

Design of Feasibility Study Parameters for Selection of B3 Waste Treatment Location in Bangkalan District

Rina Sri Wulandari, Waluyo Prasetyo, Luqman Hakim, Taqwanur

Industrial Engineering Department
Universitas Nahdlatul Ulama Sidoarjo
Sidoarjo, Indonesia

rinasriwulandari.ti@unusida.ac.id, waluyo.tin@unusida.ac.id, hqm_ft@unusida.ac.id,
taqwanur.tin@unusida.ac.id

Medya Ayunda Fitri

Chemical Engineering Department
Universitas Nahdlatul Ulama Sidoarjo
Sidoarjo, Indonesia

medyafitri.tkm@unusida.ac.id

Abstract

B3 waste is waste that needs serious management by individuals, waste-producing companies and the government. In order to managed this waste, the first thing that must be done to determine the location of the waste management. This research discussed a feasibility of study related to the location of B3 medical waste treatment in Bangkalan Regency. The location selection in this research used several criteria that have been determined by BAPEDAL Decree No. 01 of 1995 and eligibility based on SNI parameters. There were two alternative locations for chose a location for B3 waste treatment. Based on the results of the assessment that has been carried out on alternative locations for medical B3 waste treatment, it can be concluded that the first alternative location has a higher feasibility than the second one. The first location meets various predetermined criteria. Availability of land for the construction and development of 24,711 m² medical B3 waste treatment in accordance with the criteria established by BAPEDAL's rule. The topography is relatively flat, and is not a disaster-prone area or a nature reserve. The existing access road already exists, it only needs to improve the quality of the road to the waste treatment location. Then, create a buffer around the location to maintain the quality of the surrounding environment that it does not decrease or be polluted.

Keywords

Hazardous Waste, Criteria, Parameters.

1. Introduction

The hospital is a health facility that provides health services for the entire community. Health services provided by hospitals include outpatient services, inpatient services, emergency services, medical services, and non-medical services. The Decree of the Minister of Health of the Republic of Indonesia No. 1204/Menkes/SK/X/2004 explains that the hospital, as a one of meeting point for sick and healthy people, is used by the community as a health service facility that allows the occurrence of disease transmission, environmental pollution, and health problems. All types of activities that occur in the hospital have a positive or negative impact. The positive impact given is the facilities for improving public health, while the negative impact is the presence of waste that requires special handling. One example of a hazardous hospital waste is a syringe which can cause infection with hepatitis B, C and also HIV. In addition, other hospital waste can also cause diseases, including cholera, typhoid, malaria, and skin diseases (Riyanto, 2013).

Around 70–90% of solid waste originating from health installations is general waste that resembles household waste and does not contain risks. The remaining 10–25% is considered dangerous, this waste can cause various types of health impacts. The production of solid medical waste in hospitals in Indonesia nationally is estimated at 376,089 tons/day (Astuti, 2014). Hospital waste is generally divided into two groups, namely medical waste and non-medical

waste (Pertiwi, 2017). Hospital medical waste is categorized as hazardous and toxic (B3) waste as stated in Appendix I of PP No. 101 of 2014 that medical waste has infectious characteristics.

Madura Island consists of 4 districts including Bangkalan, Sampang, Pamekasan, and Sumenep. This island has health facilities in each district. Health facilities in each district and even in each sub-district are sources of B3 medical waste. Based on information from the Bangkalan District Health Office, the average medical waste produced by 22 public health centers in Bangkalan District ranges from 10 kg to 20 kg per month. In fact, one of the public health centers in Bangkalan District is the largest producer of medical waste, reaching 2 quintals per month. This information only shows data for one district in each public health centers.

Based on the data, it is necessary to build a B3 waste management site, especially for medical waste on Madura Island. The planning of development is focused in Bangkalan District because it is main entrance to Madura Island. There are two lands that will be used as locations for medical B3 waste management. Therefore, a feasibility study was carried out on both locations. This feasibility study was expected to provide an overview of a proper location based on the central government policies. Ease of access and the size of the land were considerations that could be taken for the proper location. The analysis was based on the rule of BAPEDAL and the SNI parameters.

2. Literature Review

3. Methods

In addition to referring to the rule of BAPEDAL, the assessment of site selection was also carried out by adopting SNI 03-3241-1994 concerning Procedures for Selection of Locations for Final Disposal of Waste. Parameter SNI 03-3241-1994 contains technical requirements and provisions in determining the location of B3 medical waste management. These general requirements include:

1. It has been included in the urban and regional spatial planning.
2. Type of impermeable soil
3. Unproductive area for agriculture
4. Can be used for a minimum of 5 to 10 years
5. Does not harm or pollute water sources
6. The distance from the service center area is a maximum of 10 km
7. Flood-free area

The site selection criteria are divided into 3 parts:

1. Regional criteria, namely the criteria used to determine the feasible zone or the unfeasible zone as follows:
 - a. Geological condition:
 - Not located in the Holocene fault zone (fault areas that are still active).
 - Must not be in the geological danger zone.
 - b. Hydrogeological condition:
 - Must not have a groundwater level of less than 3 meters
 - No soil clearance is more than 10-6 cm/second
 - Distance to drinking water sources must be greater than 100 meters
 - In the event that there is no zone that meets the criteria mentioned above, then technology input must be applied
 - Zone slope must be less than 20%
 - The distance from the airport must be greater than 3,000 m for turbo jet flights and greater than 1,500 meters for other types.
 - Not allowed in protected areas or nature reserves and flooded areas with a return period of 25 years.
2. Elimination criteria used to choose the best location, including:
 - a. Climate:
 - Rain, the smaller rain intensity is better.
 - Wind, the dominant wind direction does not go to settlements is considered better.
 - b. Utilities: the more complete is the better

- c. Biological environment:
 - Habitat: less variety is rated better.
 - Support: less support to flora and fauna is rated better.
 - d. Soil Condition:
 - Soil productivity: more unproductive, rated better.
 - Capacity and life: can accommodate more land and longer is considered better.
 - Land ownership: the more varied land ownership is considered not good
 - e. Demography: the lower the population density is better.
 - f. Administration border: within administrative limits is considered better.
 - g. Noise: the more buffer zones are rated better.
 - h. Smell: the more buffer zones are rated better.
 - i. Aesthetics: the less visible from the outside is better.
 - j. Economy: the lower of unit management cost (Rp/m³ or Rp/ton) is better.
3. Determination criteria is criteria used by the authorized agency that approves and determines the selected location in accordance with the policies of the local authorized agency and the applicable provisions. Each criterion and parameter are then given a weight and value.

4. Data Collection

The service areas targeted for B3 medical waste management were all health facilities on Madura Island. This was based on information that so far on Madura Island there was still no location for integrated B3 medical waste management. Data on existing health facilities on Madura Island are shown in Table 1.

Table 1. Medical Facilities on Madura Island

District	Medical Facilities	Year	
		2019	2020
Bangkalan	Hospital	3	4
	Maternity Hospital	2	3
	Polyclinic	9	9
	Public Health Center	25	29
	Auxiliary Health Center	69	72
Sampang	Hospital	2	2
	Maternity Hospital	0	0
	Polyclinic	4	4
	Public Health Center	21	22
	Auxiliary Health Center	55	56
Pamekasan	Hospital	6	6
	Maternity Hospital	1	1
	Polyclinic	8	8
	Public Health Center	20	20
	Auxiliary Health Center	34	34
Sumenep	Hospital	2	2
	Maternity Hospital	1	1
	Polyclinic	8	10
	Public Health Center	32	30
	Auxiliary Health Center	68	64

Based on these data, it can be ascertained that the volume of medical waste generated in the district on Madura Island is very large. This is one of the basics for the need to build a medical B3 waste management site.

Based on data from health facilities in 4 districts on Madura Island, data on the volume of medical B3 waste produced was collected. The data was obtained from the Ministry of Environment, and the information also gathered from the Health Office in each district. Clearly the data can be seen in Table 2.

Table 2. Volume of Medical B3 Waste

Districts	Health Facilities	Volume (ton)
Bangkalan	Local Public Hospital Syarifah Ambami Rato Ebu Bangkalan	169,63
Sampang	Local Public Hospital Dr Muhammad Zyn Sampang	165,26
Pamekasan	Local Public Hospital H. Slamet Martodirdjo Pamekasan	172,60
Sumenep	Hospital dr. H. Moh. Anwar Sumenep	179,95

The data was taken from Regional General Hospitals in four districts on Madura Island. Based on information obtained from the Bangkalan District Health Office, data were obtained that each health center in Bangkalan Regency produced an average of 5 kg of medical B3 waste per month. This waste was increasing during a pandemic.

5. Results and Discussion

The first location is at coordinates 7°08'56.60"S and 112°47'12.6"T. The first location consists of 5 plots of land, each of which has an area of:

- a. The first land has an area of 4,818 m²
- b. The second land has an area of 2,020 m²
- c. The third land has an area of 7,691 m²
- d. The fourth land has an area of 6,178 m²
- e. The fifth land has an area of 3,569 m²

The whole land area is 24,711 m², which means that the location fulfils the first requirement of BAPEDAL decision. The area to be used for B3 waste management is at least 1 (one) hectare. The location is also an annual flood-free area and quite far from public facilities. In addition, the location is 200 m from the main road and 100 m from other roads. Around the first location there are no public facilities such as trade, hospitals, health services or social activities, hotels, restaurants, religious facilities, educational facilities, or residential areas. From the results of satellite imagery, it shows that the settlements and various facilities are far from the first location.

The first location has a very wide access road of ± 4 m, it makes easier for access in and out of vehicles which will later be used for transporting medical B3 waste. The land in the first location is also unproductive land so it is suitable to be utilized as a waste management location.

The second location is at coordinates 7°08'41.2"S and 112°47'4.76"T. This location consists of two lands including:

- a. The first land with an area of 1,234 m²
- b. The second land with an area of 1,433 m²

The sum of land area at the second location is 2,667 m², which means that the location does not meet the requirements based on BAPEDAL decision. Limited land is a constraint because the company will find difficulties to build waste treatment facilities. In addition, the second location belonging to PD Sumber Daya Bangkalan Regency is very close to residential areas. This causes the second land to be unproper for the medical B3 waste management.

The distance of the residential area from the proposed land of waste management location is ±50 m, so based on the decision issued by BAPEDAL, this should be avoided. The location of adjacent land to the settlement indicates that the location is also close to public facilities. The results of the assessment of alternative B3 medical waste management locations can be seen in Table 3.

Table 3. Location Feasibility Assessment Results

No	PARAMETER	WEIGHT	POINT	First Location		Second Location	
				Point	B x N	Point	B x N
I	PUBLIC						
1.	Administration Coverage	5					

No	PARAMETER	WEIGHT	POINT	First Location		Second Location	
				Point	B x N	Point	B x N
	a. In the administration coverage		10	0	0	0	0
	b. Out of administration coverage but in one of integrated B3 waste management		5				
	c. Out of administration coverage and out of integrated B3 waste management		1				
	d. Out of administration coverage		1				
2	Land-Right Owner	3					
	a. Local-Central Government		10	10	30	10	30
	b. Personal (1 owner)		7				
	c. Private or company (1 owner)		5				
	d. More than 1 land-right owner		3				
	e. Social or religious organization		1				
3	Land Capacity	5					
	a. More than 10 years		10	10	50	0	0
	b. 5-10 years		8				
	c. 3-5 years		5				
	d. Less than 3 years		1				
4	Land Owners	3					
	a. 1 Head of Family		10	10	30	10	30
	b. 2-3 Head of Family		8				
	c. 4-5 Head of Family		5				
	d. 6-10 Head of Family		3				
	e. More than 10 Head of Family		1				
5	Community Participations	3					
	a. Spontaneity		10	0	0	0	0
	b. Mobilization		5				
	c. Negotiation		1				
II	PHYSICS ENVIRONMENT						
1	Land (above ground water)	5					
	a. Groundwater < 10 ⁻⁹ cm/second		10	0	0	0	0
	b. Groundwater 10 ⁻⁹ cm/ second - 10 ⁻⁶ cm/second		7				
	c. Groundwater > 10 ⁻⁶ cm/second reject unless there is technology applied						
2	Soil Water	5					
	a. ≥ 10 m Groundwater < 10 ⁻⁶ cm/second		10	0	0	0	0
	b. > 10 m Groundwater < 10 ⁻⁶ cm/second		8				
	c. ≤ 10 m Groundwater < 10 ⁻⁶ cm/second - 10 ⁻⁴ cm/second		3				
	d. > 10 m dengan kelulusan < 10 ⁻⁶ cm/second - 10 ⁻⁴ cm/second		1				
3	Flow of Soil Water System	3					
	a. Discharge area or local (discharge area)		10	0	0	0	0
	b. Recharge area (supply area) and discharge local area		5				
	c. Recharge area regional and local		1				
4	Concern with Soil Water	3					
	a. Possibility of use with hydraulic limitation		10	0	0	0	0

No	PARAMETER	WEIGHT	POINT	First Location		Second Location	
				Point	B x N	Point	B x N
	b. Projected in use with hydraulic limitation		5				
	c. Projected in use with no hydraulic limitation		1				
5	Flood Threat	2					
	a. Flood-free area		10	10	20	10	20
	b. Possibility of flood > 25 years		5				
	c. Possibility of flood < 25 years Rejected (except on new technology supporting)						
6	Covering Land	4					
	a. Sufficient covering land		10	10	40	1	4
	b. Sufficient covering land to half of use		5				
	c. No covering land		1				
7	Rain Intensity	3					
	a. Below of 500 mm per year		10	10	30	10	30
	b. Between of 500 mm to 1000 mm per year		5				
	c. More than 1000 mm per year		1				
8	Access to the Location	5					
	a. Flat-good condition		10	10	50	10	50
	b. Flat-bad condition		5				
	c. Uneven ground condition		1				
9	Waste Transport (One Way)	5					
	a. Less than 15 minutes from waste centroid		10				
	b. Between 16 to 30 minutes from waste centroid		8				
	c. Between 31 to 60 minutes from waste centroid		5	5	25	5	25
	d. More than 60 minutes from waste centroid		1				
10	Entrance	4					
	a. Waste transporters don't route through settlement		10	10	40	10	40
	b. Waste transporters route through medium-density settlement (≤ 300 persons/Ha)		5				
	c. Waste transporters route through high-density settlement (>300 persons/Ha)		1				
11	Traffic	3					
	a. Located on 500 m from the main street		10				
	b. Located on < 500 m on low traffic		8	8	40	8	40
	c. Located on < 500 m on medium traffic		5				
	d. Located on high traffic		1				
12	Land Use	5					
	a. Having low impact to local land use		10	10	50	5	25
	b. Having medium impact to local land use		5				
	c. Having large impact to local land use		1				
13	Agriculture	3					

No	PARAMETER	WEIGHT	POINT	First Location		Second Location	
				Point	B x N	Point	B x N
	a. Located on unproductive land		10	10	30	5	15
	b. No impact to local agriculture		5				
	c. High impact to local land use		1				
14	Protected areas or nature reserves	2					
	a. There are no protected areas or nature reserves around it		10	10	20	10	20
	b. There are protected areas or nature reserves in the vicinity that are not negatively affected		5				
	c. There are protected areas or nature reserves in the vicinity that are negatively affected		1				
15	Biologic	3					
	a. Low Habitat		10	10	30	10	30
	b. High Habitat		5				
	c. Critical Habitat		1				
16	Noise and Smell	2					
	a. Buffering Zone Available		10	10	20	10	20
	b. Limited Buffering Zone Available		5				
	c. No Buffering Zone Available		1				
17	Aesthetics	3					
	a. Protection operation is not visible from the outside		10				
	b. The protection operation is slightly visible from the outside		5	5	15	5	15
	c. Protection operation visible from the outside		1				

6. Conclusion

Based on the assessment results of alternative locations for medical B3 waste treatment, it can be concluded that the first alternative location has a higher feasibility than the second one. The first alternative location is in Pangpong Village, Labang District, which is currently an unproductive vacant land. The distance to the nearest settlement is far enough so that it does not cause a significant social impact on the local community. Availability of land for the construction and development of 24,711 m² medical B3 waste treatment in accordance with the criteria established by BAPEDAL's decision. The topography is relatively flat, and is not a disaster-prone area or a nature reserve. The existing access road already exists, it only needs to improve the road quality to the waste treatment location and create a buffer around the location to maintain the quality of the surrounding environment so that it does not decrease or be polluted.

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Biographies

Rina Sri Wulandari is a lecturer of Universitas Nahdlatul Ulama Sidoarjo, Industrial Engineering Department.

Waluyo Prasetyo is a lecturer of Universitas Nahdlatul Ulama Sidoarjo, Industrial Engineering Department.

Luqman Hakim is a lecturer of Universitas Nahdlatul Ulama Sidoarjo, Industrial Engineering Department.

Taqwanur is a lecturer of Universitas Nahdlatul Ulama Sidoarjo, Industrial Engineering Department.

Medya Ayunda Fitri is a lecturer of Universitas Nahdlatul Ulama Sidoarjo, Chemical Engineering Department.