Waste Management Evaluation in Bima Regency, NTT Province

Paramita Dwi Sukmawati [1*], Yuli Pratiwi[1], Suparni Setyowati Rahayu[1], Rahmatunnisa[1]

[1]*Institut Sains & Teknologi AKPRIND Yogyakarta, Indonesia*
Corresponding author's email: mita@akprind.ac.id

ABSTRACT
Garbage is a consequence of life, which has often caused problems in many places. One way to overcome the waste problem is to provide TPS. One area in Indonesia that does not yet have TPS facilities is in Bima Regency, NTB Province. This study aims to 1) determine the location of TPS in Bima Regency by using the Geographic Information System, 2) Knowing the type of TPS that is recommended based on the mapping of TPS locations using the Geographic Information System, 3) Knowing the amount of waste generated in Bima RegencyThe study phase begins with determining the TPS sample location by considering the factors of distance to built-up land, distance to highway, and distance to the river. GIS application was used to map the suitability of TPS locations. TPS type recommendations based on mapping location using a GIS program. Determination of waste samples and waste collection to calculate the amount of waste generation. The recommended locations for the construction of TPS in Bima District (Bolo and Woha Districts) based on the results of analysis using Geographic Information Systems and field surveys are; a) Bolo District consisting of Nggembe Village, Saonolo Village, Timu Village, Daru Village, b) Woha District consisting of Pandai Village, Donggobolo Village, Risa Village, Dadibou Village, Kalampa Village, Tente Village. The proposed types of TPS are based on mapping the TPS locations suitable for Bolo sub-district are Ngembe, Saonolo (TPS1), Timu (TPS2), and Daru (TPS3) villages. Meanwhile, the appropriate TPS locations for the Woha sub-district are Pandai, Donggolobo (TPS1), Risa, Dadibou (TPS2), and Kalampa and Tente (TPS3) villages. The waste generation in Bolo and Woha sub-districts, Bima district, is for Bolo sub-district, which is 0.0098 kg/person/day, and Woha sub-district is 0.00857 kg/person/day.

Keywords: *Waste Management; Bima Regency; Geographic Information Systems*

1. INTRODUCTION

According to Constitution number 18 of 2008, waste is the residue of daily human activities and/or solid natural processes. Garbage is a consequence of life, which often and in many places has caused problems, for that it is necessary to do waste management. According to the Ministry of Environment and Forestry [1], waste management aims to improve public health and environmental quality and make waste a resource. However, in reality, there are still many problems in waste management.

Problems in waste management that often occur include the community's behavior and lifestyle, which still tends to lead to an increase in the rate of waste generation, which is very burdensome for waste management facilities, such as Temporary Shelters (TPS). TPS are facilities located close to residential or commercial areas [2]. TPS is used to receive and collect waste from collection vehicles until it can be transferred to a more extensive transfer vehicle for disposal back to a landfill, treatment center (such as waste for energy plants), or composting facilities [3].

The role of TPS is crucial for the community and for the government in maintaining environmental cleanliness because before waste is disposed of to the Final Processing Site (TPA), it is first transported to the TPS, making it easier for people to dispose of trash. The availability of temporary TPS in every area, including villages, sub-districts, and cities/districts, is very much

Z. B. Pambuko et al. (Eds.): BIS-HSS 2021, ASSEHR 667, pp. 1056–1064, 2023.
https://doi.org/10.2991/978-2-494069-49-7_176

needed to help deal with the waste problem; however, some areas in Indonesia still do not yet have TPS.

One area in Indonesia that does not yet have TPS facilities is in Bima Regency, NTB Province. As a result of the unavailability of TPS facilities, there is still a lot of waste being disposed of carelessly. Furthermore, the ineffectiveness of the waste transportation process carried out by the cleaning crew is a result of the lack of TPS facilities poorthe Bima Regency area.

Based on this, the author wants to map the location of TPS in Bima Regency, namely by using a Geographic Information System (GIS). GIS is a database system with unique capabilities to handle spatially referenced data along with a set of work operations [4]. The purpose of this study was to determine the location of TPS in Bima Regency using the Geographic Information System, to find out the type of TPS recommended based on the mapping of TPS locations using the Geographic Information System, to determine the amount of waste generated in Bima Regency. This research has theoretical and practical benefits. Theoretically, this research is expected to provide scientific contributions to community participation in environmental management. The benefits are material for consideration and useful input for the Bima Regency Government in overcoming solid waste problems.

2. METHODS

The variables investigated in this study are the appropriate location for TPS construction, the recommended type of TPS, and the amount of waste generated in the Bima Regency. Primary data collection was done using observation techniques, namely purposive sampling, documentation techniques, and interviews. Secondary data collection techniques are carried out by searching for data from the relevant agencies. Determination of the mapping of TPS location points is done by scoring (scoring), TPS recommendations are determined based on SNI 19-2454-2002 [5], waste generation is calculated based on SNI 19-3964-1994 [6].

The TPS suitability map was obtained from three influence parameters. The three parameters of influence include distance to built-up land (settlement), distance to the main road, distance to the river. The categorization findings of the total score of the three characteristics are used to determine the location's suitability for TPS. Tables 1 to 3 show the details of data analysis as described by Glanville and Chang [7]:

Data analysis uses a scoring or award approach, namely the weighted tiered rating in the Geographic Information System. A map of the location's suitability for the TPS location is created by multiplying the weight of each criterion by categorizing the influence parameters. The classification of location suitability classes for TPS can be seen as follows:

$$Ki = \frac{Xt-Xr}{K} \quad (1)$$

description:

Ki = location suitability class interval for TPS

Xt = the total number of highest scores of value (18)

Xr = the total number of lowest scores of value (6)

K = number of location suitability classes for TPS

$$\text{then, } Ki = \frac{18-6}{3} = 4$$

Based on the above formula, it is obtained that the interval class (Ki) is four class intervals. The class of location suitability for disposal temporary shelters (TPS) is presented in Table 4. The recommendation is based on comparing the suitability of the TPS location and the Bima Regency Spatial Plan. The method is to filter the suitability of the TPS location with the filtering criteria presented in Table 5.

Table 1. Class and value of TPS distance to the river

Distance to river	Class	Value	Weight	Total score
<30 m	Bad	1	1	1
30-60 m	Medium	2	1	2
>60 m	Good	3	1	3
Total				6

Table 2. Class and value of TPS distance to the main road

Distance to the main road	Class	Value	Weight	Total score
<50 m	Bad	1	2	2
>100 m	Medium	2	2	4
50-100 m	Good	3	2	6
Total				12

Table 3. Class and value of TPS distance to built-up land

Distance to built-up land	Class	Value	Weight	Total score
<50 m	Bad	1	3	3
>100 m	Medium	2	3	6
50-100 m	Good	3	3	9
Total				18

Table 5. City Spatial Plan Comparison

Filter	Criteria
A	Built-up Area
B	Green open area

The matrix of the relationship between the suitability of the land location for TPS and the City Spatial Plan can be seen in Table 6.

Table 6. The matrix between the physical suitability of the land and the city spatial plan

Location Suitability for TPS	City Spatial Plan Filter A	B
Suitable (S1)	R1	R4
Quite Suitable (S2)	R2	R4
Not Suitable (S3)	R3	R4

Description:
RI = Recommendation 1 (suitable to the City Spatial Plan)
R2 = Recommendation 2 (quite suitable to the City Spatial Plan)
R3 = Recommendation 3 (not suitable to the City Spatial Plan)
R4 = Not recommended
A = Filter A
B = Filter B

3. RESULTS AND DISCUSSIONS

3.1. Acquisition and conformity mapping of TPS locations

The TPS suitability map was obtained from three influence parameters. The three parameters of influence include distance to built-up land (settlement), distance to the main road, distance to the river. The determination of the map is obtained from the classification of the relevant parameters.

3.2. Distance to the main road

TPS distance to the road is a parameter that affects the determination of TPS location. The location relates to accessibility and aesthetic aspects (Fig. 1). This road distance map was created to determine the accessibility of waste transportation from the TPS that would be constructed. In addition, the distance to the road is made to maintain aesthetics so that the TPS built will not interfere with road users who pass through the road segment. The distance to this road is divided into three classes, namely bad (<50 m), good (50-100 m), and medium (> 100 m).

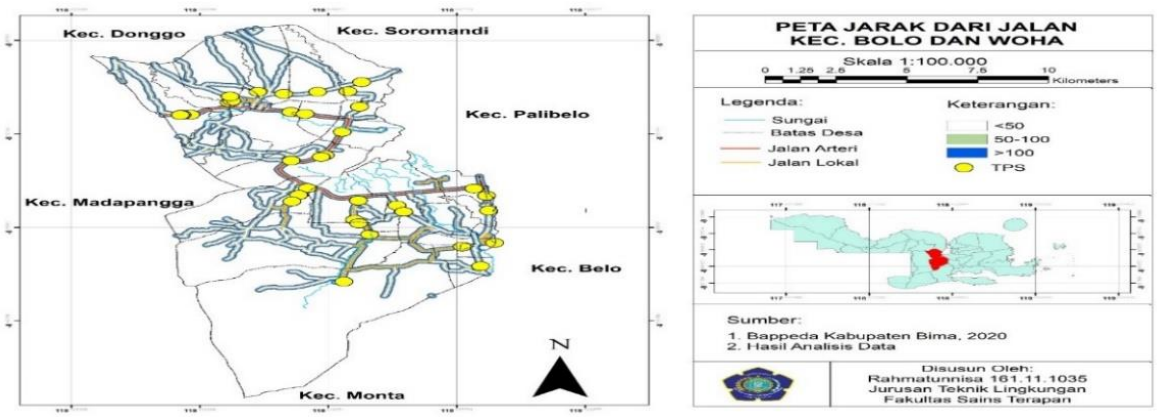

Figure 1 Map of TPS distance to the road (reprinted with permission)

3.3. Distance to the river

The map of the distance between the TPS and the river is closely related to its impact. The environmental impact caused is pollution. If not appropriately managed and properly, TPS can cause pollution to the river. The distance from TPS to the river is at least 30 meters from the river. The farther from the river, the better. In classifying the distance to the river, it is divided into three classes, namely <30 m is classified as bad, 30-60 m is classified as moderate, and >60 m is classified as good (Fig. 2).

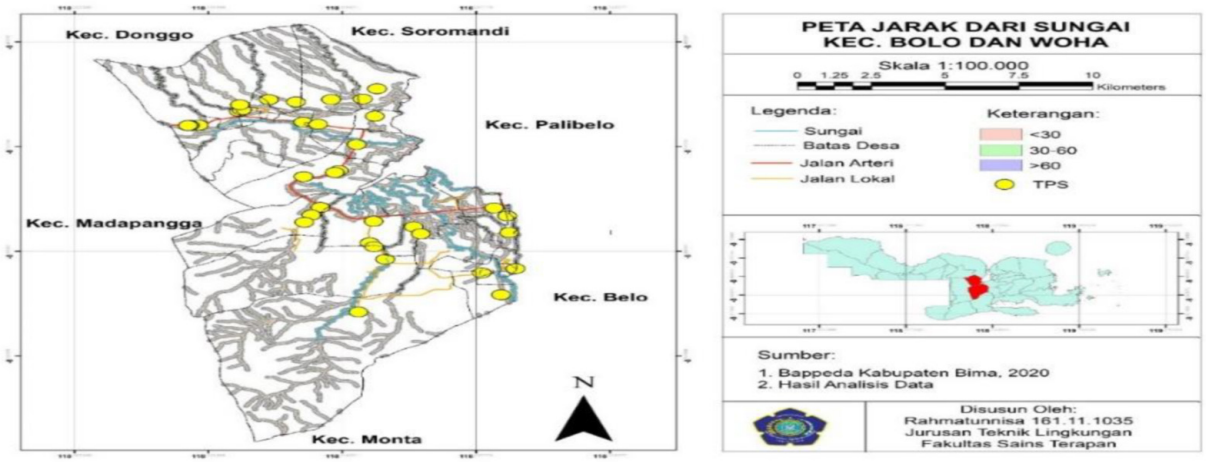

Figure 2 Map of TPS distance to the river (reprinted with permission)

3.4. Distance to built-up land

Making maps of built-up land (settlements) is carried out by a buffering process. The distance to the built-up land (territory) is carried out in the entire built-up area. Build-up land (settlements) buffering is carried out on existing land use maps. In the land-use map, simplification will be carried out first, namely, choosing which elements or components are considered essential and influential in determining the location of TPS. In the land use map, the selected elements are buildings and settlements. These two elements are considered significant and have an essential role in making TPS. The distance between TPS and settlements is closely related to the impact of pollution, one of which is an unpleasant odor for the community.

At a distance of <50 m and 0 m, it is not appropriate to build a TPS because the construction of TPS in the area can disturb the comfort and health of the people around the TPS. A distance of 50-100 m is suitable for TPS locations; at that distance, it will be easier for people to reach and access TPS. The community can use and utilize these facilities properly and reduce environmental pollution because they are managed together. For distances >100 m, it belongs to the medium class; it is difficult for people to access TPS at that distance. Long distances cause people to care less and less use TPS, so people tend to throw garbage in any place that is considered easy to access without thinking about the impact (Fig. 3).

3.5. Location suitability for TPS

The suitability of the location shows the level of land capability for TPS in Bolo and Woha District. The suitability map for TPS locations was obtained from GIS analysis and classified based on a predetermined score. Table 7, Table 8 and Fig 4 presents the result of the data analysis carried out.

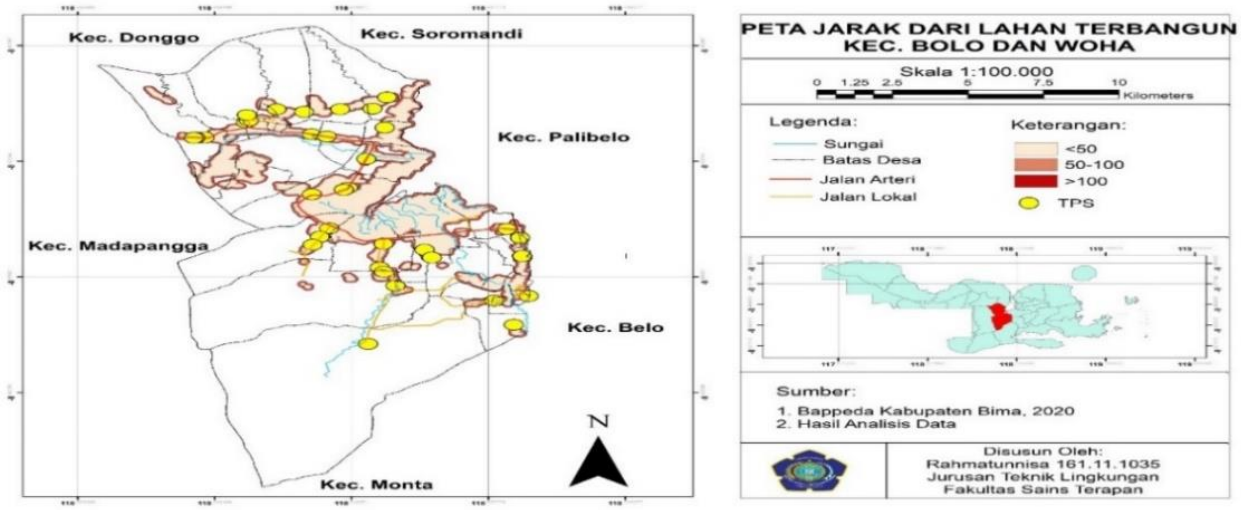

Figure 3 Map of TPS distance to the built-up land (reprinted with permission)

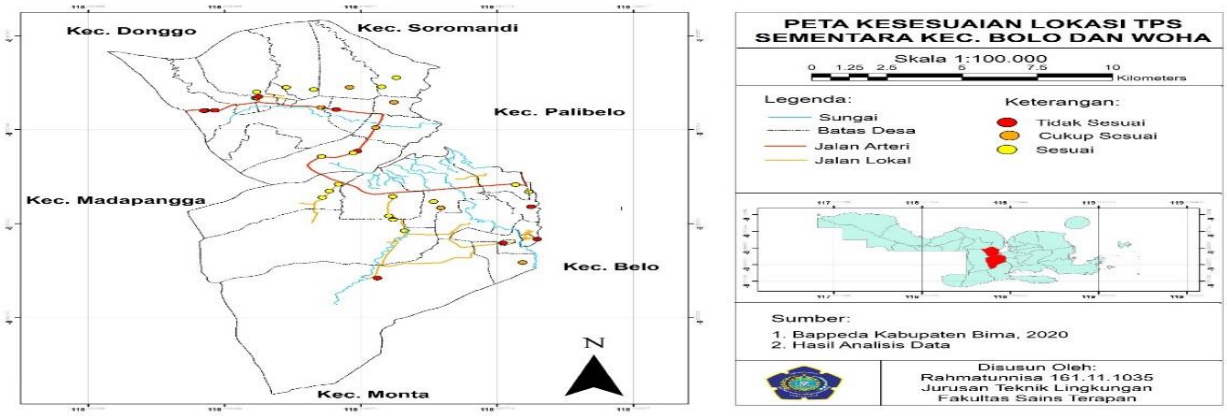

Figure 4 Map of TPS location suitability (reprinted with permission)

Table 7. Classification of location suitability for TPS in Bolo District

Coordinate			Observed parameters – distance to (m)					
No.	X	Y	Location	Road	River	Built-up Land	Total Score	classification
1	S8°30'31.92"	E118°38'8.47"	Timu	65	210	45	12	Quite suitable
2	S8°30'36.00"	E118°38'22.49"	Timu	20	215	30	8	Not suitable
3	S8°30'18.91"	E118°39'25.67"	Daru	33	100	160	11	Quite suitable
4	S8°29'44.57"	E118°39'11.29"	Nggembe	88	115	105	15	Suitable
5	S8°29'20.85"	E118°39'32.25"	Nggembe	34	150	50	14	Suitable
6	S8°29'44.63"	E118°38'37.90"	Rada	60	120	40	12	Quite suitable
7	S8°29'51.53"	E118°38'9.33"	Tumpu	60	80	113	15	Suitable
8	S8°30'37.29"	E118°35'54.17"	Tambe	25	140	9	8	Not suitable
9	S8°30'37.34"	E118°35'53.28"	Tambe	25	140	9	8	Not suitable
10	S8°30'38.63"	E118°36'37.57"	Tambe	30	90	10	8	Not suitable
11	S8°31'16.39"	E118°39'5.33"	Sondo	50	60	20	8	Quite suitable
12	S8°32'15.10"	E118°38'40.27"	Sanolo	25	60	56	14	Suitable
13	S8°32'24.56"	E118°36'6.84"	Sanolo	40	75	60	14	Suitable
14	S8°32'10.84"	E118°38'45.72"	Sanolo	21	220	8	8	Not suitable
15	S8°30'9.73"	E118°36'56.40"	Rato	50	300	12	12	Quite suitable
16	S8°30'6.00"	E118°36'58.94"	Rato	20	280	6	8	Not suitable
17	S8°29'57.07"	E118°36'57.92"	Rato	42	130	50	14	Suitable
18	S8°29'43.82"	E118°37'25.15"	Tumpu	62	240	105	15	Suitable

Table 8. Classification of location suitability for TPS in Woha District

Coordinate			Observed parameters – distance to (m)					
No.	X	Y	Location	Road	River	Built-up Land	Total Score	classification
1	S8°33'35.23"	E118°38'20.62"	Pandai	250	850	100	16	Suitable
2	S8°33'43.42"	E118°38'14.99"	Pandai	40	50	55	13	Suitable
3	S8°34'16.15"	E118°37'59.00"	Pandai	37	300	50	14	Suitable
4	S8°33'55.27"	E118°39'23.16"	Donggobolo	20	500	50	14	Suitable
5	S8°34'39.22"	E118°39'19.81"	Risa	30	50	100	13	Suitable
6	S8°34'48.28"	E118°39'33.40"	Risa	30	400	50	14	Suitable
7	S8°35'13.26"	E118°39'36.54"	Risa	42	350	65	14	Suitable
8	S8°37'1.52"	E118°39'0.95"	Keli	30	750	35	8	Not suitable
9	S8°34'58.17"	E118°40'44.50"	Kalampa	50	80	30	12	Quite suitable
10	S8°35'47.62"	E118°40'53.38"	Waduwani	20	600	45	8	Not suitable
11	S8°36'25.64"	E118°41'43.38"	Tente	10	20	60	12	Quite suitable
12	S8°35'33.14"	E118°41'59.47"	Nisa	15	800	22	8	Not suitable
13	S8°34'19.40"	E118°41'52.25"	Rabakodo	10	500	30	8	Not suitable
14	S8°33'27.57"	E118°41'23.22"	Talabiu	23	200	100	14	Suitable
15	S8°33'44.32"	E118°39'58.88"	Dadibou	30	400	50	14	Suitable
16	S8°34'42.55"	E118°40'35.85"	Kalampa	35	880	90	14	Suitable

3.6. City Spatial Plan (CSP)

The TPS location suitability map is filtered using the CSP map. The built-up and green areas of the CSP map were simplified for this study. Residential areas, trade, offices, education, and other activities are all included in the built area. The green area is an area used to maintain environmental balance and as the lungs of the city. Green areas are prone to change from year to year if the local government is not serious about implementing regulations and laws.

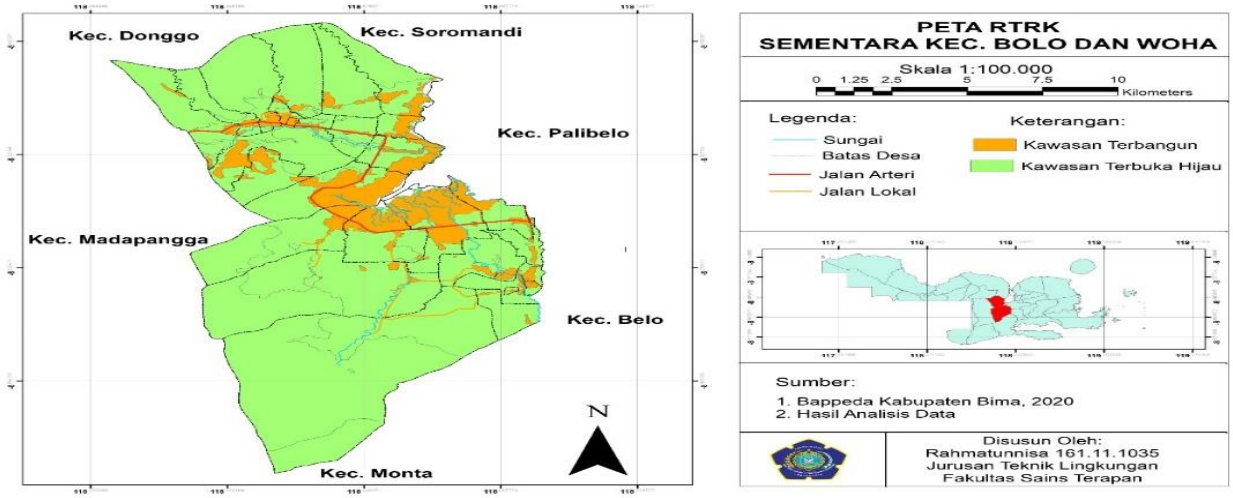

Figure 5 Map of CSP of Bolo and Woha District (reprinted with permission)

3.7. Recommendations for TPS locations

The recommendation map was obtained by comparing a two-dimensional table between the TPS and CSP suitability maps. This recommendation is made to align the analysis results with the existing CSP. A comparison of the TPS map obtained with the CSP map is carried out so that there are no errors in the placement of the TPS construction. A TPS can't build a green area map because the green area is designated for maintaining the balance of the urban environment and the city's lungs. The TPS is observed because of the narrowing of green areas due to the increasing need for land both for settlements and public facilities.

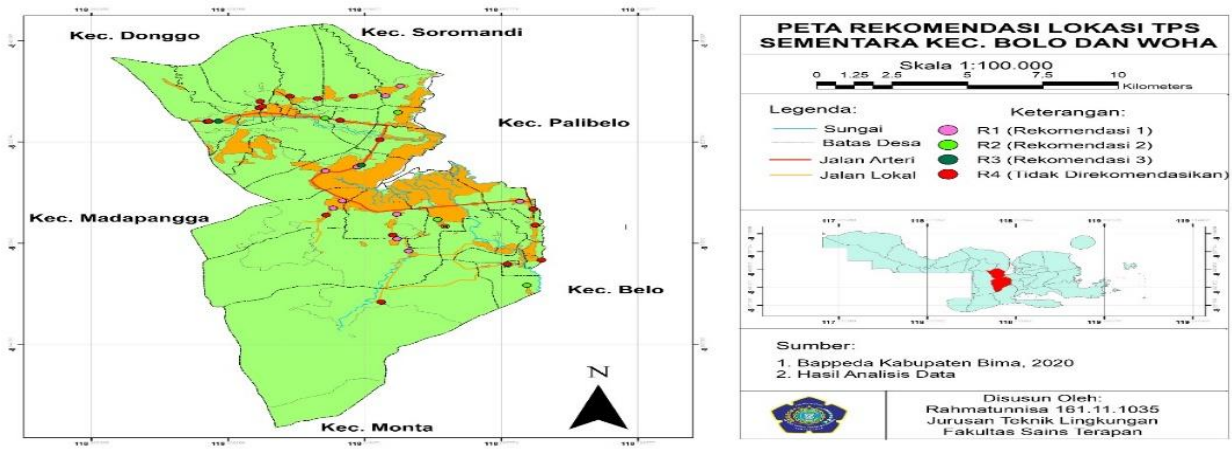

Figure 6 Map recommendation for TPS locations in Bolo and Woha districts (reprinted with permission)

3.8. Recommended type of appropriate TPS

Based on the types of TPS according to SNI 19-2454-2002 above, recommendations for suitable TPS for mapping locations in Bolo District and Woha District are determined based on the land area of the mapping location. It is more acceptable to recommend the construction of a type 3 TPS if the mapping location has a land area of 10-50 m^2, whereas it is more appropriate to recommend the construction of a type 2 TPS if the mapping location has a land area of 60-200 m^2 and for a more exact mapping location. A land area of >200 m^2 is recommended to construct type 1 TPS.

3.9. Garbage sampling results

The volume of waste is known by measuring the height of the waste in the measuring box, then

multiplying the length and width of the measuring box. Waste volume data collection was carried out for eight consecutive days to represent the dynamic cycle of waste products for one week. The following is the volume of waste from residential and non-residential facilities for eight straight days starting from waste sampling on 17-24 January 2021 for Bolo District and 31 January-7.February 2021 for Woha District.

Table 9. Classification of the level of conformity of the recommended TPS locations in Woha and Bolo Districts

No.	Coordinate		Location		Classification
	X	Y	Village	District	
1	S8°29'44.57"	E118°39'11.29"	Nggembe	Bolo	Recommendation 1
2	S8°29'20.85"	E118°39'32.25"	Nggembe	Bolo	Recommendation 1
3	S8°32'15.10"	E118°38'40.27"	Sanolo	Bolo	Recommendation 1
4	S8°32'24.56"	E118°36'6.84"	Sanolo	Bolo	Recommendation 1
5	S8°30'31.92"	E118°38'8.47"	Timu	Bolo	Recommendation 2
6	S8°30'18.91"	E118°39'25.67"	Daru	Bolo	Recommendation 2
7	S8°33'35.23"	E118°38'20.62"	Pandai	Woha	Recommendation 1
8	S8°33'43.42"	E118°38'14.99"	Pandai	Woha	Recommendation 1
9	S8°33'55.27"	E118°39'23.16"	Donggobolo	Woha	Recommendation 1
10	S8°34'48.28"	E118°39'33.40"	Risa	Woha	Recommendation 1
11	S8°35'13.26"	E118°39'36.54"	Risa	Woha	Recommendation 1
12	S8°33'44.32"	E118°39'58.88"	Dadibou	Woha	Recommendation 1
13	S8°34'58.17"	E118°40'44.50"	Kalampa	Woha	Recommendation 2
14	S8°36'25.64"	E118°41'43.38"	Tente	Woha	Recommendation 2

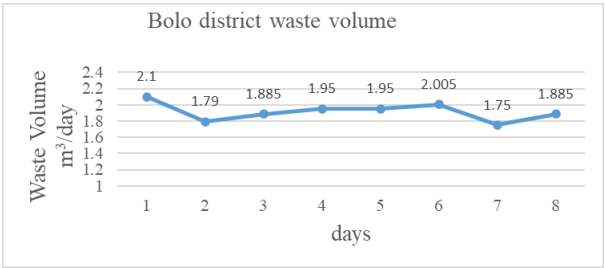

Figure 7 Graph of the amount of waste in Bolo District

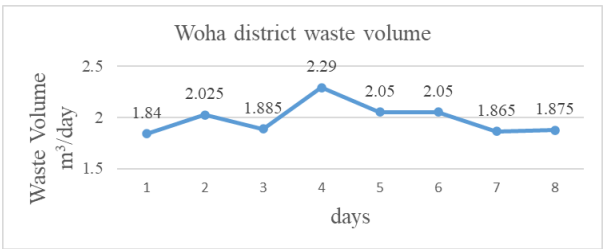

Figure 8 Graph of the amount of waste in Woha District

3.10. Density Analysis and Waste Generation

The waste density measurement was carried out based on SNI 19-3964-1994 by mixing the well and putting the waste into a wooden box measuring 0.5m x 1.0m x 1.0m.

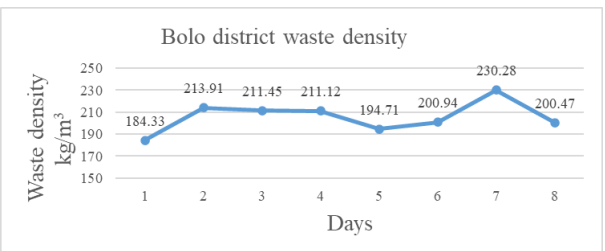

Figure 9 Graph of waste density in Bolo District

It is necessary to know the waste generation rate for the Bolo District area to calculate the amount of waste generated. The waste generation rate is calculated by dividing the average volume of waste per day by the known population of Bolo District and multiplying by the average density that has been determined. Obtained for eight consecutive days. The following is an example of calculating the waste generation in Bolo District:

The following is an example of calculating waste generation:

$$\text{Waste pile rate} = \frac{\text{Average waste volume}}{\text{number of population}} \text{ x density}$$

The following is an example of calculating the rate of waste generation in Bolo District:
Average waste volume: 1,914 m3/day
The population of Bolo Subdistrict: 48,708 people
Waste density : 205.90 kg/m3

$$\text{Waste generation rate} = \frac{1914\ \boldsymbol{m^3}/\text{day}}{48{,}708} \text{ x } 205.90 \text{ kg/ m}^3$$

Waste generation rate = 0.0098 kg/person/day

Based on the calculation results, the rate of waste generation in Bolo District is 0.0098 kg/person/day.

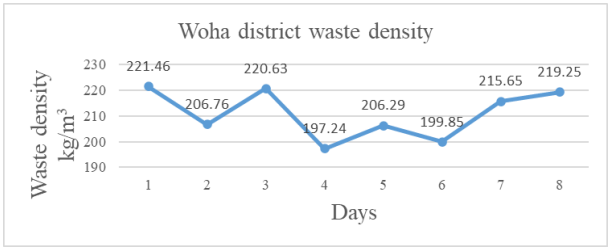

Figure 10 Graph of waste density in Woha District

To compute the amount of waste generated, the rate of waste creation for the Woha District region must be known. The waste generation rate is derived by calculating the average volume of waste per day by the estimated population of Woha District and multiplying by the estimated average density. Obtained for eight consecutive days. The following is an example of calculating the waste generation in Woha District:

The following is an example of calculating waste generation:

$$\text{Waste generation rate} = \frac{\text{Average waste volume}}{\text{number of population}} \text{ x density}$$

The following is an example of calculating the rate of waste generation in Woha District:

Average waste volume: 1,985 m^3/day
Woha District Population: 48,837 people
Waste density : 210.89 kg/m^3

$$\text{Waste generation rate} = \frac{1985\ \boldsymbol{m^3}/\text{day}}{48{,}837} \text{ x } 210.89 \text{ kg/ } m^3$$

Waste generation rate = 0,00857 kg/person/day

Based on the calculation results, the waste generation rate in Woha District is 0.00857 kg/person/day.

4. CONCLUSIONS

Based on the research that has been done, several conclusions can be drawn as follows:

1. The recommended locations for the construction of TPS in Bima Regency (Bolo district and Woha district) based on the results of analysis using Geographic Information Systems and field surveys are:
   a. Bolo District which consists of Nggembe Village which is located at coordinates S8029'44,57724"/ E118039'11,29644", S8029'20.85"/ E118039'32,256", Saonolo Village which is located at coordinates S8032'15,10872"/ E118038'40,27236", S8032'24,5688"/ E118036'6,8478", Timu Village which is located at coordinates S8030'31,92588"/ E118038'8,4786" and Daru Village which is located at coordinates S8030'18 ,91188"/ E118039'25,67988".
   b. Woha District which consists of Pandai Village which is located at coordinates S8033'35,23824"/ E118038'20,6286", S8033'43,42788"/ E118038'14,99388", Donggobolo Village which is located at coordinates S8033'55,27692 "/ E118039'23,16024", Risa Village which is located at coordinates S8035'13,26264"/ E118039'36,54252", S8034'48,28476"/ E118039'33,4062", Dadibou Village which is located at coordinates S8033 '44,32248"/ E118039'58,88592", Kalampa Village which is located at coordinates S8034'58,17612"/ E118040'44,508", S8034'42,55392"/ E118040'35,85288" and Tente Village which is located at coordinates S8036'25,64028"/ E118041'43,38708".
2. The recommended types of TPS based on the mapping of TPS locations using the Geographic Information System are,
   a. Bolo District
      1) Locations that are suitable for TPS type 1 with an area of >200 m2 are Nggembe Village which is located at coordinates S8029'44,57724"/ E118039'11,29644", S8029'20.85"/ E118039'32,256", Desa Saonolo which is located at coordinates S8032'15,10872"/ E118038'40,27236", S8032'24,5688"/ E118036'6,8478".
      2) The appropriate location for TPS type 2 with a location area of 60-200 m2 is Timu Village, located at coordinates S8030'31.92588"/ E118038'8.4786".
      3) The suitable location for TPS type 3 with an area of 10-20 m2 is Daru Village, located at coordinates S8030'18,91188"/ E118039'25,67988".
   b. Woha District
      1) The suitable location for TPS type 1 with an area of >200 m2 is Pandai Village which is located at coordinates S8033'35,23824"/ E118038'20,6286", S8033'43,42788"/ E118038'14,99388" , Donggobolo Village which is located at coordinates S8033'55,27692"/ E118039'23,16024", Risa Village which is located at coordinates S8035'13,26264"/ E118039'36,54252".
      2) Locations suitable for TPS for type 2 with a location area of 60-200 m2 are Risa Village which is located at coordinates S8034'48,28476"/ E118039'33,4062", Dadibou Village which is located at coordinates S8033'44,32248" / E118039'58,88592".
      3) Locations that are suitable for TPS type 3 with an area of 10-20 m2 are Kalampa Village which is located at coordinates S8034'58,17612"/ E118040'44,508", S8034'42,55392"/ E118040'35,85288" and Tente Village is located at coordinates S8036'25,64028"/ E118041'43,38708".
3. Waste generation in Bolo Subdistrict and Woha Subdistrict, Bima Regency based on the results of calculations using the density box, the rate of waste generation for Bolo District is 0.0098 kg/person/day, and Woha District is 0.00857 kg/person/day

ACKNOWLEDGMENTS

Special thanks to the Department of Environmental Engineering, AKPRIND Institute of Science & Technology Yogyakarta for the independent research conducted by lecturers and students with publication costs funded by a grant from the Independent Campus Competition Program (PKKM).

REFERENCES

[1] Ministry of Environment and Forestry. "National Plastic Waste Reduction Strategic Actions for Indonesia, Republic of Indonesia. (2020). Available at https://wedocs.unep.org/bitstream/handle/20.500.11822/32898/NPWRSI.pdf

[2] USAID. "Clean Cities, Blue Ocean – Initial Solid Waste Management Assessment (ISWMA) Indonesia. (2021). Available at https://pdf.usaid.gov/pdf_docs/PA00XWPP.pdf

[3] N. Ferronato and V. Torretta. "Waste Mismanagement in Developing Countries: A Review of Global Issues". International Journal of Environmental Research and Public Health. 16(1060). (2019). 1-28. DOI: 10.3390/ijerph16061060.

[4] F.M. Howari and H. Ghrefat. "Chapter 4 – Geographic Information System: Spatial Data Structures, Models, and Case Studies". Pollution Assessment for Sustainable Practices in Applied Sciences and Engineering. (2021). 165-198. DOI: 10.1016/B978-0-12-809582-9.00004-9.

[5] Indonesia National Standard Agency. "Operational, technical procedures for urban waste management". SNI 19-2454-2002. (2002).

[6] Indonesia National Standard Agency. "Methods of taking and measuring samples of the generation and composition of municipal solid waste". SNI 19-3964-1994. (1994).

[7] K. Glanville and H.C. Chang. "Remote Sensing Analysis Techniques and Sensor Requirements to Support the Mapping of Illegal Domestic Waste Disposal Sites in Queensland, Australia". Remote Sensing. 7 (2015). 13053-13069. DOI: 10.3390/rs71013053.