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Alternative Locations for TPS 3R (Study: Purwokerto Kulon Village, Banyumas Regency)

Chahya Chairani[1*], Dwi Nowo Martono[1], Sri Wahyono[1]

[1] School Of Environmental Science, Universitas Indonesia, Jakarta, Indonesia

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Corresponding Author:
Chahya Chairani
chahya.chairani91@ui.ac.id

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Abstract: Purwokerto is planning to build Tempat Pengolahan Sampah Reduce, Reuse, Recycle (TPS 3R) in each of its villages, this is due to minimize the quantity of waste that will be transported to *Tempat Pembuangan Akhir* (TPA), 12 TPS 3R have been built in 12 urban villages ini this city. South Purwoketo Subdistrict only has 1 TPS 3R in 1 village while there are 6 village that do not yet have TPS 3R, so the location of this research is in Purwokerto Kulon which is close to the activity center of Purwokerto. This study aims to find an alternative location for TPS 3R in Kelurahan Purwokerto Kulon. The method used in this study uses the AHP method and Spatial Analysis. This study resulted in locations that were "Very Appropriate", "Sufficiently Appropriate" and "Not Appropriate". There are 3 alternative location points with the "Very Appropriate" category to build TPS 3R in Purwokerto Kulon. These 3 locations are in the middle of the Purwokerto Kulon Village area, these 3 locations are on vacant land with a land area of >200 m² with a slope of 0% - 8% or flat, located > 200 m from a body of water/river and these three locations located in an area with minimal human activity. These three alternative locations are able to serve in waste processing in Purwokerto Kulon Village because their placement is close to the service area within a radius of no more than 1 Km.

Keywords: TPS 3R; Alternative Locations; GIS

Introduction

An increase in population can result in high production of waste generated from human activities, if improper waste management and disposal will cause environmental problems by increasing air, water and soil pollution and this waste can also cause some problems in urban settlements and it is estimated that only 60% waste in big cities that can be transported to landfill (Sakurai, 1980; Sakawi et al. 2011; Aryanti & Muliantara, 2018; Singh, 2019). Waste management has 3 stages that must be carried out, namely consisting of temporary waste collection, waste transportation and final disposal/processing in Final Disposal Sites (TPA) (Marantika et al., 2014). Garbage collection from temporary places or TPS is the first step in waste management activities, but this activity only transports waste from the source or TPS to Final Disposal Sites, so the government holds activities to reduce the quantity of waste from sources by holding TPS 3R or Reduce Reuse Waste Processing Sites. recycle. PU Ministerial Decree No. 3 regarding the implementation of waste infrastructure and facilities emphasizes that it is better to reduce waste at the source by sorting and reducing waste, because this activity is the responsibility of all parties from the community to the government. TPS 3R has a very important role in the waste collection/ collection stage, functional requirements from the waste collection process to its processing, this aims to reduce the quantity of waste that will be transported or processed further at the Final Disposal Site (TPA).

The criteria for the construction of the TPS 3R refers to regulations such as Ministerial Decree No. 3 of 2013 concerning the Implementation of Waste Infrastructure and Facilities in the Handling of Household Waste and Types of Household Waste, to the regional regulation that will be reviewed, namely the Banyumas Regency Regulation Number 9 of 2020. In the Menteri Pekerjaan Umum (2013), Regulation Number 3 of 2013 concerning the Implementation of Infrastructural and Residential Waste Facilities Handling household waste and similar household waste, said that the criteria for selecting a TPS

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3R location in area must be more than 200 m² with the availability of facilities to classify waste into at least 5 types of waste equipped with a selection room, composting and/or bio gas producing unit, buffer zone warehouse and not disturbing aesthetics and traffic. The type of construction for holding the remaining waste processing at TPS 3R is not a permanent container, with a location area and capacity according to needs, easy to access, does not pollute the environment and has a collection and transportation schedule. In the Peraturan Daerah Kab. Banyumas (2020), No. 9 of 2020, states that TPS and/or TPS 3R must meet the following requirements to have facilities are available for classifying waste into at least 5 types, with a location area and capacity according to needs, easy to access, does not pollute the environment and has a collection and transportation schedule.

In determining the appropriate location for alternative locations, TPS 3R can use geospatial information system technology, using GIS technology can facilitate dealing with regional waste problems using the multi-criteria decision analysis method which has been widely practiced to solve spatial problems because this approach combines qualitative and quantitative information sources. (Singh, 2019). This system proposes the collection of data from various sources and the formation of map layers such as, neighborhood and city maps, demographic maps showing population distribution by region, maps of waste generation in different areas, existing patterns of waste collection from trash bins, distribution of work in different neighborhoods, information on other organizations involved in sustainable waste management and plans for existing waste disposal routes. From these layers an analysis can, be carried out to obtain logistics and spatial planning (Ahmed, 2006). One of the problems of waste management, namely the problem of placing an inappropriate TPS 3R location can be overcome effectively by using geospatial techniques, GIS can make a predictable analysis of the situation and future trends that will help in planning for the long term, researchers have used many techniques remote sensing and GIS to solve waste management problems around the world (Hannan et al., 2015; Khan and Samadder, 2014; Rada et al., 2013; Vaskan et al., 2013; Chang et al., 2008; Sener et al., 2006).

Banyumas Regency has a strategic policy regarding the management of household waste and similar household waste as stated in the Banyumas Regent's Regulation No. 45 of 2018, which targets by 2025 there will be a 30% reduction in waste in this district and 70% of waste handling, so the government plans to hold 1 TPS 3R in every kelurahan in this city. In 2018 TPS 3R were built in 5 locations outside Purwokerto, in 2019 8 TPS 3R in 8 locations were in Purwokerto namely East Purwokerto (1), South Purwokerto (1), West Purwokerto (2) and North Purwokerto (5) and in 2020 9 units will be built and 2 of them will be built in East and North Purwokerto. Purwokerto Kulon Village is one of the villages in South Purwokerto District that does not yet have a TPS 3R and this village is close to the city center, has a fairly high intensity of human activity and various land uses. So that Purwokerto Kulon Village can be used as an area to determine the appropriate alternative location for TPS 3R. Based on the background that has been presented, this research aims to determine the appropriate alternative location for TPS 3R in Purwokerto Kulon Village with reference to the Menteri Pekerjaan Umum (2013), Regulation No. 3 of 2013 and the district regulation. Banyumas No. 9 of 2020.

Method

This research took place in 2022, which is located in Purwokerto Kulon Village, South Purwokerto District, Banyumas Regency. The following is a map of the research location (Figure 1). The data used in this study uses secondary data and after the data is processed, the results of the processing will be validated in the field, along with the data used and their sources (Table 1).

Figure 1. Research Location

This study uses quantitative methods, using Analytical Hierarchy Process (AHP) techniques and descriptive spatial analysis. Determination of alternative TPS locations was determined using the Analytical Hierarchy Process (AHP) method. This Analytical Hierarchy Process (AHP) method helps in determining the weighting value for each parameter that can determine alternative TPS locations. This AHP method helps solve complex problems by structuring a hierarchy of criteria, stakeholders, results and by drawing various considerations to develop weights or priorities (Rahayu et al, 2019). Processing results can be said to be consistent if the inconsistency is less than 0.1. If the matrix is declared consistent, the weight of each parameter is obtained. The parameter that has the highest value is the highest parameter in determining the alternative

location of TPS 3R. By using the weights that have been obtained, it will facilitate further data processing and data analysis to conclude the research results. The following is an overview of the AHP hierarchical structure of this research.

Table 1. Data and Data Sources

Data	Data Type	Data Source
Administrative Area Shapefile	Secondary Data	Dinas Permukiman dan Perumahan Rakyat Kab.Banyumas
Shapefile Neraca Subdistrict Land Use	Secondary Data	ATR/BPN Kab.Banyumas
Purwokerto Land Use Shapefile	Secondary Data	Dinas Permukiman dan Perumahan Rakyat Kab.Banyumas
Road Network Shapefile	Secondary Data	Dinas Permukiman dan Perumahan Rakyat Kab.Banyumas
River/Body of Water Shapefile	Secondary Data	ATR/BPN Kab.Banyumas

Descriptive spatial analysis is a set of techniques that can be used in data processing of Geographic Information Systems, this method is used to research and explore data from spatial perspective so that it depends on the location of the object under study and the results are described simply. In the spatial analysis section, researchers will analyze with a spatial approach to produce alternative locations of TPS 3R with variables that have been scored using the AHP method, spatial analysis is carried out using the overlay method and the query method.

Result and Discussion

From the literature that has been submitted regarding the criteria for the location of the TPS 3R, it can be said that there are several parameters that support and are used in analyzing the determination of the appropriate TPS 3R location, namely, roads, rivers/bodies of water, use of resistance, topography, and soil availability. Determination of the alternative location of TPS 3R using several parameters, namely land use, which is a parameter to see human activities as well as parameters for determining the right location. The use of land used is land without buildings consisting of forests and parks, rice fields, gardens, fields/fields. Grasslands, Shrubs and Open Ground. (Tulun et al., 2021). Slope, parameters that facilitate the construction and accessibility of TPS 3R activities. The slope is divided into > 40% (Very Steep), 25% - 40% (Steep), 15% - 25% (Slightly Steep), 8% - 15% (Slope) and 0% - 8% (Flat). Road, is a parameter used to facilitate the accessibility of TPS 3R activities. The road is divided into several functions, namely Arterial Road, Collector Road, Local Road and Environmental Road. Distance from Water Bodies/Rivers, Distance from TPS 3R to rivers needs to be considered to avoid environmental pollution. The minimum distance used is 500 meters to avoid contamination of water bodies (Rohmah et al., 2020; Tulun et al., 2021). Land Availability, is the result of land use analysis with land tenure.

Table 2. AHP Calculation Results

Parameter	Sub-Parameter	Score	Weight
Land Use	Forest and Park	1	0.32
	Rice fields	2	
	Garden, Moor/Field	3	
	Meadow, Bush	4	
	Vacant land	5	
Slope	> 40% (Very Steep)	1	0.10
	25% - 40% (Steep)	2	
	15% - 25% (Slightly Steep)	3	
	8% - 15% (Slope)	4	
	0% - 8% (Flat)	5	
Road	Arterial Road	2	0.12
	Collector Street	3	
	Local Street	4	
	Neighborhood Road	5	
Body Water/ River	< 50 m	1	0.13
	50 m – 100 m	2	
	100 m – 150 m	3	
	150 m – 200 m	4	
	>200 m	5	
Land Availability	Not available	1	0.32
	Available	5	

To get the results of the alternative location of TPS 3R using the weighting method and using the Analytical Hierarchy Process (AHP). The AHP method is used to determine the most influential variable in determining the alternative location of TPS 3R. Collecting data using a questionnaire that will be filled out by resource persons who are experts and related in the construction of TPS 3R in Purwokerto. The results of AHP processing, land use is the parameter that most influences the location of TPS 3R with the most suitable sub-parameter vacant land. The second influential parameter is the availability of land. The third influential parameter, namely the distance from the water body/river, becomes an important parameter so as not to experience environmental pollution. The 4th parameter is the road and the 5th parameter is the slope, these two parameters have low values because they can be adjusted to the surrounding conditions. After finding which parameters have the most influence in determining the location of

TPS 3R, then a spatial analysis will be carried out using the "Union" tool to combine all the spatial data of the parameters used. Furthermore, to find out the appropriate location for the alternative location of TPS 3R in this village, the "Qurey" method will be used.

The questionnaire to find out which parameter has the most influence was filled out by 5 resource persons who are experts and related in the construction of the TPS 3R in Purwokerto which consists of 5 ASN from the relevant agencies in the construction of the TPS 3R in Banyumas Regency. The data collected will be processed using Expert Choice software. From the calculations using the software, it is stated that the most important parameters in determining the location of TPS 3R, the following table results from these calculations (Table 2).

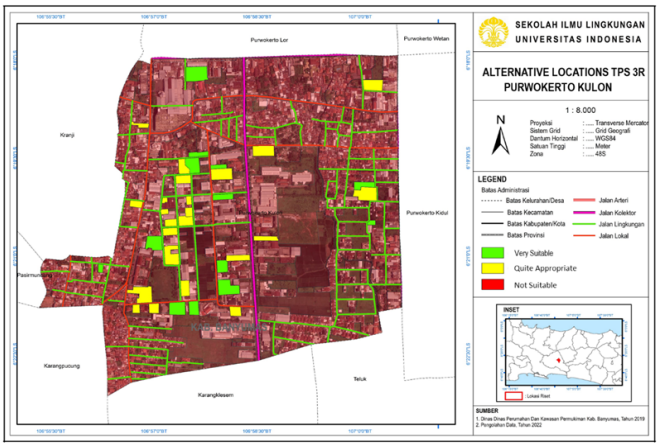

Figure 2. Map of Alternative Locations of TPS 3R in Purwokerto Kulon

The alternative locations of TPS 3R in Purwokerto Kulon Village are spread quite a lot in the western part of this village. The green area indicates "SS" or "Very Suitable" which means that the location is available and the land use is suitable for the TPS 3R location. The yellow area indicates "CS" or "Sufficiently Suitable" which means land is not available and land use is suitable for the TPS 3R location (Fig. 2). Meanwhile, the red area indicates that the "TS" or "Not Suitable" means that the land is not available and the land use is not suitable. The following is a classification score for determining the suitability level of alternative locations for TPS 3R in Purwokerto Kulon Village (Table 3).

Table 3. Score Classification

Classification	Score
Very Suitable	>3.63
Quite Appropriate	3.62 – 2.24
Not Suitable	>2.23

Alternative locations that have been generated will be validated to see the actual situation in the field. The determination of the validation point is determined by looking at the score from that location, the location with the suitability of "Very Appropriate" or "SS" becomes the validation sample that will be brought in and will be re-sorted. There are 3 location points obtained after field validation. These 3 locations are in the middle of the Purwokerto Kulon Village area, the surroundings of this location are warehouses and far from settlements, road access is easy to pass and has minimal traffic intensity, with flat slopes and far from water bodies/rivers. Banyumas Regency Regulation No. 9 of 2020 states that the placement of TPS 3R locations as close as possible to the service area within a radius of no more than 1 Km, these 3 locations can reach all aspects to be served (Figure 3.)

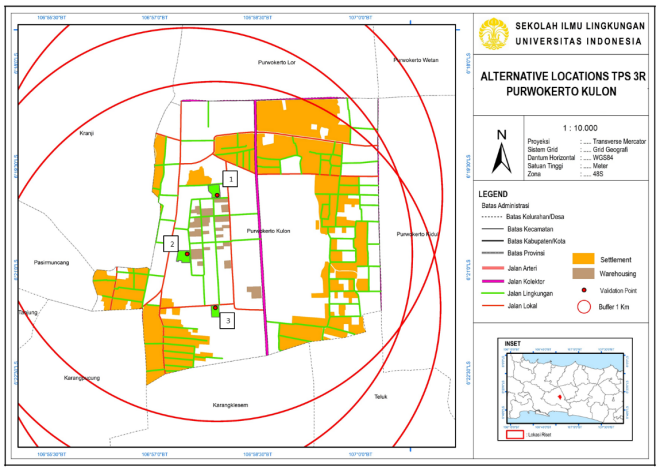

Figure 3. Location of Validation

Figure 4. Location 1

Location 1 is on dry land/field which is on a slope of 0% - 8% with an area of 1,019 m², this location is > 200 m from a body of water/river, location 1 is on Jl. Studion with the function of an environmental road that has low traffic intensity and is close to the exit access to the local road, namely Jl. Situmpur. Location 1 is far from settlements, but adjacent to rice fields with a small area (Figure 4).

Location 2 is on vacant land located on a slope of 0% - 8% with a land area of 2,853 m², this location is >

200 m from a body of water/river and location 2 is on a neighborhood road with low traffic intensity and is located close to exit access to jl. Pioneers of Independence (Figure 5).

Location 3 is vacant land with a slope of 0% - 8% and has an area of 1,797 m², this location is > 200 m from a body of water/river, and this location is on Jl. Mini Stadium with local road function with low traffic intensity and close to exit access to collector road. This location 1 environment has a location far from settlements and is close to the warehousing area. (Figure 6).

Figure 5. Location 2

Figure 6. Location 3

Conclusion

The determination of the location of the 3R TS in Purwokerto refers to the criteria set forth in the Banyumas Regency Regional Regulation No. 6 of 2019 namely Land Use, Land Availability, Distance from Water/River Bodies, Slope Slope and Roads. Purwokerto Kulon has several alternative locations for TPS 3R which are spread out in the center of the Purwokerto Kulon Village area which is located between warehouses, fields/fields, rice fields and vacant land with minimal human activities.

There are 3 classifications of suitability levels for alternative locations, namely "Strongly Agree" which means that the location is available and the use of land is suitable for the TPS 3R location, level 2 or "Sufficiently Appropriate" which means the land is not available and the land use is suitable for the TPS 3R location and last level or "Not Suitable" which means land is not available and land use is not suitable.

There are 3 alternative locations of TPS 3R which are very suitable after the field validation. These 3 locations are in the same area so they have the same criteria. These 3 locations are on vacant land and available fields/fields, the slopes of these 3 locations are in 0% - 8% or flat, located > 200 m away from water bodies/ rivers, these 3 locations are close to environmental and local roads which has minimal traffic intensity, the condition and road network in this area facilitates accessibility for TPS 3R activities.

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