Asian Journal of Aquatic Sciences, April 2024. Vol 7, Issue (1) 26-32
e-issn: 2716-4608
p-issn: 2655-366X

INPUT OF DOMESTIC WASTE IN THE ESTUARY OF DUMAI RIVER AND MESJID RIVER INTO THE RUPAT STRAIT WATERS

Anggie Sukma Dewi[1*], Syahril Nedi[1], Bintal Amin[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine,
Universitas Riau, Pekanbaru, 28293 Indonesia
*anggie.sukma0430@student.unri.ac.id

ABSTRACT

The study was conducted in December 2022 in the Dumai River Estuary and Dumai City Mesjid River Estuary, Riau Province. The purpose of this study is to determine the amount and type of garbage that enters the sea through the estuary of the Dumai River and the Mesjid River, the difference between the amount and type of waste, and the difference between days from the garbage contained in the estuary of the Dumai River and the Mesjid River in Dumai City. The research method used is a direct survey method in the field, where data collection is carried out directly at low tide using a net stretched at the mouth of the river so that garbage is collected and trapped following the river's flow into the net. Based on the research conducted, it was found that the types of waste trapped were plastic, foamy plastic, cloth, paper, rubber, and wood. The amount of input and composition of waste in two weeks to the mouth of the Dumai River was 28,26 kg in the first week and 30,64 kg in the second week, while in the estuary of the Mesjid River, it was less, namely the first week as much as 20,59 kg, and in the second week as much as 19,44 kg. The difference between the amount and type of waste contained in the Dumai River and the Mesjid River for two weeks found that plastic waste occupied the most significant amount, namely 30,43 kg with a composition of 51,55% and 49,71 kg with a composition of 49,71% based on total waste input. The difference in waste input based on the day at the mouth of the Dumai River and the highest Mesjid River is found on Sunday, namely at the mouth of the Dumai River with a total waste of 27,79 kg and at the mouth of the Mesjid River with a total of 16,67 kg.

Keywords: Garbage, Dumai River, Mesjid River, Dumai, Rupat Strait

1. INTRODUCTION

Dumai is a city in Riau Province located on the East Coast of Sumatra facing the Strait of Malacca which is one of the busiest service routes in the world and is a hinterland region within the Indonesia-Malaysia-Singapore growth triangle (IMS-GT) and Indonesia-Malaysia-Thailand triangle area (IMT-GT). The economic growth of Dumai City is not only from the industrial sector but also in the fields of services and tourism, trade and foreign crossings, etc. Dumai City has several rivers, including the Dumai Mesjid River. High economic growth can lead to an increase in the amount of litter produced from various sources. Litters that are not appropriately treated can enter rivers with various natural and human factors and be carried by currents and waves to estuaries and marine waters, affecting aquatic ecosystems.

Waste is a big problem not only in Indonesia but throughout the world. Garbage is a solid waste of organic and inorganic materials that are no longer valid and must be managed to protect development investments and endanger the environment[1]. The waters of the Mesjid River and Dumai River are places where

Received : 16 January 2024
Accepted : 4 March 2024

various human activities take place in fulfilling life, such as ports, settlements, trade, transportation channels, fisheries, etc. The utilization of rivers for multiple activities from time to time continues to increase. Therefore, the increase in river use has impacted decreasing water quality. In addition, the development of Dumai City, especially around the riverbanks, has negatively impacted waters. This encourages growth in the land area, which is marked by increased residential development, infrastructure development, plantations, and small industries supporting major industrial activities.

Coastal and marine pollution is increasing with the entry of remnants of human activities, and marine nature receives materials carried by water from agricultural areas, household waste, garbage, and waste materials from ships, offshore oil spills, and many more materials that are wasted into the sea[2]. The entry of garbage into river and estuary waters will disrupt the environment's aesthetics and beauty and reduce the water's quality.

The continuous decline in the quality of river and estuary waters will hurt communities around river and estuarine waters and disrupt ecosystem stability. In addition, the input of garbage entering from the river into the mouth of the river also affects the damage to the estuary ecosystem. Seeing the various kinds of problems that occur, this research is essential to know the input of waste entering from the river to the mouth of the Dumai River and the estuary of the Mesjid River, as well as the amount and type of waste produced in the two estuaries.

2. RESEARCH METHOD

Time and Place

The study was conducted in December 2022 at the Dumai River Estuary and Dumai City Mesjid River Estuary, Riau Province (Figure 1). Data processing and analysis is carried out at the Chemical Oceanography Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine, Universitas Riau.

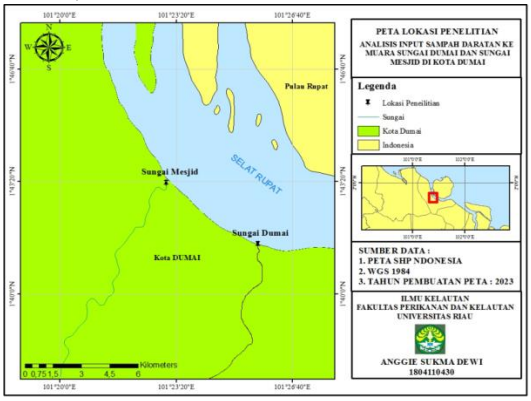

Figure 1. Research Location Map

Research methods

This research was conducted using the method survey, where data was collected directly at the mouth of the Dumai River and the Mesjid River at low tide using nets stretched so that rubbish was collected and trapped following the river flow into the net. Primary data was obtained from directly trapped waste samples into the net, while secondary data refers to existing literature, then analyzed and discussed descriptively.

Research procedure

The rubbish that was identified was found floating at the mouth of the river and was collected using a net stretched horizontally on the side of the river for six hours at low tide[3]. The net area used is 5 x 2 m mesh size 2 cm, and the waste taken is waste with a size of more than 2 cm. Data was collected six times on Thursday, Sunday, and Tuesday in two weeks. The trapped samples are expected to provide an initial picture of the type and amount of waste in the Dumai and Mesjid Rivers.

All trapped garbage is netted in each estuary for six hours, then collected into trash bags according to the estuary, and then the waste is weighed to get the overall weight of each estuary. Then, it was sorted by type, weighed individually, and recorded. The collected garbage is identified using a datasheet from UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter[4]. The datasheet

categorizes floating waste into eight categories: plastic, foam, fabric, glass and ceramics, metal, paper and cardboard, and wood. Each category is divided into sub-categories according to the form of waste in the field[5].

Data Analysis

The data obtained from the results of the study were analyzed using data sheets from UNEP / IOC Guidelines on Survey and Monitoring of Marine Litter, then analyzed using the composition formula of each type of litter according to SNI 19-3964-1994 and a T-test was carried out to determine the comparison of the amount of waste found in the Dumai River and the Mesjid River, and the ANOVA test to determine the comparison between garbage based on the day in the Dumai River and the Mesjid River. To calculate the composition of litters from each type of litters according to SNI[6] as follows:

$$\text{The composition of the litter (\%)} = \frac{\text{Weight of sorted waste components (kg)}}{\text{Total weight of waste (kg)}}$$

As for determining the proportion using the formula:

$$\text{Proportion} = \frac{X}{N} \text{ x } 100\%$$

Remarks:
X = Number of proportion items
N = Number of all items

3. RESULT AND DISCUSSION

Types of Trash Found

The types of waste found at the mouth of the Dumai River and the Mesjid River are shown in Table 1.

Table 1. Types of Waste Found

Category	Type
Plastic	Bottle caps, plastic bottles, bottled beverage cups, food containers, plastic bags, straws, fishing nets, plastic ropes, food wrappers and detergents,
Foamed plastic	Food container, fruit wrapper, cooling box, foam sponge, float
Cloth	Pants, shirts, pieces of cloth, sacks
Paper	Beverage containers, cigarette packs, food boxes
Roober	Sandals/footwear, inner tube, rubber band
Wood	Skewers, ice cream sticks, wooden twigs

Based on Table 1, it is found that the plastic category has the highest type compared to the other seven categories. Most of these types of waste are single-use plastic packaging that most consumers choose because of their ease of use. Communities around the Dumai River and Mesjid River use more plastic packaging, such as drinking water, plastic bags, and food packaging. These three products are part of the single-use plastic.

The amount and type of plastic waste found are influenced by community activities around the river and poor waste management, so it becomes a source of waste in the river. Community activities contributing to river waste are transportation routes, ports, fisheries, home industries, markets, housing, etc[7]. Arifin[8] stated that waste from residents' activities thrown into rivers is one of the sources of waste in the ocean.

Amount and Composition of Waste at the Dumai River Estuary

The research results found that the amount of waste entering the Dumai River estuary was 28,26 kg in the first week and 30,64 kg in the second week. Plastic is the dominant type of waste entering the river mouth, namely 14,63 kg in the first week and 15,8 kg in the second week. A different kind of waste obtained is foamed plastic, cloth, paper, rubber, and wood (Figure 1).

A comparison of the amount of each waste based on type in the first week and the second week shows that Based on the results above, it was found that the majority of waste was plastic; it is suspected that this plastic came from human waste that was

intentionally or unintentionally thrown away or left around river banks, namely 14,63 kg in the first week, and 15,8 kg in the second week. Subekti in Derraik[9] stated that in the rainy season, rubbish will enter water bodies so that river water discharge increases. This condition results in the rubbish being washed away, and rubbish that is washed away will be carried towards the river. The high presence of plastic waste is that it is used in almost all human activities, and its persistence lasts for a long time in the marine environment. Furthermore, if we look at the day the net was dismantled, we can compare the amount of waste in Figure 3.

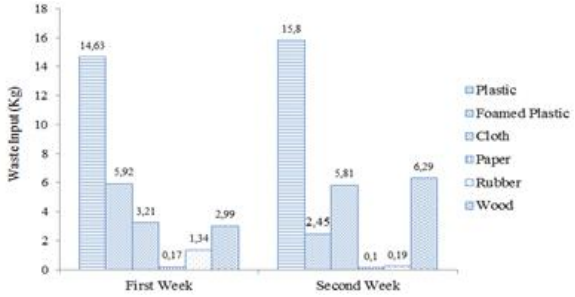

Figure 2. First and Second Week Waste in the Dumai River Estuary

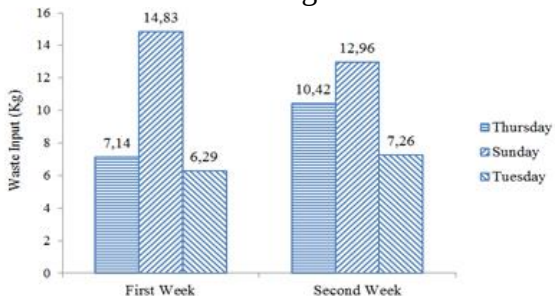

Figure 3. Amount of Waste Input Based on Time Sampling

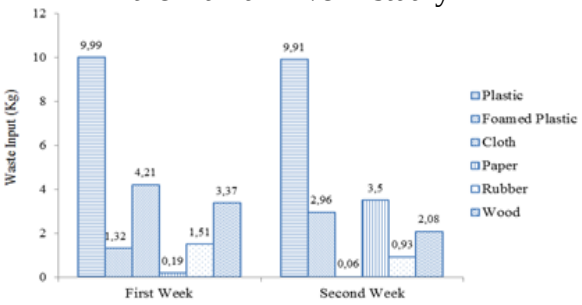

Figure 4. Waste Input First and Second at the Mouth of the Mesjid River

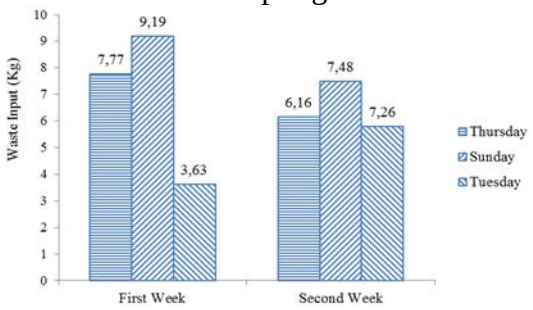

Figure 5. Amount of Solid Waste Based on Sampling Time

Figure 3, the comparison of the amount of trash netted at the river mouth based on the day the garbage was collected is clear. The highest amount of waste input into the Dumai River estuary occurred on Sunday, namely 14,83 kg in the first week and 12,96 kg in the second week. The amount and type of plastic waste found at the mouth of the Dumai River is influenced by community activities around the river and poor waste management, so it becomes a source of waste in the river.

Furthermore, obtained from the composition of waste at the mouth of the Dumai River, plastic waste was the most frequently found in the first week, with a proportion of 63.45% on Thursday, 40,26% on Sunday, and 65,66% on Tuesday. The type of waste that occupies the second largest proportion is 33,47% on Thursday, 10,32% on Sunday, and 31,78% on Tuesday. Furthermore, the composition of waste at the mouth of the Dumai River in the second week showed that the most significant type of waste was found, namely plastic, with a proportion of 44,91% on Thursday, 54,4% on Sunday, and 56,06% on Tuesday. The least amount of waste found was paper and rubber, namely 0% on Thursday, 0,62% and 0,85% on Sunday, and 0,28% and 1,1% on Tuesday.

Amount and Composition of Waste at the Mouth of the Mesjid River

From the results obtained, it is known that the amount of waste that occurred in the first week was 20,59 kg, and in the second week, it was 19,44 kg. Plastic was the most significant type of waste obtained, weighing 9,99 kg in the first week and 9,91 kg in the second week. The kind of rubbish caught at the mouth of the Mesjid River is

the same as that witnessed at the mouth of the Dumai River, namely plastic, foamed plastic, cloth, paper, rubber, and wood (Figure 4).

Based on Figure 4, you can see the comparison of the amount of each waste based on its type in the first week and the second week at the mouth of the Mesjid River. From Figure 5, it is clear that the comparison of the amount of rubbish caught at the river mouth based on the day of rubbish collection is clear. The most waste was found on Sunday, 9,19 kg in the first week and 7,48 kg in the second week.

The high level of plastic waste is because residents around the research location discard this material, or it could also come from waste thrown away by residents who live around the research location and come from upstream rivers. Considering that the research location is close to residential areas. This type of waste has a low density, so it floats in water and is usually easily carried by sea currents. This physical and oceanographic phenomenon will significantly influence the amount of rubbish that washes up on beaches[10].

From the results obtained, the waste composition at the mouth of the Mesjid River is known. The type of waste with the highest proportion in the first week was plastic waste, with 39,77% on Thursday, 55,5% on Sunday, and 49,59% on Tuesday. Then type the least amount of garbage found was paper on Thursdays and Sundays with proportions of 0,64% and 0,65%. Furthermore, in the second week, the most common type of waste found was still plastic waste, namely 41,23% on Thursday, 58,16% on Sunday, and 52,07% on Tuesday. Most waste is foamed plastic: 24,84% on Thursday, 1,07% on Sunday, and 23,28% on Tuesday. The most minor type of waste found in the second week was cloth on Thursday, with a proportion of 0,8%.

Differences in the Amount of Waste Input from the Dumai River and the Mesjid River

Table 2, it was found that the highest waste input entering the mouth of the Dumai River and the Mesjid River was on Sunday, namely at the mouth of the Dumai River with a total of 27,79 kg of waste and at the mouth of the Mesjid River with a total of 16,67 kg.

Table 2. Difference between Days in the Dumai River and the Mesjid River (kg)

	Dumai River Estuary				Mesjid River Estuary			
Week	Thursday	Sunday	Tuesday	Total	Thursday	Sunday	Tuesday	Total
I	7,14	14,83	6,29	28,26	7,77	9,19	3,63	20,59
II	10,42	12,96	7,26	30,64	6,16	7,48	5,8	19,44
Total	17,56	27,79	13,55	58,9	13,93	16,67	9,43	40,03

From the research that has been carried out, the overall amount of rubbish trapped in nets for two weeks at the mouth of the Dumai River and the Mesjid River can be seen in Table 3.

Table 3. Total Waste Input from the Dumai River and the Mesjid River

Type of Waste	Dumai River Estuary		Estuary of Mesjid River	
	Total rubbish (kg)	Proportion (%)	Total rubbish (kg)	Proportion (%)
Plastic	30,43	51,55	19,9	49,71
Foamed Plastic	8,37	14,21	4,28	10,7
Cloth	9,02	15,31	4,27	10,67
Paper	0,27	0,46	3,69	9,22
Rubber	1,53	2,6	2,44	6,1
Wood	9,28	15,76	5,45	13,6
Total	58,9	100	40,03	100

Based on Table 3, the amount of waste input in two weeks to the mouth of the Dumai River was 58,9 kg, while at the mouth of the Mesjid River, it was less, namely 40,03 kg. These results show a difference of 18,87 kg of waste entering the mouth of the Dumai River and the Mesjid River in two weeks. The total waste was obtained for two weeks: Thursday, Thursday, Sunday, and Tuesday.

Thus, the weekly average is 29,45 kg; if calculated monthly, the figure is 117,8 kg. This means the amount of rubbish entering the Dumai sea via the Dumai River is 117,8 kg. Meanwhile, at the Mesjid River, the average per week was 20,02 kg; if calculated monthly, the figure was 80,06 kg. It is estimated that the rubbish into that enter sea is 37,74 kg from these two rivers. This can substantially negatively impact the life of organisms in Dumai's marine waters. Therefore, it is necessary to carry out prevention through effective waste management policies from the government, such as programs for waste banks with the implementation of EPR (Extended Producer Responsibility) and education to the community in the form of 3R activities to reduce reuse. The cycle needs to be implemented.

Differences between Sampling Locations

The amount of waste input at the mouth of the Dumai River is more significant than at the mouth of the Mesjid River because almost all of the Dumai River is a densely populated residential area. Waste discharge from anthropogenic communities is linked to the number of residents living on the riverbanks from data on the number of West Dumai sub-districts. According to Mongtoeun et al.[11], a larger population will produce more plastic waste. Still, the amount of plastic waste in the water is influenced by various other factors, namely the type of waste management, city location, dams and waste traps, seasons and seasonal river discharge, and flood events[12].

Based on the amount, plastic waste occupies the most significant position. Communities around the Dumai River and Mesjid River use more plastic packaging, such as drinking water, plastic bags, and food packaging. These three products are part of the single-use plastic group, also known as single-use plastic. Ryan et al.[13] mentioned that along with the demands of modern life that are all practical, the use of single-use plastic products is expected to increase every year. Hence, it is necessary to issue policies to reduce single-use plastic consumption.

Most people pay less attention to environmental cleanliness, and this habit causes piles of garbage and problems in the environment, such as the climate becoming unclean and rivers becoming dirty due to piles of garbage[14.] The residents around the Dumai River have a variety of locations for garbage disposal, so the trash is thrown in various places and carried by the current into the river. The differences and many ways of waste processing affect the amount of plastic waste that enters the waters and becomes an essential source in certain areas.

4. CONCLUSION

Based on research conducted at the mouth of the Dumai River and the mouth of the Mesjid River in Dumai City, Riau Province, it was found that the types of litter trapped in nets were plastic, foamed plastic, cloth, paper, rubber, and wood. It was found that the amount of input and composition of litter in two weeks to the mouth of the Dumai River was 28.26 kg in the first week and 30.64 kg in the second week, while at the mouth of the Mesjid River, it was less, namely in the first week as much as 20.59 kg, and in the second week as much as 19.44 kg. The difference between the amount and type of litter in the Dumai River and the Mesjid River last night for two weeks, it was found that plastic litter occupied the most significant amount, namely 30.43 kg with a composition of 51.55% and 49.71 kg with a composition of 49.71% based on total litters input. The difference in litter input based on

the day at the mouth of the Dumai River and the Mesjid River is the highest amount of rubbish found on Sunday, namely at the mouth of the Dumai River with a total of 27.79 kg of litter and at the mouth of the Mesjid River with a total of 16.67 kg.

REFERENCES

1. Anggraini, D., Pertiwi, M.B., Bahrin, D. Pengaruh Jenis Sampah, Komposisi Masukan dan Waktu Tinggal terhadap Komposisi Biogas dari Sampah Organik. *Teknik Kimia,* 2012; 18(1), 17–23.
2. Elyazar, N., Mahendra, M.S., Wardi, I.N. Dampak Aktivitas Masyarakat terhadap Tingkat Pencemaran Air Laut di Pantai Kuta Kabupaten Badung serta Upaya Pelestarian Lingkungan. *Ecotrophic: Jurnal Ilmu Lingkungan,* 2007; 2(1): 1-18.
3. Riskiana, R., Effendi, H., Wardiatno, Y. Abundance and composition of plastic waste in the Baturusa Watershed, Bangka Belitung Islands Province. *Journal of Natural Resources and Environmental Management.* 2020; 10(4): 650-659.
4. Cheshire, A., Adler, E., Barbière, J., Cohen, Y. *UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter.* UNEP Regional Seas Reports and Studies, No. 186; IOC Technical Series. 2009.
5. Agustina, S., Nuraini, S.P., Purnawan, S., Siregar, E.E.W. Initial Identification of Inorganic Floating Waste at The Mouth of The Krueng Aceh River, Banda Aceh City. *Depik,*, 2020; 9(1): 131-140.
6. [SNI] Standar Nasional Indonesia. 19-3964-1994. *Metode Pengambilan dan Pengukuran Contoh Timbulan dan Komposisi Sampah Perkotaan.* Badan Standarisasi Nasional.
7. Hadi, I., Suhendrayatna, S., Muchlisin, Z.A. Water Quality Status and Heavy Metal Content in Water and Sediment in the Krueng Aceh Estuary, Banda Aceh City. *Depik,* 2018; 7(2): 91-99.
8. Arifin, M.Z. Dampak Sampah Plastik bagi Ekosistme Laut. *Matric Bulletin,* 2017; 14(1): 44-48.
9. Derraik, J.G.B. The Pollution of the Marine Environment by Plastic Debris: A Review. *Marine Pollution Bulletin,* 2002; 44(9) :842-52.
10. Yusra, Y., Erlini, R. Komposisi dan Kepadatan Sampah Laut (Marine Debris) Pantai Purus, Kota Padang. *Jurnal Katalisator,* 2021; 6(1): 100-109.
11. Mongtoeun, Y., Fujiwara, T., Vin, S. Household Solid Litters Generation and Socioeconomic Factors in the Capital City of Cambodia. *International Journal of Environmental Sciences and Natural Resources*, 2019; 20(1): 1-4.
12. Calcar, C.J., Emmerik, T.H.M. Abundance of Plastic Debris Across European and Asian Rivers. *Environmental Research Letters*, 2019; 14(12): 124051.
13. Ryan, P.G., Moore, C., Van Franeker, J.A., Moloney, C.L. Monitoring the Abundance of Plastic Debris in the Marine Environment. *Philosophical Transactions of the Royal Society,* 2009; 364: 1999-2012.
14. Agus, R.N., Oktaviyanthi, R., Sholahudin, U. 3R: An Alternative for Household Waste Processing. *Kaibon Abhinaya: Journal of Community Service*, 2019; 1(2): 72.