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Identification of Types and Abundance of Solid Waste in Pangkalan Jambi Village, Bengkalis Regency

Identifikasi Jenis dan Kelimpahan Limbah Padat di Desa Pangkalan Jambi Kabupaten Bengkalis

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ABSTRACT

Various human activities fulfill their welfare by producing food, drinks, and other goods which in turn can generate solid waste and liquid waste. Solid waste often contaminates residential areas, coastal mangroves, and the aquatic environment. In addition, the mangrove coast which is used as a tourist area can also receive solid waste as a result of local activities. This study aims to identify the type and abundance of solid waste in Pangkalan Jambi Village, Bengkalis Regency. This research was conducted in Pangkalan Jambi Village, Bukit Batu District, Bengkalis Regency. The method in this study is a survey method. Sampling technique using the quadrant transects method, each station was drawn as many as 5 transect, and each transect consisted of 5 plots with a quadrant plot size of 5 x 5 m^2. The data analyzed included identifying the amount of solid waste, calculating the abundance of solid waste, analyzing the differences in the type and abundance of solid waste between stations, and measuring environmental parameters. The results showed that the highest abundance of solid waste was obtained during the weekend at 3.15 units/m^2. The second highest was before the weekend at 2.53 units/m^2, and the lowest solid waste was obtained during the weekend at 2.36 units/m^2. Meanwhile, the highest weight of solid waste was found in the tourist area of the Mangrove Education Center (MEC), the second highest came from the community settlements of Pangkalan Jambi Village and the lowest was in the Mangrove Area of Pangkalan Jambi Village. The types of solid waste at the research location are plastic, metal, glass, rubber, wood, cloth, and others.

Keywords: Pangkalan Jambi Mangrove, Solid Waste, Quadrant Transect

ABSTRAK

Berbagai aktivitas manusia untuk memenuhi kesejahteraan hidupnya dengan memproduksi makanan, minuman dan barang lainnya yang pada akhirnya dapat menimbulkan limbah padat dan limbah cair. Limbah padat sering kali mencemari pemukiman warga, pesisir mangrove, maupun lingkungan perairan. Selain itu, pesisir mangrove yang dijadikan kawasan wisata juga dapat menerima limbah padat sebagai hasil dari aktivitas setempat. Penelitian ini bertujuan untuk mengidentifikasi jenis dan kelimpahan limbah padat di Desa Pangkalan Jambi Kabupaten Bengkalis. Penelitian ini dilakukan di Desa Pangkalan Jambi, Kecamatan Bukit Batu Kabupaten Bengkalis. Metode dalam penelitian ini adalah metode survei. Teknik Pengambilan sampel dengan metode transek kuadran, setiap stasiun ditarik sebanyak 5 (lima) transek, setiap transek terdiri atas 5 (plot) dengan ukuran petak kuadran 5 x 5 m^2. Data yang dianalisis meliputi identifikasi jumlah limbah padat, menghitung kelimpahan limbah padat, menganalisis perbedaan jenis dan kelimpahan limbah padat antar stasiun dan pengukuran parameter lingkungan. Hasil penelitian menunjukkan bahwa kelimpahan limbah padat yang paling tinggi didapatkan pada saat *weekend* sebesar 3,15 unit/m^2. Tertinggi kedua pada saat *before weekend* sebesar 2,53 unit/m^2, limbah padat terendah didapatkan pada waktu *after weekend* sebesar 2,36 unit/m^2. Sedangkan bobot limbah padat paling tinggi terdapat di kawasan wisata *Mangrove Education Center* (MEC), tertinggi kedua berasal dari pemukiman masyarakat Desa Pangkalan Jambi dan yang paing terendah di Kawasan Mangrove Desa Pangkalan Jambi. jenis limbah padat di lokasi penelitian berupa sampah plastik, logam/metal, kaca, karet, kayu, kain dan lainnya.

Kata Kunci: Mangrove Pangkalan Jambi, Limbah Padat, Transek Kuadran

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INTRODUCTION

Various human activities fulfill their welfare by producing food, drinks, and other goods which in turn can generate solid waste and liquid waste. Garbage in coastal areas is one of the complex problems faced by an area that is close to the beach or coast that has a river that flows into the sea. About 10% of all newly produced plastic will find its way into rivers and end up in the sea (Dewi, 2015). Marine debris consists of organic and anorganic materials that are solid and not easily decomposed which are discarded and accumulated and spread on the surface of the sea and beaches. Marine waste, especially anorganic (undegradable) type of waste, is a very important and interesting problem to study because the impact caused by this type of waste can threaten the survival and sustainability of biota in the waters (Ningsih *et al.*, 2020).

According to Susilawati (2022), a collection of several wastes is called waste. Waste is divided into 2 types, namely solid waste and liquid waste. Solid waste is waste that is solid and comes from the residue of domestic activities or industrial activities. Examples of solid waste, such as paper, iron filings, cloth, plastic, wood, rubber, and others. This solid waste often contaminates residential areas, coastal mangroves, and the aquatic environment. In addition, the mangrove coast which is used as a tourist area can also receive solid waste as a result of local activities.

Pangkalan Jambi Village, Bukit Batu District, Bengkalis Regency has one tourist destination based on mangrove education. Besides that, tourist areas and residential areas are also close to the oil industry, namely Pertamina and the port. As a result of mangrove tourism, the oil industry, residents' settlements, and ports can cause the remaining results of activities in the form of waste including solid waste. Various kinds of problems arise due to the existence of solid waste such as reducing the beauty of coastal areas, causing various kinds of diseases, affecting food networks, and reducing the productivity of fish caught. If this happens, it will have an impact on the food chain, economy, and public health in the area (Citasari & Nuril, 2012).

Information regarding the condition of solid waste in Pangkalan Jambi Village, Bengkalis Regency, has not been well documented, both in terms of the abundance of solid waste by type, as well as the amount and mass present in the area. Seeing the various kinds of problems that occur, it is important to conduct this research to identify the type and abundance of solid waste in the mangrove ecosystem area of Pangkalan Jambi Village, Bengkalis Regency.

MATERIALS AND METHOD

Time and place

This research was conducted in the Pangkalan Jambi Village, Bukit Batu District, Bengkalis Regency with the implementation time in January 2023.

Determination of Research Stations

Determining the research location first checks the tide schedule, this is following the opinion of Opfer *et al.* (2012), that the high and low water levels (tides) that occur will affect the volume or amount of solid waste contained in a coastal area. Sampling locations consist of 3 (three) stations. Station 1 is located in the residential area of the Pangkalan Jambi Village community with coordinate points (Latitude: 1.295635º and Longitude: 102.148616º). Station 2 is located in the tourist area of the Mangrove Education Center (MEC) with coordinates (Latitude: 1.289665º and Longitude: 102.149692º). Station 3 is located in the mangrove area of Pangkalan Jambi Village with coordinate points (Latitude: 1.277467º and Longitude: 102.150831º).

Collection of Solid Waste Data

The process of data collection is done by determining the research area along 100 m. Then divided the area with a length of 20 m each so that there are 5 transects. Then on each transect, a plot with a size of 5x5 m^2 was made (Figure 1). Then all the solid waste contained in the plot is taken, and put in sacks/trash back. Next, perform the characteristics of the types of solid waste based on classification by NOAA (2015). After carrying out the characteristics of the type of solid waste, then the amount of solid waste is calculated and then the solid waste is weighed using a scale.

Figure 1. Transect data collection

Solid waste that has been weighed by mass is then entered at the stage of calculating the amount of mass (M) from each station and the abundance (K) of waste with the formula:

$$\text{Mass (m)} = \frac{\text{Total weight of solid waste(g)}}{\text{plot length (m)x plot width (m)}}$$

$$\text{Abundance (K)} = \frac{\text{Total solid waste per type}}{\text{plot length (m)x plot width (m)}}$$

RESULT AND DISCUSSION

Research Location

The research location is located in Bengkalis Regency on the east coast of Sumatra Island which is in the position 100º57'57.6"- 102º30'25.2" East Longitude and 2º7'37.2"-0º55'33.6" North Latitude to be precise in the village of Pangkalan Jambi. Pangkalan Jambi Village has an area of around 20.30 hectares with a population of around 1,271 people. Pangkalan Jambi Village has located about 20 km from the capital city of Bengkalis, close to residential areas, fishing activities, as well as port and industrial activities (Figure 2).

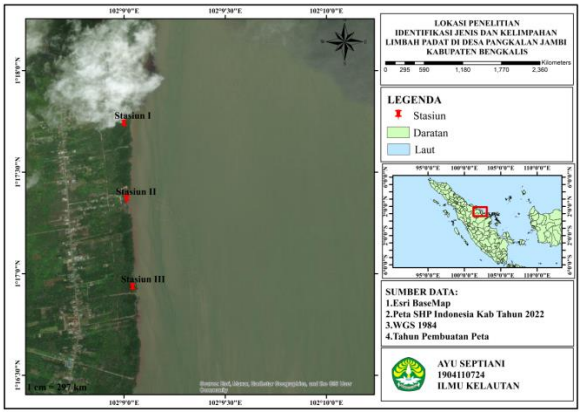

Figure 2. Research location

Station 1 is located in a residential area of residents. At station 2 is the Mangrove Education Center (MEC) Tourism Area of Pangkalan Jambi Village, the area is used as a tourist spot and a place for local product and culinary development. At station 3, namely the Mangrove Area of Pangkalan Jambi Village, in that area, there is a mangrove ecosystem which is one of the coastal ecosystems that is rarely touched by humans or rarely occurs anthropogenic activity so it is still maintained and natural.

Type, Amount, and Mass of Solid Waste

Based on the identification results that were carried out at stations I, II, and III, a total of 796 units of solid waste were obtained with 8 different types of solid waste (Table 1).

Based on the results of research conducted at three stations, during Before Weekend the first highest producer of solid waste was the community settlement of Pangkalan Jambi Village with a total of 110 units, the second highest producer of solid waste was the tourist area of the Mangrove Education Center (MEC) with a total of 89 units, while the producer of solid waste The lowest density is the mangrove area of Pangkalan Jambi Village, which totals 38 units. Meanwhile, during the weekend the Mangrove Education Center (MEC) tourism

area was the highest producer of solid waste with a total of 223 units, the second highest producer of solid waste was the community settlement of Pangkalan Jambi Village with a total of 66 units, and the lowest producer of solid waste was the mangrove area of Pangkalan Jambi Village a total of 34 units. Also, during the after weekend the Mangrove Education Center (MEC) tourism area was still the highest producer of solid waste with a total of 131 units, the second highest producer of solid waste was the residential community of Pangkalan Jambi Village with a total of 79 units, and the lowest producer of solid waste was the mangrove area of the Pangkalan Jambi Village which totals 26 units.

Table 1. The amount and type of solid waste at Stations I, II, and III

Type	Total solid waste (Unit)											
	Before Weekend				*Weekend*				*AfterWeekend*			
	1	2	3	average	1	2	3	average	1	2	3	average
Plastic	67	64	25	52	48	185	16	83	68	111	16	65
Metal	15	7	-	7	8	6	-	5	7	5	-	4
Paper	4	1	-	2	4	5	-	3	3	2	-	2
Glass	3	-	1	1	2	4	-	2	-	1	-	0
Rubber	7	-	2	3	1	-	3	1	-	-	2	0
Wood	6	7	9	7	-	5	10	5	-	1	6	2
Cloth	4	2	1	2	-	4	4	3	-	-	2	0
Other	4	8	-	4	3	14	1	6	1	11	-	4
Total	110	89	38	78	66	223	34	108	79	131	26	77

Note: Station 1: Pangkalan Jambi Village Community Settlements; Station 2: Tourism Area Mangrove Education Center (MEC) Pangkalan Jambi Village; Station 3: Mangrove Area of Pangkalan Jambi Village

Table 2. Mass of Solid Waste at Stations I, II, and III

Type	Solid waste mass (g)											
	Before Weekend				*Weekend*				*After Weekend*			
	1	2	3	average	1	2	3	average	1	2	3	average
Plastic	1.362	1.882	1.037	1.427	1.774	12.025	590	4.796	2.001	4.631	781	2.471
Metal	331	414	-	248	410	217	-	209	402	156	-	186
Paper	201	49	-	83	47	130	-	59	30	22	-	17
Glass	831	-	37	289	460	657	-	372	-	50	-	17
Rubber	371	-	90	154	43	-	206	42	-	-	70	23
Wood	511	2.413	567	1.164	-	1.084	1.271	785	-	50	320	123
Cloth	446	244	50	247	-	192	221	138	-	-	63	21
Other	313	568	-	294	60	622	133	272	17	296	-	104
Total	4.366	5.570	1.781	3.906	2.794	14.927	2.421	6.673	2.450	5.205	1.234	2.962

Note: Station 1: Pangkalan Jambi Village Community Settlements; Station 2: Tourism Area Mangrove Education Center (MEC) Pangkalan Jambi Village; Station 3: Mangrove Area of Pangkalan Jambi Village

Table 2 shows that the total weight of the solid waste that has been collected is 40.748 kg. The total solid waste is obtained from the accumulated total weight of the three stations before the weekend, the weekend, and after. It can be seen in Table 4, before the weekend the highest weight of solid waste was found in the Mangrove Education Center (MEC) Tourism Area of 5,570 kg. The second highest solid waste weight came from the Pangkalan Jambi Village community settlement of 4.366 kg. Then the weight of solid waste with the lowest amount was found in the Mangrove Area of Pangkalan Jambi Village, which was 1.781 kg. At the weekend the Mangrove Education Center (MEC) Tourism Area is also the location that produces the highest solid waste weight, which is 14.927 kg. The second-highest solid waste weight came from the Pangkalan Jambi Village Community Settlement at 2.794 kg. Then the weight of solid waste with the lowest amount was also found in the Mangrove Area of Pangkalan Jambi Village which produced a solid waste weight of 2.421 kg. During the after weekend, the Mangrove Education Center (MEC) Tourism Area is also the location that produces the highest solid waste weight, which is 5.025 kg. The second highest solid waste weight also came from the Pangkalan Jambi Village community settlement of 2,450 kg. Then the weight of solid waste with the lowest amount was also found in the mangrove area of Pangkalan Jambi Village which produced a solid waste weight of 1.234 kg.

The amount and amount of solid waste spatially and its accumulation are influenced by several factors such as hydrography, geomorphology, wind, and anthropogenic activities (Barnes *et al.*, 2009; Ramirez *et al.*, 2013). In addition, the presence of solid waste is also thought to be caused by tourism activities, residential areas, industry, and ports that are close to the coast (Hardesty *et al.*, 2016; Fitria *et al.*, 2019). Based on the results of the data in Tables 1 and 2, the Pangkalan Jambi Village community settlement is station 1 where the solid waste in the area is caused by the presence of residents' settlements. The lack of public awareness of the impact of littering causes the disposal of household waste and also fishermen's waste, such as nets, hooks, and

others, to enter the ocean waters with the ocean currents. At station 2 is the Mangrove Education Center (MEC) Tourism Area of Pangkalan Jambi Village, the area is used as a tourist spot and a place for developing local products and culinary delights, where solid waste comes from the large number of visitors who travel to the area and are not responsible for disposing of waste carelessly. The types of waste that visitors generally throw away include plastic bags, food wrappers, drink bottles, cigarette butts, and others. Thus causing solid waste from the waste. At station 3, namely the Mangrove Area of Pangkalan Jambi Village, in that area, there is a mangrove ecosystem which is one of the coastal ecosystems that is rarely touched by humans or rarely occurs anthropogenic activity. It can be seen from the previous description that the ecosystem of the mangrove area of the Jambi base village is still natural and well-maintained.

Based on the results of the data presented in Table 1, plastic waste is the most common type of solid waste, with 600 units or 75% of all types of waste found. Then followed by the type of solid waste metal/metal (48 units or 6%), wood (44 units or 6%), which cannot be classified (42 units or 5%), paper (19 units or 3%), cloth (17 units or 2%), rubber (15 units or 2%), and the least glass-type solid waste found, namely 11 units or equal to 1%. can be seen in Figure 2.

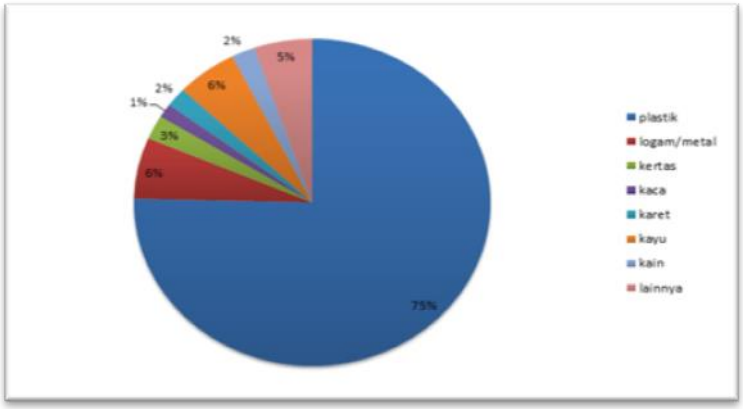

Figure 2. Percentage of solid waste in Pangkalan Jambi Village Area

Solid Waste Abundance

The abundance of solid waste based on the time of collection can be seen in Table 3.

Table 3. The abundance of solid waste before, weekend, and after the weekend

Type	Abundance (Unit/M^2)		
	Before Weekend	*Weekend*	*After Weekend*
Plastic	1,56	2,39	1,95
Metal	0,36	0,14	0,12
Paper	0,05	0,09	0,05
Glass	0,05	0,06	0,01
Rubber	0,09	0,04	0,02
Wood	0,23	0,15	0,07
Cloth	0,07	0,08	0,02
Other	0,12	0,2	0,12
Total	2,53	3,15	2,36

Based on Table 3, research conducted in January 2023 the results of the abundance of solid waste during the before, weekend, and after weekends were 8.04 units/m^2. The highest abundance of solid waste was obtained during the weekend at 3.15 units/m^2. The second highest abundance of solid waste was before the weekend at 2.53 units/m^2, while the lowest abundance of solid waste was obtained after the weekend at 2.36 units/m^2.

This is supported by research by Aditya *et al.* (2019) which states that weekend waste production is higher than before weekend and after the weekend. The high amount of solid waste abundance during the Weekend is thought to be caused by a large number of human activities during the Weekend than the activities before and after the weekend. The existence of cleaning staff and garbage collection on weekends can also be expected to affect the amount of solid waste before and after the weekend.

The main cause of the entry of solid waste into the aquatic environment is thought to be caused by the large number of human activities that produce waste. According to Aditya *et al.* (2019), it is estimated that 60-

80% of solid waste originating from activities on land enters the marine/water environment through run-off flows, while activities carried out at sea such as fishing, sea transportation routes, and tourism can also contribute to waste causing solid waste.

CONCLUSION

Based on the results of the research, the solid waste found was a type of plastic, metal/metal, paper, glass, rubber, wood, cloth, and others. Solid waste in the form of plastic is the most common type of solid waste (75%) and the least found is glass solid waste (1%). The abundance of solid waste at the weekend is higher than before and after the weekend. The high amount of solid waste abundance during the weekend is thought to be caused by a large number of human activities during the Weekend than the activities before and after the weekend. The abundance of solid waste between stations was not significantly different

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