sustainable household waste management directly targeting fishing families (W2, W3, T1, T2, T3, and T4) 2. Implementation of monthly marine conservation and waste-free community service activities initiated by the local government and the community (W1, W2, W3, W4, T1, and T2)

Furthermore, waste found in the coastal and marine areas of Tapanuli Tengah Regency should be able to become a source of economic improvement for fishing families, and good and sustainable waste management can protect these coastal and marine areas from environmental pollution and increased greenhouse gas effects, thereby preventing damage and death to marine ecosystems that play a major role in human life.

This is in line with previous research findings that state that coastal communities consist of groups of people who each have their own unique and specific social values and economic activities. Therefore, every empowerment program for coastal communities, including independent waste management based on the 3R principle, must be designed fairly and appropriately without discriminating between one group and another, let alone between one coastal area and another [16].

The Sicanang Waste Bank in Belawan City, Medan, is an example of a waste management mechanism that involves the active participation of the community through a waste bank as a partner in waste management and reduction of the amount of waste disposed of in landfills. The waste management mechanism at BSIS involves the collection of sorted waste from the established waste bank, such as plastic, paper, glass, and metal, which is then further sorted according to the requests of third parties/recycling companies [17].

Based on the results of a SWOT analysis of waste management strategies in the coastal areas of Tapanuli Tengah Regency in order to preserve the sea and improve the economy of fishing families in the coastal areas of Tapanuli Tengah Regency (research locations: Mela I Village, Pondok Batu Village, Hajoran Village, and Jago Jago Village), it can be concluded that:

Strength - Oppotunity (SO) Strategy

The strategy that can be utilized by the Tapanuli Tengah Regency Government is to develop MSMEs with the concept of sustainable organic and non-organic waste management. This can be done by the local government by empowering the local community, namely fishing families in the coastal area of Tapanuli Tengah Regency.

The next strategy is to create new economic opportunities for fishing families in the coastal area of Tapanuli Tengah Regency (research locations: Mela I Village, Pondok Batu Village, Hajoran Village, and Jago-Jago Village).

Weaknesses - Opportunities (WO) Strategy

The lack of active socialization to coastal communities in the research location as part of education related to the importance of protecting the coastal environment and seas from waste is one weakness that can be improved. Then, related to the construction of

waste disposal sites for organic and inorganic waste, this is an opportunity that can be promoted in order to maintain the cleanliness of coastal areas and seas and can be a source of additional income for fishing families in Tapanuli Tengah Regency.

Figure 6. Waste management activities

Strength - Threat (ST) Strategy

The threat posed by the research location, namely the increasing amount of waste accumulating in the sea and potentially damaging important ecosystems in coastal and marine areas, can be prevented through the creation of waste banks at the village/sub-district level, directly managed by the Tapanuli Tengah Regency Government. Furthermore, community empowerment can also be carried out for the production of handicrafts from plastic waste and the composting of organic waste as an effort to preserve the sea and as part of efforts to improve the economy of fishing families in the coastal areas of Tapanuli Tengah Regency.

Weakness-Threat (WT) Strategy

Internal weaknesses in waste management in the coastal areas of Tapanuli Tengah Regency must be addressed immediately so that they do not become a continuing threat to the sea, the ecosystem, and humans. Active dissemination of information on proper and sustainable household waste management, directly targeting fishing families, needs to be intensified. followed by the implementation of monthly marine conservation and waste-free community service operations initiated by the local government and the community. This will create a sustainable marine environment that can be used as an additional source of income for fishing families in the coastal areas of Tapanuli Tengah Regency (specifically in the research locations: Mela I Village, Pondok Batu Village, Hajoran Village, and Jago Jago Village).

IV. Conclusion

The category of non-organic waste, namely plastic waste, is the most commonly found type of waste in the coastal and marine areas of Tapanuli Tengah Regency, followed by foam/styrofoam waste, diapers/baby wipes, and fabric waste. All of this waste was found piled up on the beaches and in the sea at the research locations (Mela I Village, Pondok Batu Villaget, Hajoran Village, and Jago Jago Village).

Several waste management strategies in the coastal areas of Tapanuli Tengah Regency (research locations: Mela I Village, Pondok Batu Village, Hajoran Villaget, and Jago Jago Village) that can be applied with the aim of preserving the sea and improving the economy of fishing families include active socialization to coastal communities as part of education on the importance of keeping coastal and marine environments free of waste, Construction of waste disposal sites for organic and inorganic waste, creation of Village/Subdistrict-level Waste Banks directly managed by the Local Government, production of handicrafts from plastic waste, composting of organic waste, and implementation of monthly "Love the Sea and Waste-Free" operations/community service initiatives also initiated by the Local Government with the community.

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References

[1] H. Y. Harahap, T. Mahaji, J. P. Siburian, T. Anugerah, & S. N. Adiprayoga. Coastal Community Perceptions of Waste Management as an Effort to Maintain Marine Sustainability in Tapanuli Tengah Regency, North Sumatera. International Journal of Marine Engineering Innovation and Research. 2024; 9(4).

[2] T. Anugerah, S. N. Adiprayoga, & O. R. Karsih. Analisis struktur pendapatan dan struktur pengeluaran rumah tangga nelayan bagan tancap di kabupaten Tapanuli Tengah. ALBACORE Jurnal Penelitian Perikanan Laut, 2024, 8.1: 081-088.

[3] H. Y. Harahap, T. Mahaji, J. P. Siburian, T. Anugerah, & S. N. Adiprayoga. Coastal Community Perceptions of Waste Management as an Effort to Maintain Marine Sustainability in Tapanuli Tengah Regency, North Sumatera. International Journal of Marine Engineering Innovation and Research. 2024; 9(4).

[4] H. Herdiansyah, H. G. Saiya, K. I. I. Afkarina, & T. L. Indra. Coastal Community Perspective, Waste Density, and Spatial Area toward Sustainable Waste Management (Case Study: Ambon Bay, Indonesia). Sustainability. 2021;13(19)

[5] A. D. Nash. Impacts of marine debris on subsistence fishermen an exploratory study. Marine Pollution Bulletin. 1992;24(3), 150-156
[6] R. P. Mahyudin. Strategi pengelolaan sampah berkelanjutan. EnviroScienteae. 2014;10(1), 33-40
[7] Undang-Undang Negara Republik Indonesia Nomor 18 Tahun 2008 tentang Pengelolaan Sampah.
[8] Y. Kusmarni. Studi kasus. UGM Jurnal Edu UGM Press. 2012;2, 1-12.
[9] B. Bungin. Penelitian Kualitatif. Kecana, h 26. Jakarta. 2007.
[10] G. Daruhadi, & P. Sopiati. Pengumpulan data penelitian. J-CEKI: Jurnal Cendekia Ilmiah. 2024;3(5), 5423-5443.
[11] S. P. Hastono. Analisis data. Depok: Fakultas Kesehatan Masyarakat Universitas Indonesia, 1-2. 2021.
[12] F. Rangkuti. Analisis SWOT teknik membedah kasus bisnis. Gramedia Pustaka Utama. 1998.
[13] T. Anugerah, & S. N. Adiprayoga. Analysis on the livelihood vulnerability of lift net fisher households, tapanuli tengah, sumatera utara. International Journal of Marine Engineering Innovation and Research, 2023, 8.4.
[14] A. Yahya. (2020). Observasi dan identifikasi sampah laut (marine debris) di Pantai Teluk Laikang Kabupaten Takalar (Doctoral dissertation, Universitas Hasanuddin).
[15] A. Isdianto, U. Yanuhar, T. D. Lelono, E. Susilo, N. F. I. F. Ramadhanti, S. P. R Nizery, ... & I. D. Puspitasari. Komposisi dan Dinamika Sampah Laut di Kawasan Ekowisata Mangrove Wonorejo, Surabaya: Composition and Dynamics of Marine Debris in the Wonorejo Mangrove Ecotourism Area, Surabaya. JFMR (Journal of Fisheries and Marine Research), 2024;8(3), 123-134.
[16] A. S. Mauludiyah, & M. Sholeh. Pengelolaan Sampah Berbasis Masyarakat Pesisir (Studi Kasus: Masyarakat Pesisir Kenjeran, Surabaya, Jawa Timur). Marine Journal, 2018;1(2), 1-7.
[17] R. Auliani. Peran bank sampah induk dalam pengelolaan sampah Kota Medan. Jurnal Abdidas, 2020;1(5), 330-338.