

Identification of Marine Debris Types in The Coastal Area of Palopo City

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Abstract

This study aims to identify the variation of marine debris along the coast of Palopo City, South Sulawesi, and to evaluate the types and levels of accumulation at three research sites: Takalalla, Benteng, and Salekoe. The research applied a quantitative descriptive method with sampling conducted using a 100-meter transect divided into 5 × 5 meter plots. The collected debris was classified by material type (plastic, rubber, metal, glass, fabric, wood, and others), followed by calculations of quantity, weight, and percentage. The findings revealed that plastic debris was the most dominant, both in terms of number and distribution. The highest accumulation was recorded in Takalalla Village (48%), followed by Benteng Village (27%), and the lowest in Salekoe Village (25%). Meanwhile, glass and natural wood contributed significantly to the total weight. These results confirm that domestic activities, tourism, and fisheries are the main sources of marine debris in the coastal area of Palopo City. This research is expected to serve as a basis for more sustainable coastal environmental management.

Keywords: Marine_Debris; Coastal; Plastic; Palopo_City

1. Introduction

One of the major problems Indonesia is facing is marine pollution from waste, which is a key factor in this issue. The ocean must be protected for sustainable development, to solve current problems, and to ensure the continuity of life in the future. Waste pollution is caused by human activities that either directly dispose of garbage into the sea or dump it into rivers that then flow into the sea [1].

Marine debris is solid material resulting from human activities that is found in the sea or on the coast and does not originate from natural sources. This waste can harm ecosystems and disrupt life in the water [2].

Palopo City, located in South Sulawesi, is one of the coastal regions that faces these challenges. The city's coastal area is utilized for various purposes, including residential settlements, fishing, and tourism activities. However, the lack of effective waste management and limited public awareness of marine debris issues have led to increasing waste accumulation along its shoreline. This situation requires comprehensive study and monitoring to provide baseline data that can support coastal management policies and raise community awareness.

This study was conducted to identify and classify the types of marine debris found along the coastal area of Palopo City. Specifically, the research focuses on three different coastal locations—Takalalla, Benteng, and Salekoe—which represent distinct characteristics of the city's shoreline. The study aims not only to determine the types and distribution of debris but also to evaluate the level of accumulation in each area. The results are expected to contribute valuable information for local governments, communities, and other stakeholders in developing sustainable strategies for managing marine debris in coastal environments.

A well-designed introduction should be able to provide answers to several essential questions, such as the statement of the problem to be solved, the state of the art of previous

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efforts to address the issue, identification of aspects overlooked by previous researchers or unexplored potential, presentation of the proposed conceptual framework to fill gaps or address aspects overlooked by previous researchers, and explanation of the main objectives of the research.

The introduction should be concise but informative. In the first paragraph, objectively discuss current issues. Connect by outlining the actions taken by previous researchers in addressing the same problem, focusing on their methods and results. Identify aspects that have not been explored or overlooked by previous research and provide scholarly criticism of previous studies.

Next, explain the proposed conceptual framework to contribute to solving the identified problem. There is no need to explicitly state novelty, but scholarly criticism of the state of the art is enough to demonstrate innovativeness. Lastly, elaborate on the scientific value of the proposed concept/idea. Conclude the introduction with a paragraph detailing the objectives of the work and providing a brief introduction to the methodology. Avoid excessive length to keep the reader's attention.

2. Methodology

Type of Research.

This study employed a quantitative descriptive approach aimed at identifying and classifying the types of marine debris in the coastal area of Palopo City. The research focused on three selected coastal sites, each representing different coastal characteristics: Takalalla, Benteng, and Salekoe.

Study Area and Period

The research was conducted along the coastline of Palopo City, South Sulawesi, specifically in Takalalla (residential area), Benteng (settlement and fishing activity area), and Salekoe (tourism area). Each location was chosen to represent distinct anthropogenic influences on marine debris accumulation. The study was carried out in 2025 during the dry season to ensure accessibility and minimize weather disturbances.

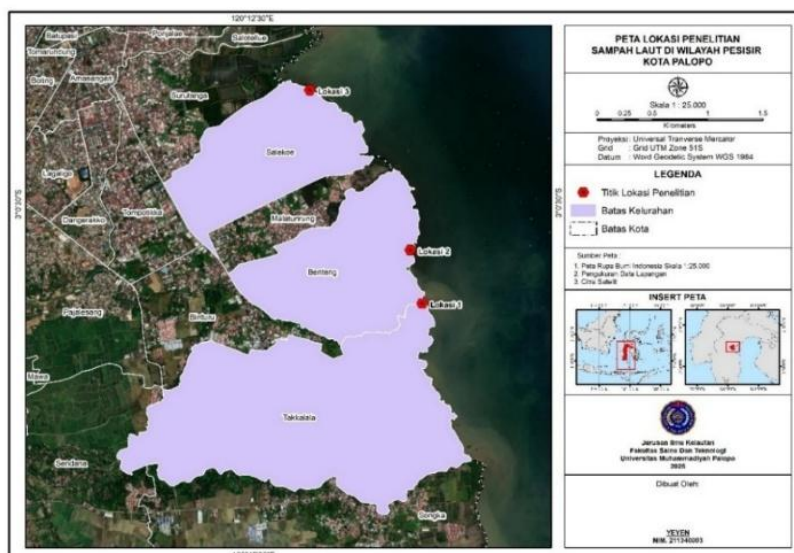


Figure 1. Research Site of Marine Debris in the Coastal Area of Palopo City

Data Collection

Marine debris samples were collected using the line transect method. At each site, a 100-meter transect was established parallel to the shoreline and divided into segments. Each segment was further subdivided into 5×5 meter plots, which served as the observation units. All visible debris within the plots was collected manually and stored in labeled bags for classification and weighing.

Classification of Marine Debris

The collected debris was classified according to categories defined by NOAA (National Oceanic and Atmospheric Administration) and UNEP (United Nations Environment Programme), including:

- Plastic (bottles, bags, packaging, Styrofoam, nets)
- Rubber (e.g., sandals, tires)
- Metal (e.g., cans, nails, wires)
- Glass (bottles, fragments)
- Fabric/Textile (clothes, sacks, synthetic materials)
- Wood (natural or processed wood pieces)
- Others (e.g., electronic and medical waste)

Data Analysis

The debris was analyzed quantitatively by calculating the total number of items, weight (in grams), and percentage for each category. Debris density was expressed as the number of items per square meter (items/m²) and weight per square meter (g/m²). The results were then compared across the three study sites to assess variations in debris type and accumulation levels.

Calculation of Numbers and Percentages

The weight of waste per square meter (M) is calculated as the total weight of waste within the area of the transect quadrat. Waste weight data per square meter (M) is reported in grams per square meter (g/m²) [3].

$$M = \frac{\text{total waste weight } g}{\text{length } m \times \text{width } m}$$

Waste density (K) is obtained by counting the number of waste items per type within the area of the transect quadrat. Waste density data are reported in units of number of items per type per square meter (m²).

$$\text{Density (K)} = \frac{\text{number of waste items per type}}{\text{length (m)} \times \text{width (m)}}$$

3. Result and Discussion

Types and Quantity of Marine Debris in the Coastal Area of Palopo City

The study revealed that various types of marine debris were present along the coastal areas of Palopo City, categorized into plastics, rubber, metal, glass, fabric, wood, and other materials. Among these, plastic debris was found to be the most dominant in terms of both

quantity and distribution. Plastic packaging, bottles, and bags constituted the majority of items, highlighting the widespread use of single-use plastics in daily community activities.

Glass and natural wood, while lower in number, contributed significantly to the total weight of debris. This suggests that heavier waste materials, although less abundant, have a greater impact on the overall mass of marine debris accumulation.

Station 1 Takalalla Village

The identification results of various types of marine debris showed that one type dominated with the highest percentage, accounting for 40.5% of the total waste found across all locations. The most common type of debris was plastic packaging, with a quantity ranging from 65 to 69 items (weighing up to 38 grams). In addition, Styrofoam, rubber (such as tires or sandals), and metal were also found in considerable amounts.

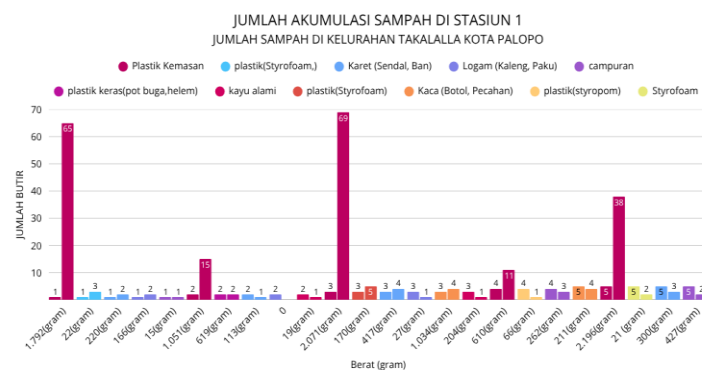


Figure 2. Quantity of Marine Debris Samples in Takalalla Village

Station 2 Benteng Village

This station was also dominated by plastic waste, particularly plastic bottles and bags, which reached 26 items in the first observation session and consistently appeared in various forms such as plastic bottles, nets, and Styrofoam. In addition, textile waste and rubber items such as tires and sandals were also frequently found. Natural wood appeared in large quantities during the second observation (14 items), indicating possible input from mangrove forests or human activities around the coast. These data suggest the influence of domestic and transportation activities that directly dispose of waste into the waters.

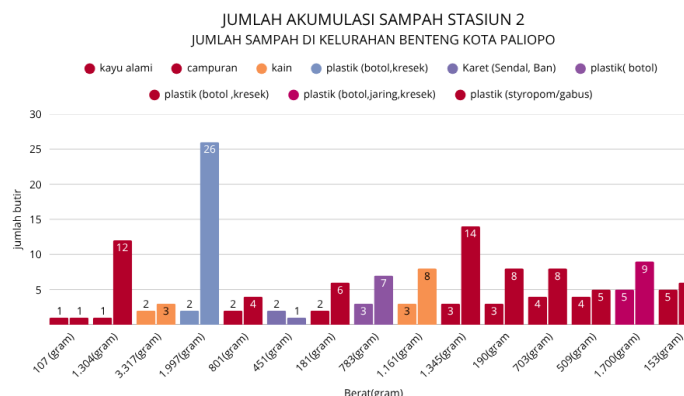


Figure 3. Quantity of Marine Debris Samples in Benteng Village

Station 3 Salekoe Village

At this station, plastic (bags, bottles, packaging) was the most dominant type of debris, with a total of 31 items, followed by other types of plastic packaging (23 items). In addition, natural wood (8 items), Styrofoam plastic, textiles, and glass fragments were also found. This variety of debris indicates diverse coastal community activities, ranging from household consumption to small-scale industries such as fisheries and trade.

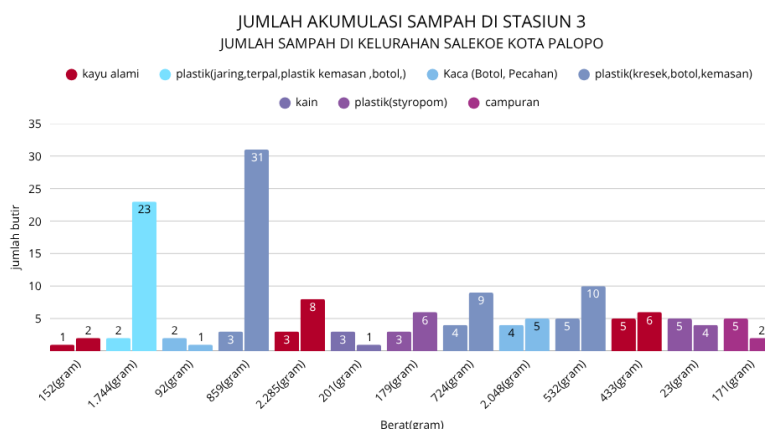


Figure 4. Quantity of Marine Debris Samples in Salekoe Village

Comparison of Debris Accumulation among Location

Takalalla: recorded the highest accumulation of debris, accounting for 48% of total findings. This site was dominated by plastic packaging and Styrofoam, reflecting the influence of household waste and local community activities.

Benteng: contributed 27%, with a notable presence of plastic bottles, rubber (sandals and tires), fabric, and heavy debris such as wood. This indicates that both domestic and fishing-related activities strongly influence waste composition in this area.

Salekoe: a coastal tourism site, recorded the lowest accumulation at 25%, but still showed a significant variety of debris types, including mixed plastics, natural wood, glass fragments, and Styrofoam. This reflects the diverse human activities related to tourism and small-scale trade.



Figure 5 Percentage of Debris Accumulation in the Coastal Area of Palopo City

4. Conclusion

1. The types of marine debris found on the coast of Palopo City consist of plastic waste, natural wood, glass/broken bottles, metal, cloth/textiles, rubber, styrofoam, and other mixed waste. Of all these categories, plastic is the most dominant type of waste, both in terms of quantity and distribution.
2. Based on weight and material type, waste classification shows that plastic items dominate the count, while glass and natural wood contribute significantly to the total weight. This condition indicates that the sources of waste in the coastal area of Palopo City come from domestic, tourism, and fishing activities.
3. The rate of marine debris accumulation varies among locations, in the following order:
 - Takalalla Village: has the highest amount of trash (240 pieces, 48% of the total).
 - Benteng Village: has the highest weight of trash 138 pieces, 27%).
 - Salekoe Village: has the lowest amount and weight of trash (125 pieces, 25%) but a fairly high variety of trash types.

5. Acknowledgement

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6. Reference

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