



# Evaluation of Handling Waste System in Doulu Tourist Area, Karo Regency, Indonesia

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## ABSTRACT

Penatapan Doulu is one of the popular tourist areas in Karo Regency, Indonesia. Tourism activities cause waste problems that have the potential to pollute the surrounding environment. This study aims to analyze and evaluate waste problems in the Penatapan Doulu tourism area which includes waste management policies and methods, as well as providing future considerations for proposed waste management strategies through the concept of collaborative management. This study analyzes all kinds of waste generated from 30 restaurants located in the Penatapan Doulu tourist area. The method for calculating waste generation and composition is based on SNI 19-3964-1994. The results showed that the total waste generation reached 76.03 kg/day with the waste composition dominated by plastic 42.02%, fruit peels 28.07%, and food 13.46%. Evaluation of the current condition obtained a value of 2.58 which is categorized as moderate. Proposed strategies that need to be carried out in the Penatapan Doulu tourist area are making trash bins based on the type of waste and pilot village programs which are a concrete manifestation of synergy between stakeholders and handling waste problems must be carried out by all parties with collaborative management carried out effectively.

**Keywords:** environment, tourism, waste management



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## 1. Introduction

Indonesia's tourism prospects require significant efforts that can increase tourism competitiveness and improve the welfare of the community, especially the creative industry. The number of foreign tourists increased by 10.4 million and domestic tourists by 255.20 million in 2015 [1]. The development of tourist attractions in Karo Regency, North Sumatra, Indonesia causes more choices for traveling. One of the leading tourist destinations in North Sumatra province is Karo Regency. Karo Regency has complete tourist destinations, ranging from religious and cultural tourism, ecotourism, historical tourism, and natural tourism. According to data from the Karo Regency Tourism Office, the number of tourist visits in 2022 is targeted at 1 million visitors. An increase in the number of visitors must be accompanied by an increase in the number of facilities, including waste management facilities sourced from tourism activities. An increase in the number of tourist visits contributes to an increase in the amount of waste generated. The waste will cause environmental pollution, sanitation, and aesthetic problems [2]. which can affect the cleanliness and comfort of tourist areas. Various methods have been applied in waste management such as biological treatment, thermal processes, and landfill [3]. However, the way waste has been handled so far is only by collecting it from the rubbish bins in urban settlements and disposing of it in landfills or burning it. This method is not good enough to solve the waste problem because it can still cause environmental pollution [4].

According to data from the Karo Regency Environmental Service in 2020, the percentage of waste handled was 83.12%. This value is still below the Karo Regency government's target of 90.66%. This can be caused by the hilly topography of the area and the coverage of a very large area. Other problems faced in the management of waste from tourism activities in Karo Regency are the absence of data on the amount of waste generated at each tourist location and the low awareness of the community and the private sector in waste management. In addition, many of the policies taken to control waste growth are still emphasized short-term management, prioritizing investment in expensive infrastructure but managing less in the field [5]. In solving the problem of waste from tourism activities in Karo Regency, it is not only the responsibility of the local government, according to Law No. 18 of 2008 the community and business actors as waste producers must be responsible for creating a clean and healthy environment [6]. The resolution of the waste problem must also pay attention to the potential, cultural diversity, and topography of the area in question. According to Akinci et al, [7], waste management systems are not general and can be different in each region, this is due to differences in community characteristics, topography, and socio-demography of an area.

The implementation of solving public problems using the collaborative management concept was reported by Nistyantara et al [8], in solving the management problems of Kelimutu National Park. From the results of the study, it was found important of mapping the interested parties to then determine the activities together. Maryanti [9], also reported the concept of solving waste management in Bogor City through a collaborative management approach, from the results of the study it was found important for the government and practitioners to provide counseling and mentoring to local communities in 3R (reduced, recycle, reused) waste management in Bogor City. In solving the problem of waste management, it is necessary to map out the amount and composition of waste generation, the potential in the area in question, and the interested parties. It aims to determine a waste management strategy using the concept of collaborative management to obtain optimal results.

In this case, the researcher conducted a study on waste management from tourism activities in the Penatapan Doulu tourist area. Tourism development strategies are still focused on technology, innovation, and operations and have not thought further about environmental sustainability that can be reduced due to tourism activities including changes in land cover and land use for accommodation, transport infrastructure, and recreation areas [2]. So this needs to be evaluated because it will affect the area where waste is processed in the Penatapan Doulu tourist area. Therefore, this study aims to analyze and evaluate waste problems in the Penatapan Doulu tourist area, which includes policies and methods of waste treatment or disposal, and provide future considerations for proposed waste management strategies through the concept of collaborative management in the Penatapan Doulu establishment area

## **2. Method**

This research uses a qualitative approach through the process of interviews, documentation, field notes, photos, videos, and recordings [2]. The subjects of this research came from Bappeda Karo, the Karo Regency Environmental Service, tourism managers, the Karo Regency Tourism Office, the Regent or Deputy Regent of Karo Regency, Doulu Village, Karo Regency, and 30 restaurants located in the Penatapan Doulu tourist area and visitors or tourists who visit.

Research observation activities were carried out for 16 days in the Penatapan Doulu tourist area from 16-31 August 2021 during public holidays, based on manual calculations performed by the author of the number visitors reached 1,590 people on 17 August 2021 with an average of 193 people/day. This is because there were major holidays during the research including celebration of Indonesian Independence Day holidays. Holidays cause an increase in the number of visitors which leads to an increase in the amount of waste generated. Measurement of waste generation in the Penatapan Doulu tourism area is carried out based on the Indonesian National Standard method or SNI 19-3964-1994.

## **3. Result and Discussion**

### **3.1. Research Study Area Overview**

The Penatapan Doulu tourist area is located in Doulu Village, Berastagi District, Karo Regency, North Sumatra Province. Doulu Village is located in the administrative area of the Berastagi District which consists of 9 villages.



Figure 1. Karo District Administrative Map - Berastagi Sub-district region  
Source: City Planning Office of Karo Regency (2020)

Doulu village has an area of 10,690 km<sup>2</sup> with a ratio to the sub-district area of 11.48%. Doulu village has natural conditions in the form of highlands with hills, with an average temperature of 16-20 °C. Doulu village has a distance of about 10 km from the capital of Berastagi District and about 80 km from the center of Medan City.



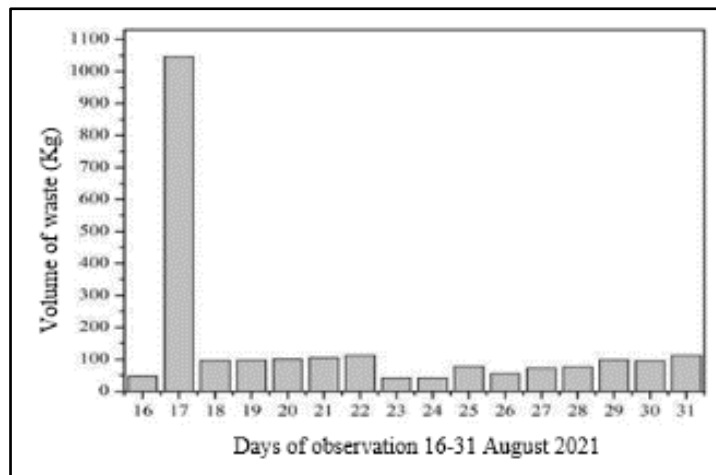
Figure 2 Location of Research Study Area  
Source: Google Maps (2023)

Inside the Penatapan Doulu tourist area, there are about 30 restaurants that provide food and drinks. The Penatapan Doulu tourist area also has 1 prayer room building, 3 public toilets, and vehicle parking. In (figure 2) it can be seen that the Penatapan Doulu tourist area is located right on the Medan-Berastagi highway so it can be easily accessed by public vehicles or private vehicles. Penatapan Doulu tourist area is open every day with 24 hours working hours.

### 3.2. Characteristics and Volume of Waste Generation

Waste generation is the amount of waste arising from the community in terms of volume and weight. The amount of waste generated from an activity will determine the amount of waste that must be managed by a city [10]. The rate of waste generation in the Penatapan Doulu tourist area ranges from 42 to 1,046.7 kg/day with an average waste generation of 76.03 kg/day. The highest increase of visitors was obtained on August 17, 2021, with a waste generation of 1046.7 kg with visitors of approximately 1.590 persons. This is due to the Independence Day of the Republic of Indonesia causing an increase in the number of visitors. The increase in the rate of waste generation also occurred on Sundays with an average amount of waste generated on Saturday

and Sunday of 98.25 kg/day. The increase in the waste generation rate on holidays is due to the opportunity to gather and do activities with family so that more waste is generated. [11]

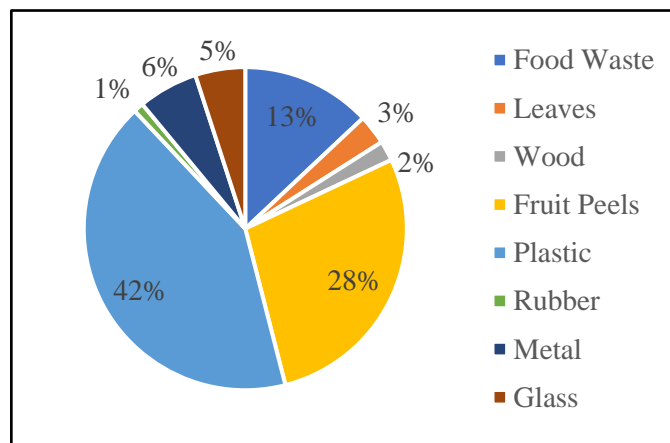


**Figure 3** Waste Generation Rate in the Penatapan Doulu Area

### 3.3. Waste Generation Based on Composition

Waste composition is a description of each component contained in solid waste and its distribution. It is usually expressed in weight percent (%). Information on waste composition is needed to determine the area of landfill sites and biological waste treatment such as composting. Waste composition is divided into the categories of decomposed waste (Pd) and non-decomposed waste (Pnd). [12]

In the pie chart below, it can be seen that the composition of waste in the Penatapan Doulu tourist area is dominated by inorganic waste at 53.94%, and organic waste at 46.01%. The largest type of inorganic waste was obtained from the type of plastic waste 42.02%, produced from food and beverage packaging both from business actors and those brought by tourists from outside the research location. Therefore, plastic waste reaches 80% of the total inorganic waste. The largest type of organic waste is produced from fruit skins 28.07% of the total waste generated. This is because the collection of research data coincides with the durian fruit season. Meanwhile, organic waste originating from food waste reaches 13.46% of the total waste generation.





**Figure 4** Composition of Waste Generation in the Penatapan Doulu Area

Based on the results of the calculation of the amount of waste generated in the Penatapan Doulu tourist area, an average of 0.83 kg/person/day or with a volume unit of 0.25 liters/person/day was obtained. The amount of waste generated in the Penatapan Doulu tourist area is still smaller, when compared to that reported by Masjhoer [13] in the Parangtritis beach tourism area, Bantul, it was obtained at 0.8 liters/person/day. Wahyu and Trihadiningrum [14] reported that the amount of waste generated in the coastal tourism area of Buleleng Bali was 170.8 kg/day.

### 3.4. Waste Management

Based on data and observations in the field, waste management in the Penatapan Doulu tourist area is carried out by looking at several aspects of waste management as shown in Table 1.

Table 1. Waste Management in Penatapan Doulu Tourism Area

No	Aspects	Results
1.	<b>Operational Techniques</b>	
	Container	<p>Limitations on the use of the provided containers resulted in visitors and businesses being patterned to mixed waste. There is no difference in the waste containers for wet and dry waste.</p>  <p>Figure 5. Container Truck</p>
	Collection	The waste collection process is not efficient. This is because waste is transported from the TPS to the landfill every 4 days. The length of the period results in a lot of waste that is not collected at the TPS.
	TPS Condition	Uncovered TPS conditions cause unpleasant odors and are a source of disease.
		 <p>Figure 6. Wastebasket</p>
<b>2. Institutional</b>		
	Management Agency	The waste management system in the Penatapan Doulu is dumping, collection, transporting the waste, and final disposal. The UPTD of the Karo Regency Environmental Agency is the party responsible for waste management
	Presence of the operator/officer	The number of janitors is 4 people with operational working hours from 07.00 - 15.00 WIB.
	Regular meetings of residents	There are no regular meetings at the residence. This is because waste management is fully carried out by the UPTD of the Karo Regency Environmental Agency.
<b>3. Financing</b>		
	Dues	The amount of trash dues is 60,000/month for the category of restaurants
	Financial Records	There is no record of waste retribution conducted by the Local Government
	Wages	Payment of wages on time to cleaning staff of Rp. 800,000/month.
<b>4. Regulation</b>		
	City Regional Regulation	Karo Regent Regulation No 25 of 2019 concerning Waste Management Strategy Karo Regent Regulation Number 47 of 2020 concerning the Work Plan of the Karo Regency Environmental Service
	Per Determination of Charges	Regional Regulation No. 4/2012 article 14 regarding Retribution Services for Waste Services.
	The existence of an appeal	The implementation of regulations in Penatapan Doulu tourist area
<b>5. Community Participation</b>		
	Citizen Contribution	The contribution of residents in waste management is only in the form of payment of garbage fees which are made every month and provision of trash bins
	Citizen Concern	Will provide a clean environment, health for society and the economy



Citizen Independence	The existence of independence in providing the condition of waste bins owned by business actors/citizens is quite good with the form of barrels/baskets
<b>6. Environment</b>	
Environmental Aesthetics	The aesthetic condition of the environment is good, because there are no piles of garbage scattered in the Penatapan Doulu tourist area. This is due to public awareness to dispose of waste in its place.

Public health



Figure 7. The environment ambiances

Public health in the tourist area is good. This is because waste, which is a source of disease-carrying bacteria and unpleasant odors, is managed in the district capital, which is about 30 km away. In addition, cleaning staff are also equipped with uniforms, masks and gloves while working

Environmental contamination

There is soil and water pollution due to waste that is not transported by transport vehicles in the waste processing area. It is also caused by the presence of some visitors who throw garbage directly into the surrounding area.



Figure 8. Environmental contamination

In the table below, it can be seen the grouping of waste based on its nature to be able to find out its processing potential. It can be seen that the percentage of waste processing more than 75% of the generated waste can be burned, but the processing of waste using the burning method is not permitted following the Minister of Environment and Forestry No. 70 of 2016. The next largest percentage of the waste is obtained based on the type of waste that can be recycled at 49.00%. Generally, recyclable waste is resold so that cleaners can earn extra income while organic waste is used as fertilizer. [15]

Table 2. Types of Management of Waste Generation in the Penatapan Doulu Area

No	Group	Types	%
1	Decompose	Food waste	13,46
2	Organic	Food waste, leaves, wood, fruit peels	46,01
3	Biodegradable	Rubber, food waste, leaves, wood, fruit peels	46,58
4	Can be burn	Rubber, wood, leaf, fruit peel, plastic	75,15
5	Recyclable	Plastic, Rubber, Metal	49

The results of observations on the existing conditions of waste management in the Penatapan Doulu tourist area are shown in (figure 9) where the containers are carried out at each restaurant as a source of waste generation using containers without covers and waste sorting. However, some business actors doing sorting waste into types of waste that can be recycled in the form of plastic, metal, and glass waste. Every day, each business actor collects waste at the temporary waste storage individually.

In the process of transporting waste from the temporary waste storage, the transport vehicle for the Environmental Service Regional Technical Implementation Unit Karo Regency is carried out every 4 (four) days. The waste is then transported to the landfills in the Kabanjahe sub-district, which is about 30 km from the research location.



Figure 9. Waste containers provided by business actors and the condition of temporary waste

From the results of field observations, it can be seen in (figure 9) that the waste container in each restaurant is a container without a lid. And also, the temporary waste storage condition is far from suitable and can cause health issues. It was found in several cases that the capacity of the waste container did not match the capacity of the waste produced so piles of garbage were found on the road.

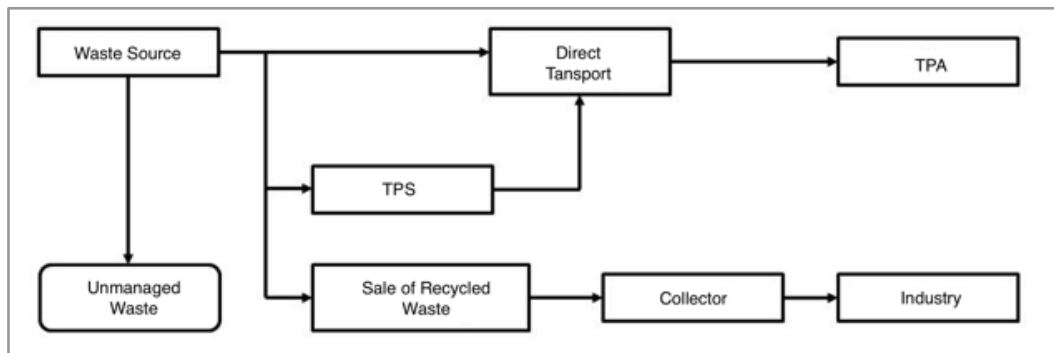


Figure 10 Existing Conditions of Waste Management at The Tourism Area of Penatapan Doulu

Based on the results of observations, an evaluation of the existing conditions was carried out by assessing aspects of waste management. The weights are arranged according to each sub-parameter. Giving sub-score values according to the results of observations, interviews, and field sampling. Giving sub-scores (1) for poor, (3) for moderate, and (5) for good.

Table 3. Assessment of the existing condition of waste management

No	Aspects	Sub-score			Total	Point	Score	Total
		Poor	Moderate	Good				
1	<b>Operational Techniques</b>							
	Container	1			1	0.05	0.05	0.17
	Collection	1			1	0.07	0.07	
	TPS Condition	1			1	0.05	0.05	
2	<b>Institutional</b>							
	Management Agency			5	5	0.07	0.35	0.64
	Presence of the operator/officer			5	5	0.05	0.25	
	Regular meetings of residents	1			1	0.04	0.04	
3	<b>Financing</b>							
	Dues	1			1	0.07	0.07	0.31
	Financial Records	1			1	0.04	0.04	
	Wages			5	5	0.04	0.2	
4	<b>Regulation</b>							
	City Regional Regulation			5	5	0.04	0.20	0.70
	Per Determination of Charges			5	5	0.07	0.35	
	The existence of an appeal			5	5	0.03	0.15	
5	<b>Community Participation</b>							
	Citizen Contribution	1			1	0.05	0.05	0.27
	Citizen Concern	1			1	0.07	0.07	
	Citizen Independence		3		3	0.05	0.15	
6	<b>Environment</b>							
	Environmental Aesthetics		3		3	0.07	0.21	0.49
	Public health		3		3	0.07	0.21	
	Environmental contamination	1			1	0.07	0.07	
	<b>Total</b>					<b>1.00</b>		<b>2.58</b>

There are six aspects in the assessment of existing conditions in the Penatapan Doulu tourism area namely operational techniques, institutional, financing, regulation, community participation, and environment. Based on these observations, an evaluation of the existing conditions is carried out by assessing aspects of waste management. Weighting is set according to each sub-parameter. Sub-scores are given according to the results of observations, interviews, and field sampling. The sub-scores are (1) poor, (3) moderate and (5) good. The analysis results show that the regulatory aspect variable is the highest variable at 0.70 and the lowest score is the technical operational aspect variable at 0.17. Based on Table 2, it is concluded that the existing condition of waste management in the Penatapan Doulu tourist area is in moderate condition with 2.58 points. Similar results were also reported by Putranto, 2022.[16] where the condition of waste management in the Banyumas district is in moderate condition. Therefore, it is necessary to evaluate to improve the performance of waste management in the Penatapan Doulu area in the condition of all aspects, namely operational technical aspects, institutional aspects, financing aspects, legal and regulatory aspects, aspects of public and private participation and environmental aspects that must be further improved [17].

So that the proposed strategy that is suitable for waste management in the Penatapan Doulu tourist area includes the potential that is owned, is economical, and involves the community in the process. Such as the manufacture of waste containers based on the type of waste following SNI 19-2454-2002 where waste containers must be economical, easy to operate, watertight, with a lid, and have aesthetic value and a pilot village program is a real form of synergy between stakeholders.



#### 4. Conclusion

Visitors in the Penatapan Doulu tourist area on 16-31 August 2021 on public holidays reached 1,590 visitors with an average of 193 people/day. Waste generation reached 0.83 kg/person/day. The composition of waste in the study area includes plastic waste at 42.02%, fruit peel at 28.07%, food waste at 13.46%, metal at 6.41%, glass and rubber at 5.52%, and leaves/wood at 4.47%.

The waste management system in the Penatapan Doulu tourist area that has been implemented is dumping, collection, transporting the waste, and final disposal. From the existing conditions of waste management, it is concluded that waste management in the Penatapan Doulu tourist area is in moderate condition with a total point of 2.58 so improvements need to be made to all component aspects. Especially in the aspects of operational techniques, financing, and community participation. So that the proposed strategy that needs to be done in the Penatapan Doulu tourist area is the creation of waste containers based on the type of waste and a pilot village program is a real form of synergy between stakeholders.

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