Solid Waste Temporary Collection Site (TPS) For the Lon Malang Beach Tourist Area, Sampang Regency

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Abstract. *The Lon Malang beach tourism is one of the tourist attractions in Sampang district, developed as a sustainable tourism area. Naturally, Malang Lon Beach has white sand, and prawn cypresses, also equipped with several facilities including photo spots suitable for social media, games for children, etc. Research data collection was carried out through interviews, field surveys, taking and measuring samples, and laboratory analysis. The research conclusion was that visitors to Lon Malang Sampang beach tourism produced waste generation of 563.8 kg/day with a waste generation rate of 1.41 kg/person/day. Lon Malang beach tourism waste is dominated by Styrofoam at 36.7%, food waste at 19.3%, plastic waste at 13.5%, and coconut shells at 12.8%. The density of Lon Malang Sampang beach waste gives an average measurement result of 79.6 kg/m3, with a water content of 41% and a water content of 3.06%. The Lon Malang Beach Waste Temporary Storage Place (TPS) is proposed to have a capacity of 12 m3, in the form of 2 (two) waste containers which will be transported using arm-roll trucks with a frequency of 3 (three) times per week.*

Keywords: *solid waste generation rate, Lon Malang beach, TPS, waste composition*

1. Introduction

The tourism industry is one way of supporting economic growth. In 2022, the Indonesian tourism industry will experience growth of 4.30%. The number of tourist visits to East Java was 198,913,339, of which 2.147% visited tourist attractions on Madura Island. The number of tourist visits is expected to continue to increase because it will increase the income of communities around tourist attractions (Chuk, Azzidhan and Melvianawati, 2023). Economic growth from the tourism sector takes the form of expanding employment opportunities, increasing regional income, and equitable spatial development. Lon Malang Beach is a natural tourist attraction, in the form of a beach with white sand and many cypress prawns. Lon Malang Beach is in Sampang Regency, precisely in Bira Tengah Village, Sukobanah District. Lon Malang Beach has a strategic location, including being easy to reach with good road conditions, being on the same route as other tourist attractions such as the Torowan Sampang waterfall, the Nepa Sampang Monkey Forest, and the natural tourist attractions of the Pamekasan - Sumenep hills. The increasing number of tourist visits to Lon Malang Beach brings economic benefits to residents, but also poses social and environmental threats around Lon Malang Beach. To prevent the negative impact of the Lon Malang Beach development, the Lon Malang Sampang Beach was developed by implementing ecotourism (Rahayuningsih et al., 2022).

The Lon Malang beach in Sampang district, apart from its natural white sand, is also equipped with attractive facilities for visitors, including play facilities for children, camping, swimming, photo spots suitable for social media, banana boats, and horse riding. Lon Malang Beach was developed as a sustainable tourism area, where Lon Malang Beach still has a large carrying capacity, from a socioeconomic, environmental, and cultural perspective. Therefore, the local government, Lon Malang beach tourism managers, and the surrounding community need to maintain existing tourism potential and keep the beach clean (Suning, Wahyuni and Ratnawati, 2023). This research aims to find out the management of existing solid waste in the Lon Malang Sampang Beach tourist area and to obtain data on waste generation rate, waste density, waste composition, water content, and ash content of waste produced by Lon Malang Sampang Beach tourists. Based on the waste data obtained, it can be used to plan a temporary waste transfer site (TPS) for Lon Malang Sampang beach tourism.

2. Literature review

Based on the classification of solid waste sources, waste generated from tourism objects is included in the source of waste from the non-domestic waste source. The characteristics of waste generated from beach tourism has similar waste characteristics to domestic waste. In beach tourism objects, waste is generated from visitor activities, food and beverage waste brought, food and beverage shopping waste at traders and restaurants available in the tourist area. Data on solid waste generation rate, waste composition, waste density, and moisture content, are needed to determine the type and amount of waste facilities, as well as determine the appropriate waste handling method at the location of the tourist attraction (Minister of Public Works of the Republic of Indonesia, 2013). Beach tourism activities have the potential to harm the environment of tourist area, if the utilization of tourist sites is greater than the carrying capacity of the environment. Therefore, tourism developers are directed towards sustainable tourism to avoid environmental damage in the form of coastal erosion, sea water pollution, damage to natural habitats, reduced biodiversity in coastal tourist areas. One of the threats to coastal tourism objects is the threat of waste from tourist activities and marine debris. Waste in coastal tourist areas must be managed well, so as not to cause health problems and reduce comfort for visitors and the community around the tourist attraction. Therefore, there needs to be good management from the local government with the tourist area managers and the community around the tourist area (Krisdhianto et al., 2023).

Temporary Waste Transfer Sites (TPS) are one of the infrastructures for handling city waste. There are several types of TPS, one of which is a waste transfer platform with ramps and containers (Darma, D.W.S. dan Alfiah, 2022). There are several technical criteria for a waste TPS, including having an area of up to 200 m2, the waste must not be in the TPS for more than 24 hours, the location of the TPS does not interfere with traffic or the aesthetic aspects of the surrounding environment, and the TPS must be kept in a clean condition after the waste is transported. by truck to the landfill (Minister of Public Works of the Republic of Indonesia, 2013), (Suherdy, Anton Zacharia; Ainun, Siti; Halomoan, 2019). Waste TPS can be used as a meeting place for carts and containers, a meeting place for collecting and transporting equipment, a parking place for waste carts, a place for sorting waste, and a place for composting waste, as well as storing cleaning equipment (BSNI, 2002), (Arini, Partama and Surata, 2022).

Research on solid waste at beach tourism objects has been carried out in the Pangandaran Beach tourist area, Goa Cemara Beach, Bantul, Yogyakarta, Carocok Painan beach tourist area, and the Nasepa beach area, North Maluku (Ashuri and

Kustiasih, 2020), (Aisha, Yuriandala and Purnama, 2021), (Aziz, Dewilda and Putri, 2020), (Tuahatu, Juliana W; Tuhumury, Novianty C; Manuputty, 2023). The waste produced from the Pangandaran Beach tourist area is differentiated based on the source of the waste, including waste from hotels, restaurants, food stalls, and sea debris (marine waste). The composition of Pangandaran beach tourism waste is food waste at 44.68% and leaf waste at 13.8%. (Ashuri and Kustiasih, 2020). In the tourist area of Goa Cypress Beach, Bantul, Yogyakarta, the amount of waste generated is 2.44 L/person.day or 0.49 kg/person.day. The composition of the solid waste consists of 36% coconut shells, 18% wood waste, 20% food waste, 8% plastic, 13% styrofoam, 4% paper, and 1% other waste, (Aisha, Yuriandala, and Purnama, 2021). Carocok Painan beach tourism produces waste of 6,149 L/day or 578.01 kg/day with the dominant waste composition being food waste at 28.32%, plastic at 26.3%, paper at 17.46%, and yard waste at 12.55% (Aziz, Dewilda and Putri, 2020). The rate of waste generation in the Natsepa Beach tourist area, Central Maluku is 0.12 kg/person. per day with a composition of 92.21% organic waste and 7.79% in the form of inorganic waste (Ashuri and Kustiasih, 2020).

Beach tourism is one of the sources of urban waste generation, therefore it is necessary to handle the waste generation to support it as a sustainable tourist attraction. The infrastructure needed for handling waste at coastal tourist attractions is designed according to the size of the waste generated, the characteristics of the waste, and the characteristics of the tourist attraction (Aziz, Arbi, and Hamdallah, 2020), (Wahyudi, Irsan and Sutrisno, 2023), (Hajji, Apif M., Mochammad Rizal A, R. Machmud Sugandi, 2024).

3. Method

The research location is The Lon Malang Beach which officially operated in 2018 and is managed by the Tourism Department. Research on waste on Lon Malang beach is limited to waste produced by visitors who visit Lon Malang beach. The marine debris that washed up on Lon Malang beach was not included in this research.



Figure 1. The Lon Malang Beach, Sampang Regency

The current waste management of Lon Malang beach tourism was obtained through interviews and field observation surveys. Interviews were conducted with Lon Malang beach management officers, and cleaning officers, a survey of waste facilities available at Lon Malang Sampang beach, as well as waste transportation mechanisms.

The source of waste at Lon Malang beach tourism comes from tourists. Tourists bring food and drink from home and throw away their rubbish at the Lon Malang Beach tourist area. Apart from that, the waste produced by Lon Malang beach tourists comes from food and drink purchased from traders in the Lon Malang beach tourist area. Data on the number of visitors in the last three years and entrance tickets to Lon Malang beach were obtained from the management.

The waste produced in the Lon Malang Beach tourist area was obtained by taking measurements for 7 (seven) days. The weight of tourist waste collected in all waste containers is measured. Waste generation is calculated by comparing the amount of waste produced divided by the number of visitors, resulting in waste generation in units of weight, kilograms per person day. Waste density or waste density is obtained by measuring the weight of the waste divided by the volume of the waste. Waste composition is obtained by sorting waste based on type, and then each type of waste is weighed and converted into a percentage of all waste measured. Measurement of the composition and density of Lon Malang beach tourism waste was carried out for 7 consecutive days with 2 (two) repetitions. Analysis of water content and ash content was carried out in the Environmental Quality Laboratory, ITATS Environmental Engineering Department on mixed waste samples from the Lon Malang Sampang beach tourism. The water content and humidity of the waste indicate the ease with which the waste decomposes, so it influences the frequency of waste transportation and the appropriate processing for the characteristics of the waste.

4. Results and Discussion.

The entry fee for the Malang Lon Beach tourist attraction is currently IDR. 8,000 per person on weekdays, while on weekends the entrance fee increases to Rp. 10,000, - per person. Between 2020 and 2022, the average number of tourists at Lon Malang beach will increase. In 2020, the average number of tourists was 8,464 people, in 2021 there were 12,953 people and it will increase to 13,657 people in 2022. The increase in the number of tourists will increase income for residents around Lon Malang beach tourism, but on the other hand, it will increase the amount of rubbish collected. produced in the Lon Malang beach area. The waste produced must be managed well because it can be a threat to the Lon Malang beach tourism environment.

The waste produced by Lon Malang beach tourists comes from provisions brought to Lon Malang beach as well as leftover food and drink waste sold by traders on Lon Malang beach. Currently, the number of traders on Lon Malang Beach is 38 people, 28 traders selling food and drinks and 12 traders selling accessories and souvenirs.

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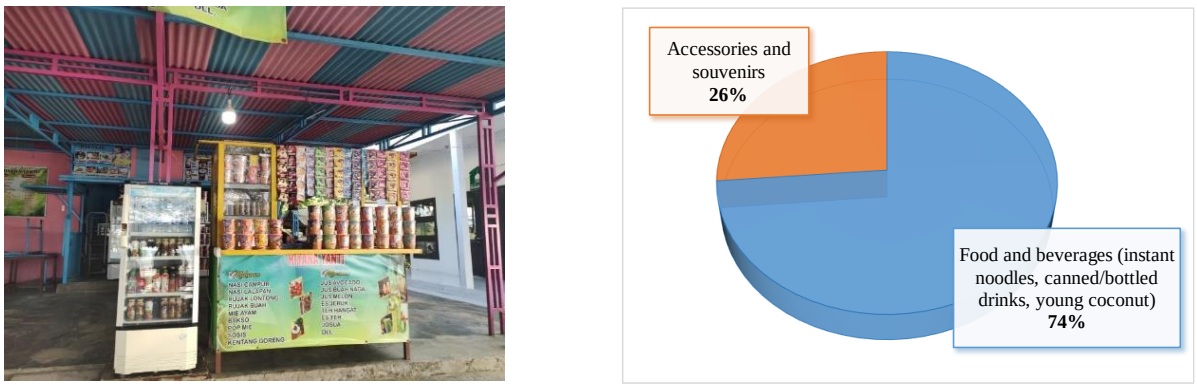


Figure 2. Number of traders and types of merchandise on Lon Malang Beach, Sampang

The Lon Malang Sampang beach tourist area has an area of around 11.9 km2. Based on secondary data, through interviews with Lon Malang beach tourism managers, it produces 563.8 kg of waste/per day. Currently, there are 5 (five) cleaning officers on duty to maintain the cleanliness of the Lon Malang beach tourist area. The number of trash containers provided at Lon Malang Beach is 85, consisting of 11 large trash containers (240 L), 18 medium-sized trash containers (40 liters), and 56 small trash containers (40 liters). The schedule for transporting Lon Malang beach waste is three (3) times a week, namely on Monday, Wednesday, and Saturday. Currently, there are no TPS available to collect rubbish in the Lon Malang beach area, so at the end of the week, many tourists will find rubbish containers that exceed their capacity. This causes visual and odor disturbances which reduce the comfort of Lon Malang Sampang beach tourists.



Figure 3. Several types of trash containers are available at Lon Malang Sampang Beach

The measurement of solid waste production at the Lon Malang Sampang Beach tourist attraction is calculated based on the waste collected in the available waste containers, then weighed for 7 (seven) days. The solid waste generation rate value, the total solid waste production is divided by the number of visitors or tourists on the day the sampling was carried out. The results of measuring the generation, number of visitors, and rate of waste generation at Lon Malang beach are presented in the following table:

Table 1. Solid waste generation, number of visitors, and solid waste generation rate at Lon Malang Beach, Sampang
Source; 2023 research results

Day	Solid waste production in a day by weight (kg/day) for type of waste container			Total solid waste production in a day by weight (kg/day)	Number of visitors (people)	Solid waste generation rate (kg/person.day)
	Large size container	Medium size container	Small size container			
Monday	140.25	96.3	198.8	435.35	287	1.52
Tuesday	165	144	207.2	516.2	350	1.47
Wednesday	125.4	67.5	218.4	411.3	264	1.56
Thursday	138.6	91.8	123.2	353.6	302	1.17
Friday	182.05	165.6	277.2	624.85	422	1.48
Saturday	217.8	177.3	327.6	722.7	550	1.31
Sunday	249.15	235.8	397.6	882.55	637	1.39
			Average	**563.8**	**Average**	**1.41**

The more visitors to the Lon Malang Sampang Beach tourism site, the more waste will be generated from tourism activities. The results show that at the end of the week (weekends) the number of visitors to Lon Malang Beach tends to increase,

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this is also accompanied by an increase in the rate of solid waste production. The results of measuring waste from visitors to Lon Malang Sampang beach produced data on the rate of waste generation of 1.41 kg/person.day or 1.41 kg/visitor.day during the research period. Compared to data on waste generation from the Goa Cemara Beach tourist area, Bantul, Yogyakarta, the amount of waste generation is 2.44 L/person.day or 0.49 kg/person per day, the waste generation from Lon Malang Beach, Sampang is much greater.

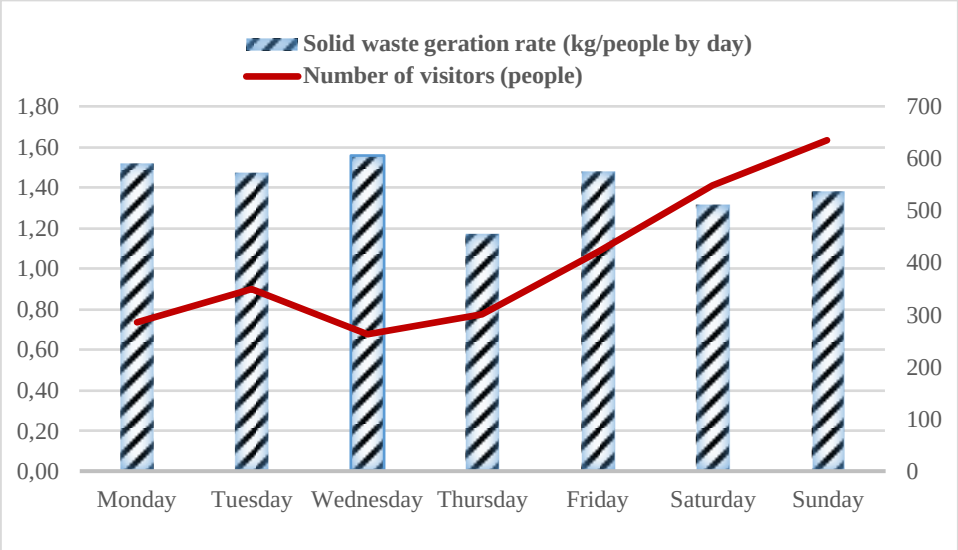


Figure 4. Relationship between the number of visitors, and solid waste generation rate of Lon Malang Beach every day of the week.

Solid waste composition of Lon Malang Beach tourism was carried out for 7 consecutive days with 2 (two) repetitions. The composition of Lon Malang Beach tourist waste is sorted into 13 types. Lon Malang Beach tourism waste is dominated by types, styrofoam as much as 24.6%, food waste as much as 17.3%, coconut shells as much as 16.9%, and plastic waste as much as 11.7%.

Table 2. solid waste composition of Lon Malang Sampang Beach tourism
Source; 2023 research results

No.	Classification of solid waste	Percentage composition of solid waste		
		1	2	average
1.	Plastic	13.5	9.9	11.7
2.	Food waste	19.3	15.3	17.3
3.	Cardboard box	4.2	7.7	5.9
4.	Styrofoam	36.7	12.4	24.6
5.	Can	1.9	5.1	3.5
6.	Bottle	2.0	9.2	5,6
7.	Wood	1.5	2.1	1.8
8.	Twig	1.4	5.0	3,2
9.	Leaf	0.8	2.1	1.4
10.	Coconut shell	12.8	20.9	16.9
11.	Straw	1.3	2.5	1.9
12.	Paper	2,2	5.0	3.6
13.	Cigarette butt	2,4	2.9	2.7
	Total	100	100.0	100.0

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The comparison of the composition of Lon Malang Beach waste is presented in the table and graph below.

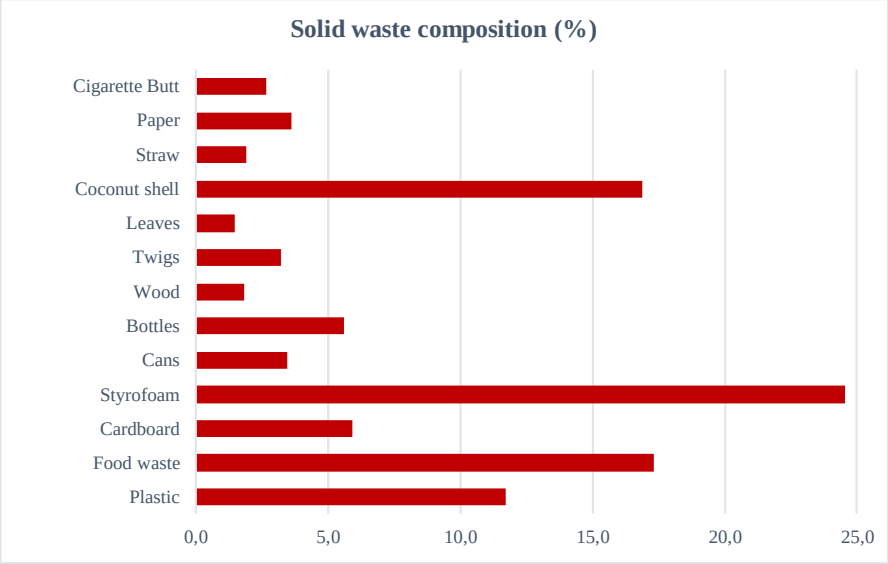


Figure 5. Solid waste composition of Lon Malang Sampang Beach tourism

Research on waste from tourist activities located on Pangandaran Beach shows that the composition of waste is dominated by food waste at 44.68% and leaf waste at 13.8%.(Ashuri and Kustiasih, 2020). The rate of waste generation in the Natsepa Beach tourist area, Central Maluku is 0.12 kg/person. per day with a composition of 92.21% organic waste and 7.79% in the form of inorganic waste (Ashuri and Kustiasih, 2020)

Solid waste density was measured every day for 7 consecutive days, to determine daily variations. Measurements were repeated two (2) times to determine seasonal variations. The average density of Lon Malang Sampang Beach solid waste is 79.6 kg/m3. This solid waste density value is the density value of solid waste at the containerization stage including fresh solid waste. The solid waste density value can be used to calculate the estimated volume of solid waste production by visitors to Lon Malang Beach, Sampang Regency.

Table 3. Solid waste density of The Lon Malang Beach, Sampang Regency
Source; 2023 research results

Solid waste density (kg/ m3)	
average of measurement 1	80.9
average of measurements 2	78.2
Average	79.6

The results of measuring the water content and moisture content of waste samples from the Lon Malang Beach tourist attraction in the Environmental Quality Laboratory, ITATS Environmental Engineering Department, obtained the following results:

Table 4 Water content and ash content of Lon Malang Beach solid waste
Source; laboratory test results 2023

Solid waste Type	**Water content (%)**	**Ash Content (%)**
Mixed waste	41	3.06

Based on data on a water content of 41% and a water content of 3.06%, the percentage of organic waste is 37.94%, which in the analysis using the heating method changes form to water vapor and gas. The organic content is 37.94%, because food and drink waste dominate Lon Malang Beach waste. Lon Malang Beach waste with a water content of 41% is easily decomposed, and should be transported to a temporary storage site (TPS) or landfill site (TPA) every day, or a maximum of every 2 days. Organic waste with high water content is suitable for biological processing, for example by composting. A good composting process will produce compost products that can be used to fertilize plants in the Lon Malang Beach area itself.

Based on data on the generation of waste from visitors to Lon Malang Beach, it is known that it is 563.8 kg/day, while the average waste density is 79.6 kg/m3. Thus, it can be obtained that the average volume of waste from Lon Malang Beach visitors is 7.1 m3/day. Currently, waste transportation services are carried out with a frequency of 3 times a week, so the Lon Malang Beach waste landfill must be able to accommodate at least 2 days of waste generation, amounting to 14 m3. However, due to fluctuations in the number of visitors to Lon Malang Beach which increased at the end of the week, the capacity of the Lon Malang Beach TPS is only 12 meter cubic. It is proposed that the Lon Malang Sampang Beach TPS be in the form of 2 containers, each with a volume of 6 m3, for a total of 12 m3. Containers will be picked up by an arm roll truck transportation system with a frequency of 3 (three) times per week, to ensure cleanliness and comfort for visitors to Lon Malang Sampang Beach

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tourism, (Suherdy, Anton Zacharia; Ainun, Siti; Halomoan, 2019), (Aziz, Arbi and Hamdallah, 2020), (Wahyudi, Irsan and Sutrisno, 2023).

Waste containers with a volume of 6 m3 have dimensions of 3.6 m long, 2.3 m wide, and 1.3 m high. The dimensions of the waste carts are 1.2 m long, 1 m wide, and 1 m high. The TPS is designed to have an area of about 40 m2 to 50 m2, which can accommodate 2 waste containers with a volume of 6 m3 and 1 waste cart. This TPS area is only used for the meeting area of the carts with the container, transferring the container to the arms roll truck, and parking 1 unit of waste carts. TPS for waste from Lon Malang beach tourism is equipped with a wall around it to maintain the aesthetics of the tourist area (Wahyudi, Irsan, and Sutrisno, 2023).

5. Conclusion

The research conclusions include: Visitors to Lon Malang Sampang Beach tourism produce waste of 563.8 kg/day with a waste generation rate of 1.41 kg/person.day or 1.41 kg/visitor.day. Lon Malang Beach tourism waste is dominated by styrofoam at 36.7%, food waste at 19.3%, plastic waste at 13.5%, and coconut shells at 12.8%. The density of Lon Malang Sampang Beach waste gives an average measurement result of 79.6 kg/m3, with a water content of 41% and a water content of 3.06%. The Lon Malang Beach Waste Temporary Storage Place (TPS) is proposed to have a capacity of 12 m3, in the form of 2 (two) waste containers which will be transported using arm-roll trucks with a frequency of 3 (three) times per week.

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