Determination of Service Priority Areas as an Effort to Increase Urban Solid Waste Service

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Abstract. Limited budget and infrastructure require that a selection be made, which areas prioritize solid waste services. The priority of waste services is determined based on the results of the assessment of the interest scale matrix of the service area. Regions with the highest matrix scores receive priority, followed by sites with lower scores. This study aims to determine the importance of increasing the solid waste service area in Ngawi district, with 19 sub-districts. The results showed that the Ngawi sub-district, as the district capital, Ngawi sub-district was the priority to improve solid waste services, followed by Kedunggalar, Karangjati, Mantingan, and Padas sub-districts.

1. Introduction

Economic status improvement and industrial developments, technological advances, educational facilities, tourism transform rural areas into urban areas. The increase in the number of urban residents accompanied by an increase in welfare and changes in lifestyle have an effect on increasing solid waste generation and the composition of the solid waste produced. Municipal solid waste must be appropriately managed to ensure sanitation and not cause environmental pollution. However, the population density and high building density do not allow urban communities to process the solid waste they produce themselves, thus demanding a solid waste service from the local government [1] [2].

The generation of solid waste produced by urban residents is increasing from time to time. Research that has been done shows that only about 60%-70% can be transported and processed in the landfill using the sanitary landfill method [3] [4]. Municipal solid waste management is a challenge that has to be faced by most cities and districts in Indonesia [2] [3].

Municipal solid waste service is simply collecting and transporting solid waste from the source of the solid waste to processing it at the final processing facility. Solid waste collection activities can be described as activities that collect solid waste from the service areas, and be brought to a temporary transfer facility in the form of TPS, TPS3R, or TPST. At the solid waste transfer facility, collected solid waste will be sorted and processed by TPS, TPS3R, or TPST officers. Furthermore, transporting solid waste to the final landfill disposal site [1].

Several factors affect the municipal solid waste collection, transfer, and transport activities. These are the amount of solid waste generated, service coverage area, building distribution, building density, road width, distance to final disposal, the topography of service area, availability of solid waste service facilities, resident socio-economic conditions, and community participation [5] [6]. Community

participation in sorting, reusing, and processing solid waste will reduce managed solid waste and prolong landfill lifetime as final disposal of solid waste.
The agent in charge of solid waste services from solid waste sources to solid waste transfer facilities in the local community, at the level of RT, RW, or housing management, while solid waste services from solid waste transfer facilities to final disposal are the responsibility of the city or local government [2] [7] [8].

Increasing solid waste services coverage is not an easy task [1], [2]. The achievements of municipal solid waste service depend on the number of residents served, the coverage area served and the amount of waste transported to the final disposal facility site. The generation of solid waste increases along with the rise in population and is supported by the lack of community participation in reducing the solid waste produced [8]. The increase in solid waste generation demands an increase in the availability of solid waste management facilities where the procurement is related to the availability of budget [9] [10].

The problem of improving solid waste services is limited by the availability of solid waste management facilities. Therefore it is necessary to select areas that receive priority for solid waste services. The research takes a case study of Ngawi Regency, which has 19 sub-districts. This research evaluating which Ngawi sub-districts have priority to get primary solid waste services for 19 sub-districts in Ngawi Regency in the future.

2. Literature review

Determination of the solid waste service area in SNI 19-2454-2002 can be done through 2 approaches, namely based on the scale of the importance of the service area and based on the development of city spatial planning [11]. The determination of the significance of the solid waste service area is calculated using a matrix. The matrix is composed of parameters, weights, and values. The weight is used to indicate the parameters that have a significant influence in determining the priority of the service area. At the same time, the high and low values are related to the impact of sanitation insecurity and economic potential on determining the solid waste service area [12].

The assessment parameters consist of 6 categories: regional functions and values, population density, environmental sanitation conditions, service areas type activity, population socio-economic levels, and neighborhood topography. Weights and values have a quantitative value. The weight has a numerical value between 1 to 3, where the more significant the scale is given, the greater the Parameter will affect the determination of the service area. The parameter score has a magnitude of 1 to 5, where the greater the value, the more vulnerable. The assessment from sanitation vulnerability aspect and the economic potential aspect. The greater the value of sanitation vulnerability, the weaker the area to sanitation, so that it gets priority for solid waste services. The smaller the potential economic value, the greater the economic potential, so it is necessary to receive solid waste services. The weight multiplied by the score will get the number of sanitation vulnerabilities and economic potential of each Parameter. The scores of sanitation insecurity and aspects of the economic potential of all parameters will be obtained from the priority number of solid waste services. The area with the highest score prioritizes the solid waste services, followed by the values below it [11] [12].

There are several weaknesses in the matrix of determining the scale of interest of the service area, including (i) the scope of use is not clear, whether it is the sub-district scale or the kelurahan/village scale, (ii) the criteria used are not equipped with detailed explanations, (iii) the score for sanitation vulnerability and economic potential is not clear depends based on the determination, (iv) the score for sanitation vulnerability and economic potential is given as a pair. Based on the weaknesses mentioned above, it is possible to modify the matrix according to the conditions of the research study and the availability of data [12].

3. Research methods

The research is located in Ngawi Regency geographically, it is situated between 1100 10' - 1110 40' East Longitude and 70 21' - 7 0 31' South Latitude, administratively consists of 19 sub-districts and 217 villages. Currently, the scope of solid waste services is mainly Ngawi sub-district as the district capital and a small number of sub-district around it. Solid waste from the service area is processed at

the Selopuro TPA (Selopuro landfill) in the Pitu sub-district. The Ngawi Regency Environmental Service (DLH Ngawi) in charge of solid waste services is the Ngawi district area [13].

For the future planning of solid waste service coverage enhancement, an assessment was carried out on 19 sub-districts in Ngawi Regency. The evaluation is carried out based on the interest scale matrix of the service area. The sub-district that has a higher total value will receive priority for solid waste services first.

The condition of 19 sub-districts in the Ngawi district was analyzed using secondary data. Such as BPS Ngawi data, sub-district reports in figures, Ngawi regional spatial plan (RTRW) report, Ngawi solid waste masterplan report, sanitation report, Ngawi district DLH report [13]. Based on the results of secondary data analysis [14], values were determined for aspects of sanitation vulnerability and elements of economic potential [15].

The service area importance scale based on SNI 19-2454-2002 has six parameters, but in this study, two parameters were added, so that it became eight parameters. The two additional parameters are the distance from the sub-district capital to the Selopuro TPA (Selopuro landfill) site and the percentage of urban areas in each sub-district. The sub-district with the closest distance to the Selopuro TPA (Selopuro landfill) site has more priority, considering that the operational costs of transporting solid waste are limitations of solid waste services. The travel time between the service area to the landfill disposal site should be less than 60 minutes. The travel time parameter is added to the matrix parameter, converted into the distance (km), assuming the speed of transporting waste from the solid waste service area to the landfill disposal site is a maximum of 40 km/hour [13]. Solid waste services are prioritized in urban areas [1] [16]. Therefore, sub-districts with a more significant percentage of urban areas will receive priority for solid waste services.

Table 1. Calculation matrix for determining the importance of the solid waste service area

No	Parameters	Weight	Score	
			Sanitation Vulnerability	Economic Potential
1	Regional Functions and Values	3		
	a. Areas on the main road/city centre		3	4
	b. Commercial area		3	5
	c. Regular residential area		4	4
	d. Industry		2	4
	e. Roads, parks, and urban forests		3	1
	f. Irregular residential areas, sewers		5	1
2	Population density	3		
	a. < 50 people/km2 - 100 people/km2 (low)		1	4
	b. >100 people/km2 - 300 people/km2 (medium)		3	3
	c. >300 people/km2 (high)		5	1
3	Service Area	3		
	a. the area that has been served		5	4
	b. The area that is near to the served area		3	3
	c. the area that is far from the served area		1	1
4	Environmental conditions	2		
	a. Good (solid waste managed, clean environment)	6	1	1
	b. Medium (solid waste managed, dirty environment)	15	2	3
	c. Bad (unmanaged solid waste, dirty environment)	15	3	2
	d. Very bad (unmanaged solid waste, squalid environment), infectious disease endemic area	15	4	1
5	Population income level	2		
	a. Low income (0-10%)		5	1
	b. Middle income (10-30%)		3	3
	c. High income (>30%)		1	5

No	Parameters	Weight	Score	
			Sanitation Vulnerability	Economic Potential
6	Topography	1		
	a. flat (slope < 5%)		2	4
	b. bumpy (slope 5 - 15%)		3	3
	c. Hill/steep (slope > 15%)		3	1
7	Distance to TPA Selopuro	2		
	a. 0 - 10 km		2	4
	b. 11 - 20 km		2	3
	c. 21 - 40 km		3	2
	d. > 40 km		4	1
8	Service area type	1		
	a. < 25% urban		1	1
	b. 25% - 50% urban		2	2
	c. 50% - 75 % urban		3	4
	d. > 75% urban		4	5

4. Results and Discussion

Based on the secondary data collected [14], the value is determined for 19 sub-districts. Multiplying the weight with the value of sanitation vulnerability is added by multiplying the weight with the potential economic value to produce the criteria's total value. Furthermore, the sum value of the eight criteria is added up, and the result is the total score for calculating the importance of the solid waste service area. The results of the analysis of the condition of 19 Ngawi district and the determination of the value for each Parameter from Table 1, the calculation results are obtained as follows:

Table 2. Recapitulation of the calculation results of determining the importance of the solid waste service area for 19 sub-districts of Ngawi Regency

No	Sub-districts	Total Weight x Value of sanitation vulnerability and economic potential for Parameter								Total Sanitation vulnerability and potential economic score
		Regional Functions and Values	Population density	Service Area	Environmental conditions	Population income level	Topography	Distance to TPA Selopuro	Service area type	
1	Sine	12	15	6	4	12	4	10	4	67
2	Ngrambe	12	18	6	4	12	4	10	4	70
3	Jogorogo	12	18	18	4	12	4	10	7	85
4	Kendal	12	15	6	4	12	4	10	4	67
5	Geneng	12	18	18	10	12	6	10	4	90
6	Gerih	12	18	18	4	12	4	10	4	82
7	Kwadungan	12	18	18	10	12	6	10	4	90
8	Pangkur	12	18	18	4	12	6	10	4	84
9	Karangjati	12	18	18	10	12	6	10	7	93
10	Bringin	12	15	6	4	12	6	10	4	69
11	Padas	12	18	18	10	12	6	10	7	93
12	Kasreman	12	18	18	4	12	6	10	7	87
13	Ngawi	24	18	27	10	12	6	12	7	116
14	Paron	12	18	18	4	12	6	10	4	84

No	Sub-districts	Total Weight x Value of sanitation vulnerability and economic potential for Parameter								Total Sanitati
15	Kedunggalar	24	15	18	10	12	6	10	2	97
16	Pitu	12	15	27	4	12	6	12	4	92
17	Widodaren	24	18	6	10	12	6	10	4	90
18	Mantingan	24	18	6	10	12	6	10	7	93
19	Karanganyar	21	15	6	10	12	6	10	4	84

The role of each criterion on the total score of the calculation results of determining the importance of the solid waste service area is depicted in the graph as follows

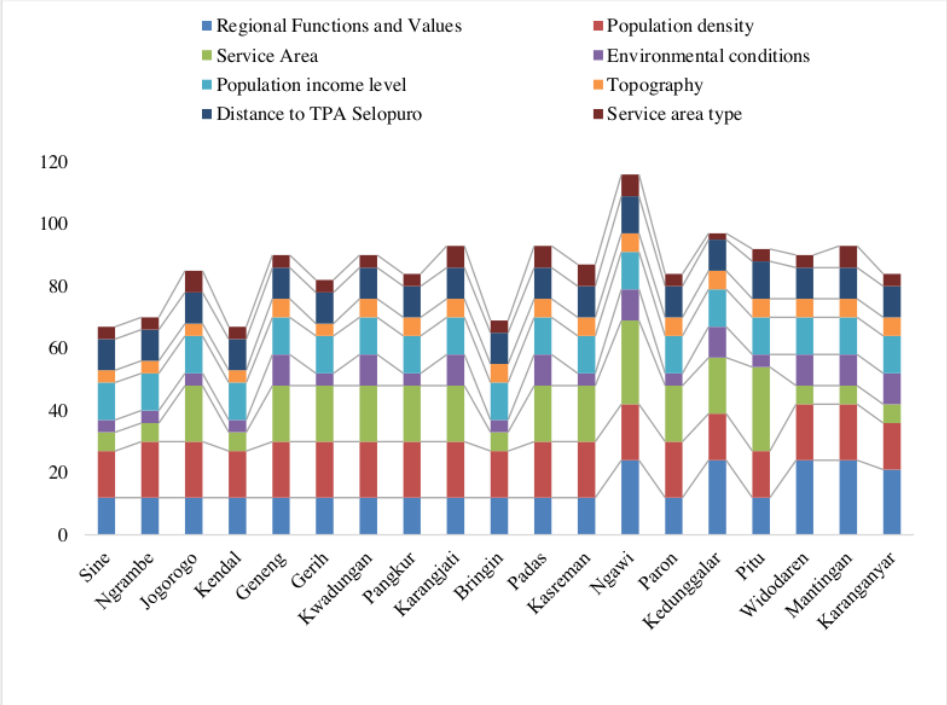

Figure 1. The total score of the calculation results of determining the importance of the solid waste service area for 19 sub-districts of Ngawi Regency

The highest total score is the first service area, followed by the number below it. The priority of sub-districts that receive solid waste services in the increasing solid waste service coverage is determined by the total score calculated for assessing the solid waste service area [11], [12]. The order of sub-districts that receive priority for solid waste services as calculation result of table 2. is illustrated in the graph below:

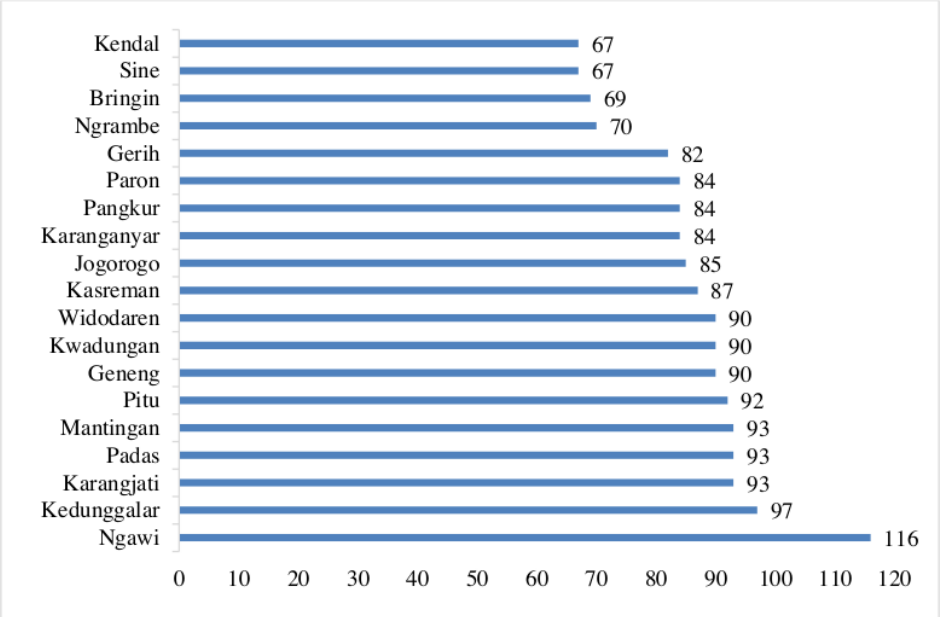

Figure 2. Priority order of sub-districts that receive solid waste services in Ngawi district

Based on the priority order of solid waste services as shown in Figure 2, the Ngawi sub-district is the priority. Ngawi sub-district is the capital of Ngawi district, where government, economic, trade, and education activities are centred in Ngawi sub-district. The second priority is the Kedunggalar sub-district, followed by the Karangjati, Padas, and Mantingan sub-districts. The districts of Kedunggalar, Karangjati, Mantingan, and Padas have the same in common. They are located on the mainland transportation route of Ngawi Regency, so they have an essential socio-economic role in maintaining cleanliness. Kedunggalar sub-district is situated close to the Selopuro TPA (Selopuro landfill), which is located in the Pitu sub-district. Karangjati sub-district is the entrance to Ngawi district from the direction of Madiun district. In contrast, the Mantingan sub-district entrance to Ngawi district from Sragen district, so aesthetically, it is necessary to prioritize solid waste services to maintain cleanliness [13].

The calculation results of the determination of the importance of the solid waste service area for the 19 sub-districts of the Ngawi Regency in table 2 and Figure 2 above do not include budgeting capabilities and solid waste service infrastructure availability. Therefore, the realization of the increase of solid waste service coverage needs to be studied further, with the ability of the regions to carry out the rise of service areas. In general, the enhancement of solid waste service coverage achieve in few stages, according to the availability of budget and facilities for solid waste service infrastructure [1] [2] [9] [10].

5. Conclusion

Based on the total score of the calculation results of determining the importance of the solid waste service area for 19 sub-districts of Ngawi district, sequentially those receiving priority for solid waste services are Ngawi, Kedunggalar, Karangjati, Mantingan, and Padas Districts. However, increasing the solid waste services area should be done gradually following the availability of budget for the solid waste infrastructure development of Ngawi Regency.

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