JOURNAL OF APPLIED GEOSPATIAL INFORMATION

Vol 7 No 2 2023

http://jurnal.polibatam.ac.id/index.php/JAGI
ISSN Online: 2579-3608

The Sensitivity Level of the Coastal Areas in Bulukumba Regency to Waste Pollution

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Received: October 30, 2023
Accepted: November 16, 2023
Published: November 16, 2023

Abstract

The presence of waste in coastal environments can lead to increased coastal damage and burden. Most of the population's activities in Bulukumba Regency are concentrated in coastal areas, thus making this region susceptible to significant pressure from waste pollution. This research aims to determine the level of coastal area sensitivity in Bulukumba towards waste pollution. The study was conducted from October to December 2022. The research location is the coastal area of Bulukumba Regency, which includes seven subdistricts: Gantarang, Ujung Bulu, Ujung Loe, Bonto Bahari, Bontotiro, Herlang, and Kajang. Primary data were obtained through interviews and direct observations at the research locations, while secondary data were collected through literature studies and relevant institutions in Bulukumba. The results of parameter weighting using the expert judgment method indicate that five important parameters are used to assess the sensitivity of the coastal environment to waste pollution. These parameters consist of current velocity (20.27%), distance of the ecosystem from the harbor (18.92%), distance of the ecosystem from settlements (18.92%), distance of the ecosystem from rivers (17.57%), and the presence of waste on the coast (17.57%). The distribution of coastal environmental sensitivity levels to waste pollution shows that the eastern coastal areas are more sensitive to waste pollution than the southern coastal areas. The current velocity is the most significant parameter influencing the coastal environment's sensitivity to waste pollution and holds the highest weight and score across all research areas.

Keywords: Bulukumba, Coastal Area Sensitivity, Waste Pollution

1. Introduction

The presence of waste in coastal environments can increase damage and the burden on coastal areas. Waste from the mainland that enters the sea and is carried by currents is called marine litter. In Indonesia, over the past 40 years (1978-2018), there have been 579 research papers on marine litter research, which is relatively low considering that Indonesia ranks as the world's fifth-largest contributor to marine litter (Meijer *et al.* 2021; Purba *et al.,* 2019). One limitation in conducting beach cleaning activities is the dependence on organizers relying on community reports and visual assessments of coastal environments littered with waste (Haarr *et al.,* 2019). These activities may not target coastal areas susceptible to waste pollution.

Bulukumba Regency comprises ten districts, seven being coastal, and most of the population's activities center in coastal areas. Bulukumba Regency is one of the regions experiencing significant and accelerated development, attracting various industries and leading to urbanization and population growth (Mulyana 2020). According to Afriandi *et al.,* (2020), the increase in the population leads to increased human activities, which, in turn, can increase waste generation. Based on data from the Environmental and Forestry Office of Bulukumba Regency in 2017, the largest source of waste generation comes from residential and commercial areas. The daily waste generation reaches approximately 1,026 m^3, with only about 12.5% (129 m^3) being correctly managed (Environmental and Forestry Office of Bulukumba Regency 2017).

Bulukumba is renowned as an area with significant marine tourism potential. The number of tourist visits to one of its attractions, Tanjung Bira Beach, has steadily increased over the past five years, with the highest growth rate recorded in 2018 at 27.58% (Inayah and Istiqomah 2021). While the increase in the number of tourist visits can positively impact the local economy, it can also lead to negative externalities in the form of waste generated from tourism activities, which can diminish environmental quality.

Waste management in Bulukumba Regency is not handled comprehensively. The waste management facilities in the city center cannot accommodate the waste production throughout the district's various regions. Limited infrastructure and a low public understanding of waste management are the primary challenges in waste management (Environmental and Forestry Office of Bulukumba Regency 2021). These waste management challenges can act as triggers for waste pollution.

The pollution of waste is multi-aspect and interconnected with one another. The sensitivity or insensitivity of coastal environments to waste pollution can be measured using an index. The Environmental Sensitivity Index (ESI) is developed to assess the level of characteristics, the depiction of sensitivity, and the vulnerability of coastal resources. The application of the ESI method has been widely used but is still limited to the sensitivity of coastal environments to oil pollution, as seen in research by PKSPL (2013), Muarif *et al.,* (2016), Putra *et al.* (2018), Danipranata *et al.,* (2019), and Rikardi *et al.,* (2021).

Currently, the ESI method has evolved into a tool that can be utilized to assess the sensitivity of coastal environments exposed to various pollutants from various sources, such as those originating from rivers, settlements, human activities in the coastal environment, and pollutants carried by currents from specific sources to coastal areas. Therefore, this research aims to analyze the level of sensitivity of coastal environments to waste pollution. The parameters used to assess the sensitivity of coastal environments are specifically focused on ecological parameters. This research also employs the expert judgment method to determine the importance of each parameter in describing environmental sensitivity. The accuracy of an index in depicting environmental conditions is greatly determined by the accuracy in selecting its forming parameters. Mapping the sensitivity level of the environment using Computer-based Geographic Information Systems (GIS) is used for data processing and spatial analysis because of its rapid capability in handling multifactorial, complex, and intricate data processing and analysis.

2. Methods

2.1 Study area

The geographical location of Bulukumba Regency is found between 5°20' S - 5°40' S and 119°58' E - 120°28' E. The eastern coast is bordered by Bone Bay and the southern part is bordered by the Flores Sea. The research was conducted in the coastal districts of Bulukumba Regency, which include seven districts: Gantarang, Ujung Bulu, Ujung Loe, Bonto Bahari, Bontotiro, Herlang, and Kajang (Figure 1). This study was carried out from October to December 2022.

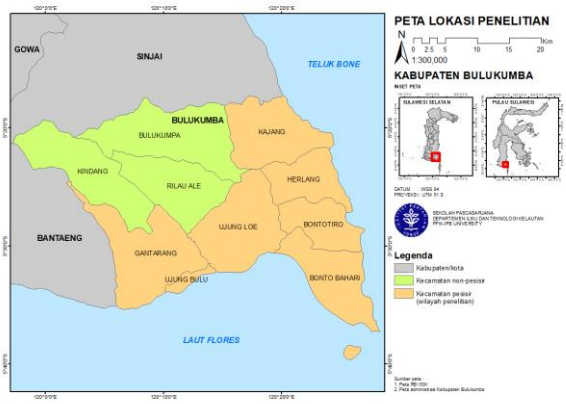


Figure 1. Map of study area

2.2 Tools and materials

The research tools utilized included questionnaires, a tape measure, GPS, a trash bag, and a laptop equipped with software such as ArcGIS, ENVI 5.3, ODV 5.6.3, Microsoft Office, and Microsoft Excel. The materials used consisted of Landsat 8 OLI imagery, expert interview data, water clarity data, waste density data, current speed and patterns data, settlement distribution data, port locations, watershed areas, mangrove ecosystems, seagrass, and coral reef data.

2.3 Data collection

The data used in this research comprises both primary and secondary data. Primary data were obtained through field observations and guided interviews using questionnaires, while secondary data were obtained through literature reviews and relevant institutions. The primary data collected include shoreline waste density and expert opinions related to the parameters used. Waste density data were acquired through trash sampling using the standing stock method, conducted in coastal areas that do not undergo regular beach cleaning (Opfer *et al.,* 2012). The collected trash samples had cross-sectional dimensions ranging from 2.5 cm to 1 m (macro waste), and waste classification followed the UNEP classification system for all in-situ waste surveys (Cheshire *et al.,* 2009). The Clean Coast Index (CCI) was employed to objectively and easily measure the actual beach cleanliness level, avoiding subjective judgments by assessors (Table 1). Expert judgment was used for assessing the parameters employed to evaluate the sensitivity of the coastal environment.

The secondary data used include the shapefile data for Bulukumba Regency and the distribution of ports obtained from the Geospatial Information Agency (BIG) in 2021, Landsat 8 satellite imagery recorded on December 8, 2022, processed to generate spatial information about water brightness acquired from the United States Geological Survey (USGS) in 2022, tidal current data from July 2022 (eastern season) and December 2022 (western season) were averaged to determine the speed and

Table 1. Clean Coast Index (CCI)

Numeric index (item/m^2)	Coast index	Explenation
0-0,1	Very clean	No litter is seen
0,1-0,25	Clean	No litter is seen over a large area A few pieces of litter can be detected
0,25-0,5	Moderate	A lot of litter on the shore Most of the shore is covered with litter
0,5-1	Dirty	recreational
>1	Extremely dirty	No litter is seen

Source : Alkalay *et al.,* (2017)

patterns of currents obtained from Marine Copernicus in 2022, seagrass and coral reef distribution data obtained from the Allen Coral Atlas in 2022, and settlement distribution, mangrove ecosystems, and river basin areas obtained from SIGAP KLHK GIS in 2019.

The approach used for mapping the coastal areas sensitivity to waste pollution in this research is based on Geographic Information Systems (GIS), where some data is transformed into spatial or spatial data. The assessment of coastal environmental sensitivity to waste pollution focuses on ecological parameters utilized. Weighting is performed based on the values obtained from interviews with relevant experts. The overall research results will be presented in the form of tabular data, diagrams, and maps. In summary, the research design is presented in a flowchart in Figure 2.

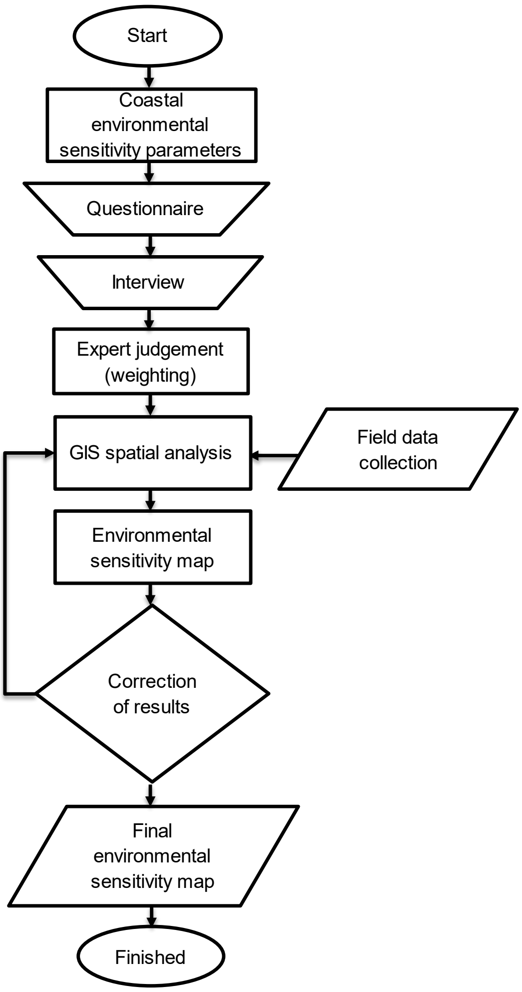


Figure 2. Research flow diagram

2.4 Weighting parameters of coastal environmental sensitivity to waste pollution

The expert surveys gather opinions and assessments from experts on a particular topic (Yousuf 2007). Specifically, in ecology, Muarif *et al.,* (2016) applied this method to assess the environmental sensitivity of mangroves. In this study, five experts participated, with four of them coming from academic backgrounds in the fields of geographic information systems, physical oceanography, coastal and marine ecology, and one expert from the local government (Department of Environment and Forestry of Bulukumba Regency in the field of cleanliness management, landscaping, and waste management). The importance level of each parameter is classified into three categories: less important, important, and very important.

2.5 Coastal environmental sensitivity index to waste pollution

An environmental sensitivity analysis of coastal pollution was conducted to identify the level of characteristics and sensitivity profiles in the area towards pollution. The region on the sensitivity map integrates six parameters (Table 2). Each parameter has been classified into several criteria assigned with scores/rankings. The scores range from 1 to 3, signifying low, moderate, and high sensitivity levels.

The environmental sensitivity of coastal areas to waste pollution is determined through the formulation of the following formula (Muarif *et al.,* 2016):

$$\mathrm{ESI_{WP}} = \sum(w_i x_i) \quad \text{...(1)}$$

Note:
ESI_{WP} = Sensitivity value of coastal environments to waste pollution
W_i = Weight of the i-th parameter
X_i = Score of the i-th parameter

To determine the width of each sensitivity class interval, it is done by dividing the obtained score by the number of specified sensitivity class categories using the equation:

$$I = R/n \quad \text{...(2)}$$

Note:
I = Interval of environmental sensitivity classes
R = Difference between the maximum score and the minimum score
n = Number of environmental sensitivity classes

Table 2. Coastal environmental sensitivity parameter to waste pollution

Parameter		Sensitivity Value		
		1 (Low)	2 (Moderate)	3 (High)
Distance of the ecosystem from rivers (m)	Mangroves/ Seagrass	200-400	101-200	0-100
	Coral reefs	2000-3000	1001-2000	0-1000
Distance of the ecosystem from the harbor (m)	Mangroves/ Seagrass	400-600	201-400	0-200
	Coral reefs	1500-3000	751-1500	0-750
Distance of the ecosystem from settlements (m)	Mangrove/ Seagrass	500-750	251-500	0-250
	Coral reefs	4000-6000	2001-4000	0-2000
The brightness of the waters (m)		>6	3-6	<3
The presence of waste on the coast		Very clean-Clean	Moderate	Dirty-Extremely dirty
Current velocity (m/s)		>1 (Fast)	0,25-1 (Moderate)	<0,25 (Slow)

Source: Modification (Nurmawati 2017; Minister of Environment Decree No. 51 of 2004; Alkalay *et al.,* 2007; Mason 1981)

The classification of coastal environmental sensitivity levels to waste pollution is divided into three classes (Table 3).

Table 3. Sensitivity levels based on ESI value

Value	Sensitivity level	Color
6,3 – 99,2	Low	Green
99,2 – 192,1	Moderate	Yellow
192,1 – 285,1	High	Red

Source: Results of data analysis (2023)

3. Results and Discussion

3.1 Weighting parameters of coastal environmental sensitivity to waste pollution

Weighting is performed to indicate the level of importance of each parameter in determining the sensitivity of the coastal environment to waste pollution. These values are obtained through expert assessments that establish the ranking order of environmental sensitivity parameters. Table 4 presents the percentage weights of environmental sensitivity parameters to waste pollution in coastal areas.

Table 4. Weighted percentage of coastal environmental sensitivity parameters

Parameters	Weight
Distance of the ecosystem from rivers	17,57%
Distance of the ecosystem from the harbor	18,92%
Distance of the ecosystem from settlements	18,92%
The brightness of the waters	6,76%
The presence of waste on the coast	17,57%
Current velocity	20,27%

Source: Results of data analysis (2023)

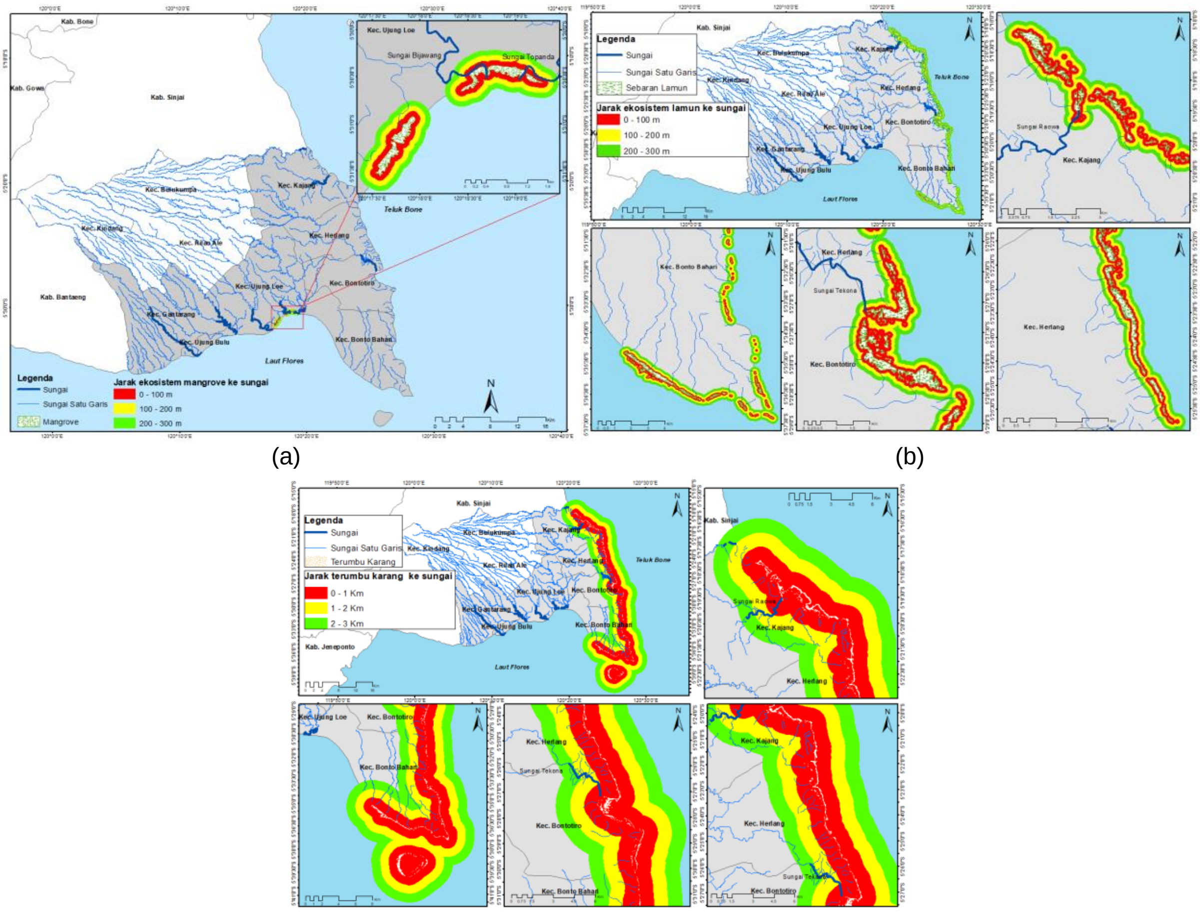
Based on the table above, the parameters for coastal environmental sensitivity to waste pollution can be categorized into three classes: groups of parameters with weight percentage ranges of 6.76% 11.26%, 11.26%-15.76%, and 15.76%-20.27%. The higher the weight percentage of a parameter, the greater its influence on determining the level of coastal environmental sensitivity to waste pollution.

Parameters such as the distance of the ecosystem from rivers, the distance of the ecosystem from ports, the distance of the ecosystem from settlements, the presence of waste on the coast, and current velocity fall into the high percentage group, specifically 15.76% - 20.27%. These five parameters hold significant importance and have a substantial impact on depicting the level of environmental sensitivity to waste pollution in a particular region.

The distance of the ecosystem from pollution sources (rivers, ports, settlements) provides insight into the fact that ecosystems close to pollution sources have a higher potential for pollution because waste can easily enter them. With a shorter distance, waste from pollution sources has a greater chance of reaching the nearest ecosystem. Furthermore, the current velocity parameter plays a role in the transportation and deposition of waste on the coast. The movement of marine litter tends to follow the direction of water currents, and both fast and slow current velocities play a crucial role in waste placement (Nursyahnita *et al.,* 2023). Meanwhile, the presence of waste on the coast can validate the entry process of waste, whether it's through direct disposal, run-off processes (from rivers and drainage), or waste carried by sea currents.

3.2 Parameters of coastal environmental sensitivity to waste pollution

The coastal area of Bulukumba Regency features distinct coastal ecosystems. Based on observations, the coastal ecosystem in the Ujung Loe district consists of mangrove ecosystems. In contrast, seagrass and coral reef ecosystems are found in the eastern coastal regions, specifically in the Bonto Bahari, Bontotiro, Herlang, and Kajang districts.



(a) (b)

(c)

Figure 3. Distance of ecosystem from rivers; (a) mangroves; (b) seagrass; (c) coral reefs

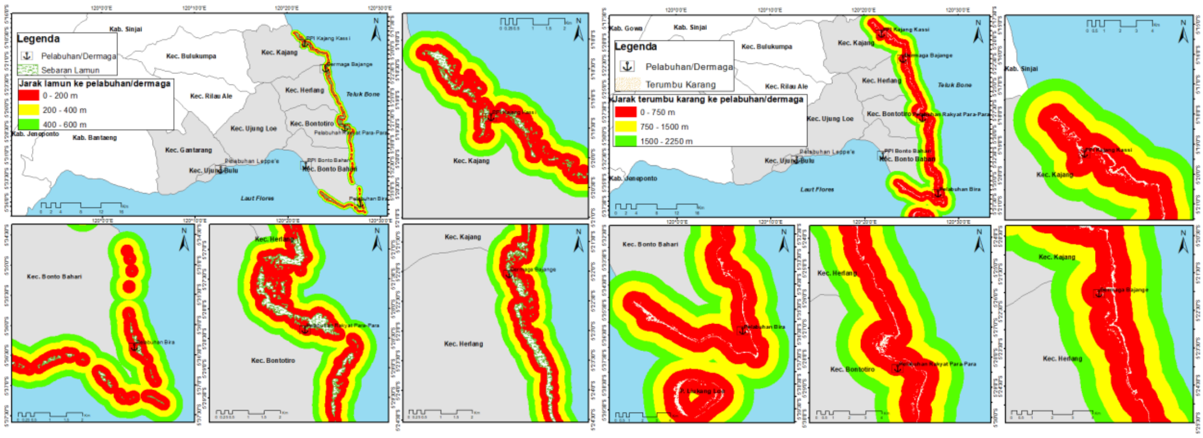
On the other hand, the Gantarang and Ujung Bulu districts do not have coastal ecosystems.

Six river streams flow through the Bulukumba Regency's coastal sub-district and empty into the sea. The Bialo River in the Ujung Bulu District flows into the Flores Sea, passing through urban areas. The Ujung Loe District has three streams: the Balantieng River, the Bijawang River, and the Topanda River, which are highly susceptible to agricultural and mining activities. The Raowa River in the Kajang District is located near the Kajang Kassi Port, making it vulnerable to transportation and fishing activities.

Based on the map above, the distance between the river streams and their estuaries is very close to the mangrove ecosystem in Ujung Loe Sub-District, which falls within the range of 0-100 meters (Figure 3a) from the pollution source (the rivers), categorizing it as a high sensitivity level. The rivers that empty into the waters of the eastern coast, specifically in Bontotiro, Herlang, and Kajang Sub-Districts, are generally near seagrass ecosystems within 0-100 meters (Figure 3b) and are within a range of 0-1 kilometer from coral reef ecosystems (Figure 3c). The closer an ecosystem is to a pollution source (such as a river), the higher the sensitivity to trash pollution. Rech *et al.,* (2014) stated that the abundance of trash deposited in coastal environments generally decreases with the distance from the river estuary. Indicates that the sensitivity to pollution is influenced by the ecosystem's proximity to the pollution source (river) influences the sensitivity to pollution.

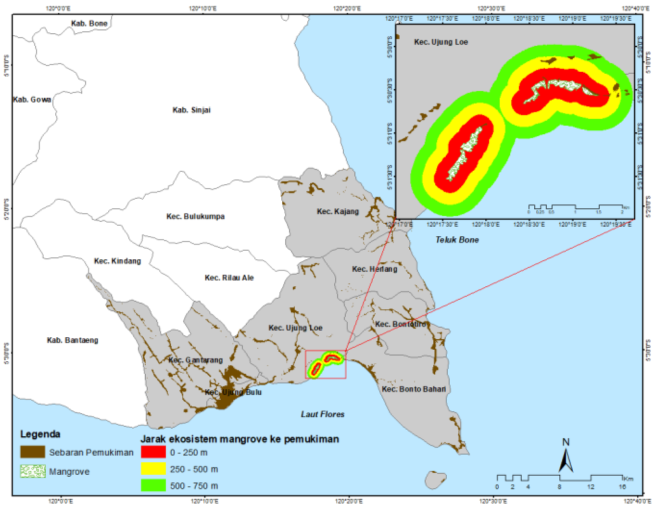
Nearly every coastal district in Bulukumba Regency has ports and docks, including two ports on the southern coast: Leppe'e Port in Ujung Bulu District and PPI Bira in Bonto Bahari District. Bira Port in Bonto Bahari District, Rakyat Para-Para Port in Bontotiro District, Bajange Pier in Herlang District, and PPI Kajang Kassi in Kajang District, all of which are situated on the eastern coast of Bulukumba Regency. Leppe'e Port and Bira Port are inter-regional crossing ports within the South Sulawesi Province, with cargo and passenger loading and unloading activities. Meanwhile, the other ports and docks function as fishing ports, where the local community engages in loading and unloading, processing, and marketing seafood products.

Based on field observations, there is a noticeable difference in environmental cleanliness between these two ferry ports. The environment around Leppe'e Port appears to be relatively clean, with regular waste disposal in the Bulukumba City area and waste collection points at the port serving as controls to prevent the spread and pollution of garbage in the port environment. In contrast, at several points in Bira Port, there is accumulated and scattered garbage in the port surroundings and waste in the port's basins. Meanwhile, for the fishing ports, namely PPI Kajang Kassi and Dermaga Bajange, inorganic waste, such as plastic ice packaging, plastic bags, and household waste, dominates the composition.



(a) (b)

Figure 4. Distance of ecosystem from harbor; (a) seagrass; (b) coral reefs



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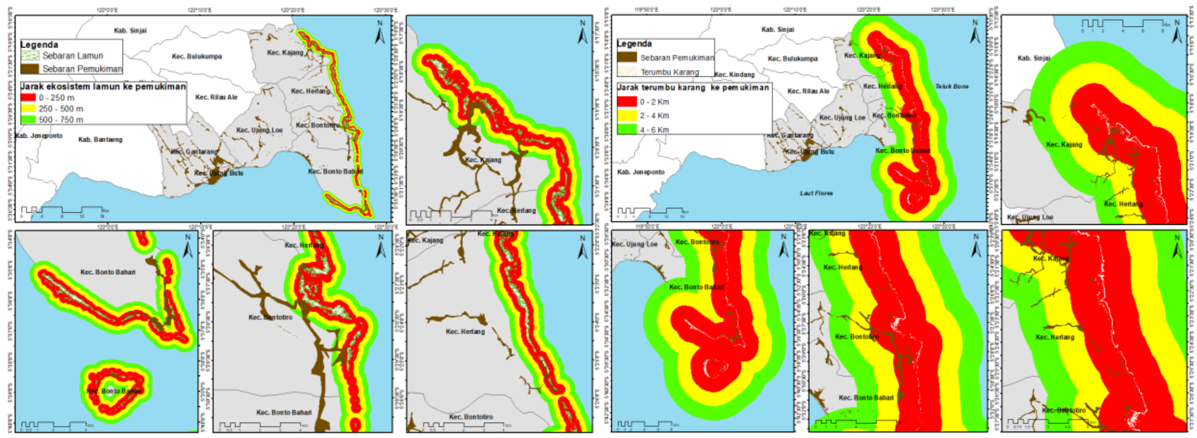


(b) (c)

Figure 5. Distance of ecosystem from settelements; (a) mangroves; (b) seagrass; (c) coral reefs

The presence of seagrass and coral reef ecosystems is within the range of 0-200 meters and 0-750 meters from the port/jetty. This proximity to the port (a potential source of pollution) indicates that both ecosystems are highly sensitive to trash pollution (Figure 4). The high level of activity and the proximity of both the ferry port and the fishing port in the coastal waters of Bulukumba Regency have significant potential to become a source of pollution for the coastal environment, including its ecosystems. Waste in the coastal environment, including its ecosystems. Waste in the port area and the harbor basins, whose dispersal cannot be controlled, will ultimately enter and pollute the coastal ecosystem. In addition, according to the report from the Department of Marine and Fisheries of South Sulawesi Province in 2022, functional facilities such as waste disposal sites are highly needed in the Kajang Kassi PPI area to control waste dispersion.

The district of Ujung Bulu serves as the epicenter of residential settlements. Sakti *et al.,* (2021) mentioned that the distribution of residential settlements is a crucial factor in modeling the distribution of unmanaged plastic waste on land, as the distribution of settlements represents the distribution of plastic consumers. During field observations conducted precisely on the coast of Bonto Bahari District, there were instances of improper behavior among coastal communities, where they disposed of household waste directly into the sea. Coastal communities' nonchalance in discarding their household waste stems from their belief that the currents will carry it away. Phelan *et al.,* (2020) also found this a common reason among coastal community groups in the Eastern Indonesian Islands who engage in activities contributing to marine waste. Factors such as knowledge, attitude, behavior, and public awareness can influence waste generation related to waste management practices (Saptenno *et al.,* 2022).

The presence of mangrove and seagrass ecosystems varies in distance; in some coastal areas, these ecosystems are within a range of 0-250 meters, making both ecosystems highly sensitive (Figure 5a and 5b). The coral reef ecosystem's distance coverage along the east coast of Bulukumba Regency is predominantly within 0-2 kilometers from human settlements, placing this distance range into the category of high sensitivity (Figure 5c). The distance between the coastline and residential housing, which is only about 1-2 meters apart, can pose both a threat and an opportunity for residents to dispose of waste directly into the sea. Additionally, most buildings near the coastline direct their sewage and sanitation pipes into the sea (Ramadan and Fajrianto, 2021).

The water clarity levels in Bulukumba Regency, in the area near the coastline and offshore, range from <3 meters to >6 meters (Figure 6). As water clarity decreases, the water quality also deteriorates. Water clarity is influenced by factors such as sedimentation and various materials present in the water.

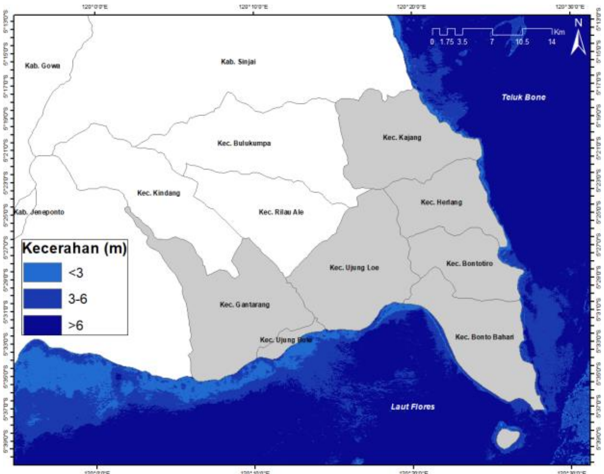
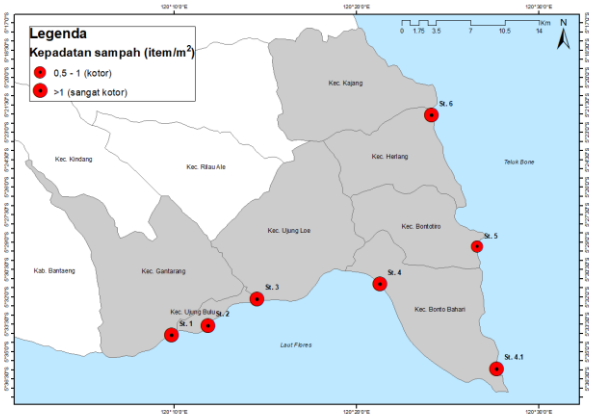


Figure 6. Brightness of the waters

The brightness near the coastal areas in the southern part ranges from 3-6 meters. It is identified that the brightness values are influenced by sedimentation due to the discharge of several major rivers into these waters. In contrast, the eastern coastal areas exhibit brightness values ranging from 3-6 meters near the shore. This relatively clear brightness level is conducive to the growth of biota within these waters, particularly supporting the photosynthesis process of aquatic plants. Consequently, the distribution of seagrass ecosystems and coral reefs is more abundant in the waters of the eastern coast.

Sampling of garbage was conducted at 7 location points, with 2 points in the Bonto Bahari Subdistrict, namely Station 4 and Station 4.1 (not included in the calculations). Garbage sampling was not carried out in the Kajang Subdistrict due to the difficulty in accessing coastal locations in that area. This aligns with the opinion of Opfer *et al.,* (2012) that surveys of marine garbage sampling locations should have characteristics such as sandy beaches, clear/easy access, a minimum coastline length of 100 meters, and no routine beach cleaning.



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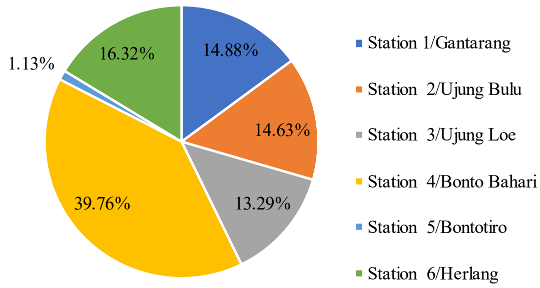

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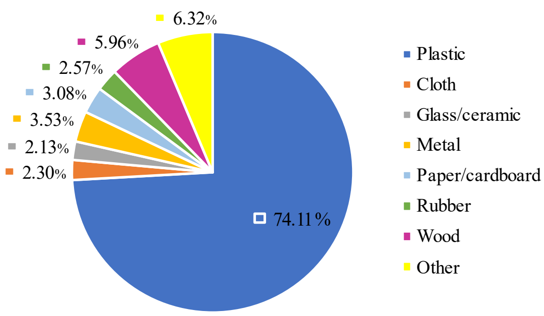


(c)

Figure 7. (a) waste density; (b) waste percentage; (c) waste composition percentage

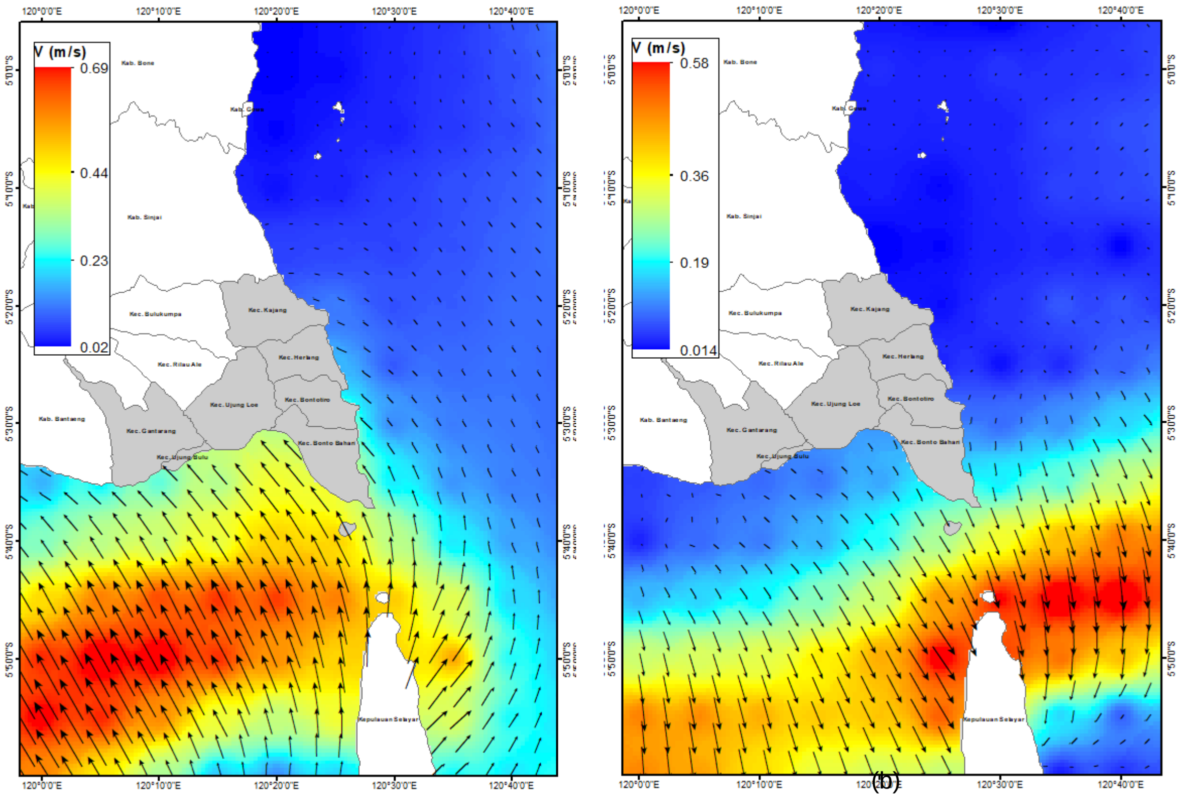
The cleanliness of the beaches in Bulukumba Regency, as assessed by the Coastal Clean Index (CCI), varies from dirty to very dirty, with the majority of the beaches being classified as very dirty (indicating a high presence of litter on the beaches) (Figure 7a). All beaches in Bulukumba Regency are categorized as highly sensitive to litter pollution.

The research results indicate that Bonto Bahari District has the highest percentage of waste at 39.76% (30.83 items/m^2), while Bontotiro District has the lowest at 1.13% (0.88 items/m^2), with other districts ranging between 13-16% (Figure 7b). Plastic, with a percentage of 74.11%, is the most commonly found waste material, followed by other materials, mainly food residues in sampling locations close to residential areas, at 6.32%. Wood accounts for 5.96%, and other materials comprise a small percentage ranging between 2% and <4% (Figure 7c). This signifies that coastal and marine environments are increasingly threatened by non-biodegradable plastic waste. According to NOAA (2015), research on marine debris worldwide has shown that plastic waste is the most common and abundant type in all bodies of water worldwide.

Furthermore, based on interviews with government officials from the Environmental and Forestry Office of Bulukumba Regency, it was revealed that regular waste collection, occurring three times a week, is only conducted in urban areas, specifically in Ujung Bulu Subdistrict and partially in Gantarang Subdistrict. In the remaining subdistricts, waste collection activities are absent. This lack of waste collection system control has resulted in the proliferation of waste pollution.

The current patterns observed at the research site during the east season range between 0.02-0.69 m/s, while during the west season, they range from 0.014-0.58 m/s (Figure 8). During the east season, the current flow towards the coast along the Bulukumba Regency shoreline in the Flores Sea indicates high current velocities moving towards the southern coast. In contrast, the currents in the eastern coast waters move slower towards the shoreline. During the west season, in both the southern and eastern coastal waters, the slower currents move offshore in a southeast and southern direction.

Based on the patterns of eastward current movements, the southern and eastern coasts can receive incoming debris carried by the ocean currents. This debris is estimated to originate from the Selayar Islands, located south of Bulukumba Regency (Figure 8a). Conversely, during the western monsoon season, the Selayar Islands can receive debris from Bulukumba Regency. The coastal currents in the south and east flow southeast and southward toward the coasts of the Selayar Islands (Figure 8b). However, the slow current velocity during the western monsoon season, which is less than 0.19 m/s, is not optimal for transporting debris to the Selayar Islands and the deposition of debris from the coast of Bulukumba. The sluggish current speed is believed insufficient for moving debris particles, leading to the continuous accumulation of debris on the coast following the tidal cycle. Additionally, the input of debris from the land also contributes to the coastal burden of debris accumulation.



(a) (b)

Figure 8. Velocity and pattern of currents; (a) east season; (b) west season

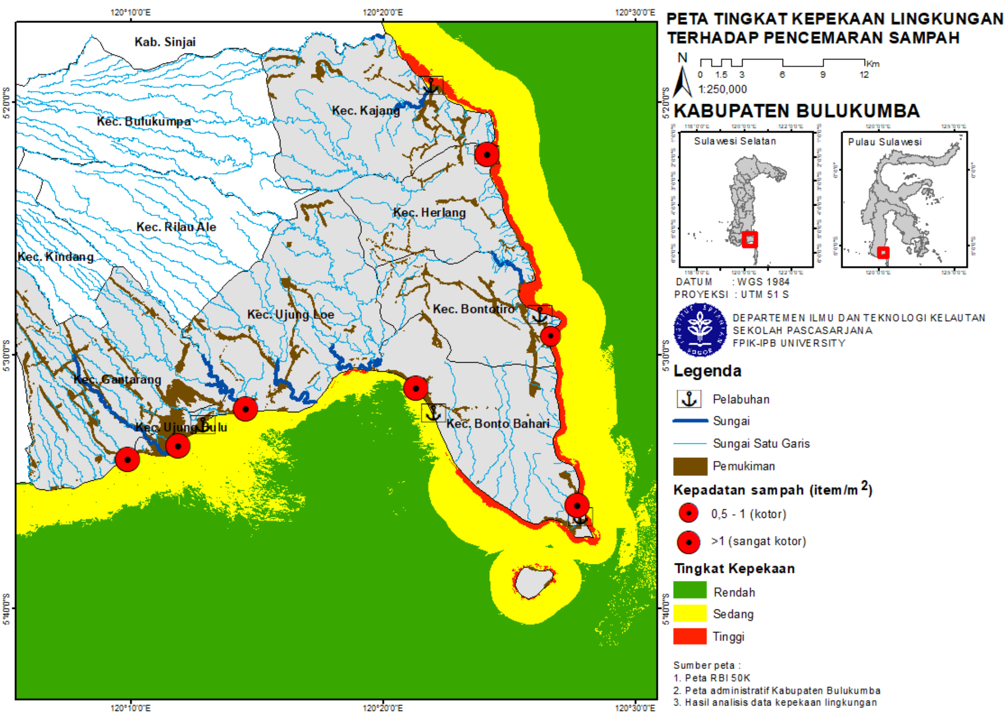


Figure 9. Map of coastal environmental sensitivity to waste pollution in Bulukumba Regency

3.3 Coastal environmental sensitivity level to waste pollution

The coastal environmental sensitivity assessment parameter results in a map of coastal environmental sensitivity to pollution from waste with a range of values from 6.3 to 285.1. The eastern coastal areas are more sensitive to waste pollution, particularly in the Bonto Bahari, Bontotiro, Herlang, and Kajang districts, compared to the southern coastal areas (Figure 9).

The East Coast areas have become more sensitive due to more complex and sensitive ecosystems, making this region more susceptible to the negative impacts of waste pollution.The varying levels of environmental sensitivity will result in different impacts and disadvantages in each research area, depending on the values of each sensitivity parameter. The assessment of environmental sensitivity is not solely based on waste accumulation but also depends on the causes of the presence of these objects. The presence of pollution sources (rivers, ports, and settlements) along with the existence of complex coastal ecosystems, as well as the proximity between the two, will contribute to a more significant impact on the environment.

4. Conclusion

The development of the analysis by applying weighting using the expert judgment method resulted in high percentage levels for five parameters: current velocity (20.27%), followed by the distance of the ecosystem from the port (18.92%), the distance of the ecosystem from residential areas (18.92%), the distance of the ecosystem from rivers (17.57%), and the presence of litter on the coast (17.57%). These five parameters are crucial for assessing the sensitivity of coastal environments to litter pollution.

The distribution of coastal environmental sensitivity to litter pollution in Bulukumba Regency indicates that the eastern coast is more sensitive to litter pollution than the southern coast. The parameter that exerts the most significant influence on coastal environmental sensitivity to litter pollution is the current velocity parameter, which holds the highest weight and score across the entire research area.

5. Recommendation

To determine variations in waste density between seasons, carrying out marine debris sampling during the east season is essential. This will help identify any differences in the regional sensitivity levels during different times of the year.

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