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EVALUATION OF MALANG CITY'S ENVIRONMENTAL QUALITY BASED ON IOT DATA USING MCDM

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Abstrak. Kota Malang merupakan salah satu kota besar di Jawa Timur yang memiliki populasi tinggi. Berdasarkan pada data IoT korelasi jumlah kendaraan dengan kualiatas udara di Kota Malang, penelitian ini melaksanakan evaluasi kualitas lingkungan dengan beberapa data kriteria antara lain kelembaban, suhu, partikulat debu, CO_2, CO dan kebisingan. Data kriteria dievaluasi melalui metode MCDM yaitu MOORA dan SAW. Metode-metode ini sangat efektif untuk mengetahui kondisi zona rawan polusi dari lokasi kualitas lingkungan terendah hingga yang tertinggi melalui rangking yang dihasilkan. Melalui metode MCDM dihasilkan Titik 1 : Jl. Raya Tlogomas, Tanggul Mas merupakan daerah yang memiliki nilai skor MOORA terendah dengan nilai -0,364 dan skor SAW 0,808 yang menandakan bahwa kawasan tersebut memiliki kualitas lingkungan paling tidak kondusif. Penelitian ini sangat memberikan informasi penting untuk kewaspadaan masyarakat maupun pihak terkait untuk berpartisipasi meminimalisir efek kesehatan yang ditimbulkan.

Abstract. *Malang City is one of the major cities in East Java with a high population. Based on the IoT data on the correlation between the number of vehicles and air quality in Malang City, this study evaluated the environmental quality with several criteria, including humidity, temperature, dust particulates, CO_2, CO, and noise. The criteria data were assessed through MCDM methods, namely MOORA and SAW. These methods is very effective in determining the condition of pollution-prone zones from the lowest to the highest environmental quality locations through the resulting ranking. Through the MOORA method, Point 1: Jl. Raya Tlogomas, Tanggul Mas is the area that has the lowest MOORA score with a value of -0.364 and SAW score with a value of 0,808, which indicates that the area has the least conducive environmental quality. This study provides vital information for the awareness of the community and related parties to minimize the health effects caused.*

1. INTRODUCTION

The high number of vehicles plays a significant role in environmental quality. This can be seen in several studies in several cities, such as Bandung [1], Gorontalo [2] and Malang City [3]. The study [3] stated that the number of vehicles affects several environmental qualities, such as humidity, temperature, dust particulates, CO_2, CO, and noise. Several of these criteria harm the environment. This is seen in the study [4] how CO_2 and CO exhaust gases produced by motor vehicles cause pollution and cause acute respiratory tract Infection [1].

Several studies have been conducted on environmental conditions in Malang City, such as analyzing the influence of vehicle numbers on carbon monoxide at the Arjosari Terminal [5], the distribution of pollutants on arterial roads in Malang City [6], and water pollution in Malang City [7]. Several studies have not explicitly focused on detailed evaluations of environmental conditions such as humidity, temperature, dust particulates, CO_2, CO, and noise in densely populated areas, especially in identifying pollution-prone zones or locations with the lowest rankings that require special attention regarding environmental impacts.

This study evaluates Internet of Things (IoT) data at six high-traffic locations in Malang City to determine the environmental quality of those locations. The method used is Multi-Criteria Decision Making (MCDM), specifically MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis). This method produces a ranking that shows that the location data points with the lowest MOORA scores represent locations with the lowest environmental quality.

The MOORA method determines the ranking of pollution levels from lowest to highest at several locations. In several studies, such as MOORA for deciding on new student admissions [8], for the feasibility of village head candidate recommendations [9], for determining the eligibility of credit recipients [10], for determining students who receive poor assistance [11], for selecting farmers who receive assistance [12], for determining scholarships [13], for identifying the best practical work student [14], for sales selection [15], and for vendor selection [16]. The research implementing MOORA shows excellent and effective results. As in the method comparison conducted [17] the MOORA method stands out for its ability to produce a clear difference in value between the worst and best alternatives. Research comparing the AHP, TOPSIS, and MOORA methods [18] shows that MOORA is the best method through sensitivity tests. Unfortunately, in its implementation, the MOORA method has not been explored optimally in Indonesia considering that only 7% of MOORA users exist [19].

2. LITERATURE STUDY

2.1 MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) Method

In their book [20] They state that the MOORA method is a multi-objective system that optimizes two or more conflicting attributes simultaneously. This method is applied to solve problems involving complex mathematical calculations. Brauers and Zavadskas introduced MOORA in 2006.

The analysis using the MOORA method involves several stages, including the following:

a. Inputting criterion values.
b. Constructing a decision matrix.
c. Calculating a normalized matrix of values for each criterion;

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2{}_{ij}}} \quad (1)$$

d. Calculating the Optimization matrix.

$$y_i = \sum_{j\in\text{Benefit}} w_j . r_{ij} - \sum_{j\in\text{Cost}} w_j . r_{ij} \quad (2)$$

e. Ranking alternative locations based on MOORA scores.

2.2 SAW (Simple Additive Weighting) Method

Simple Additive Weighting method is frequently used to address problems involving multiple decision-making attributes. Its main principle involves computing a weighted total of performance scores for each alternative across all specified attributes.

The first stage is the normalization process. This process involves calculating each alternative by determining a rating based on the type of benefit or cost criteria for that alternative. The resulting decision matrix is a scale that allows comparisons between all ranked alternatives.

If the largest value for each criterion i is the best, use equation (3), if the smallest value for each criterion i is the best, use equation (4).

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \quad (3)$$

$$r_{ij} = \frac{Min(x_{ij})}{x_{ij}} \quad (4)$$

$$V_i = \sum_{j=1}^{n} w_j x_{ij} \quad (5)$$

r_{ij}= normalized performance rating value.
x_{ij} = attribute value for each criterion.
$Max(x_{ij}$ = the largest value for each criterion i.
$Min(x_{ij})$ = the smallest value for each criterion i.

3. RESEARCH METHODS

This study employed a quantitative method, with primary data collected from field surveys using IoT sensors at six densely populated locations in Malang City. The evaluation criteria comprised six criteria: humidity, temperature, dust particulates, CO_2, CO, and noise. The decision-making approach used to determine the lowest to highest ranking of pollution-prone locations was MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) and SAW (Simple Additive Weighting).

The following IoT data sources in Table 1 are used in environmental quality evaluation.

Table 1. Data Sources for Evaluation

Point	Location	Humidity (%)	Temperature (°C)	Particulate Matter (µg/m³)	CO_2 (ppm)	CO (ppm)	Noise (dB)
Point 1	Jl. Raya Tlogomas, Tanggul Mas	66	44	274	51	593	81
Point 2	Jl. Gajayana - Dinoyo	67	46	300	40	580	75
Point 3	Titik 3 : Jl. Veteran - Sutami	70	45	287	34	456	72
Point 4	Titik 4 : Jl. MT Haryono - Soekarno Hatta	69	45	265	33	232	87
Point 5	Jl. Ahmad Yani - LA Sucipto	62	47	293	44	240	97
Point 6	Jl. Raden Panji Suroso - Blimbing	61	47	307	36	261	86

4. RESULT AND DISCUSSION

In an evaluation using the MOORA method, several important steps are required, including determining the criteria to be evaluated and the weights used. The weighting is based on the criteria's influence on environmental pollution.

Table 2. Criteria Weight

Code	Criteria	Type	Weight
C1	Humidity	Benefit	0,10
C2	Temperature	Cost	0,15
C3	Particulate Matter	Cost	0,25
C4	CO_2	Cost	0,20
C5	CO	Cost	0,15
C6	Noise	Cost	0,15

The following table contains alternative data or location points that will be evaluated.

Table 3. Alternative Data (Evaluation Zone Location Point)

Code	Location Point	Latitude	Longitude
A1	Point 1: Jl. Raya Tlogomas - Tanggul Mas	-7.92619	112.6016
A2	Point 2: Jl. Gajayana - Dinoyo	-7.94312	112.6103
A3	Point 3: Jl. Veteran - Sutami	-7.95646	112.6131
A4	Point 4: Jl. MT Haryono - Soekarno Hatta	-7.9499	112.6156
A5	Point 5: Jl. Ahmad Yani - LA Sucipto	-7.94171	112.6421
A6	Point 6: Jl. Raden Panji Suroso - Blimbing	-7.94375	112.6483

At the stage of inputting criteria and alternative data, a decision matrix is produced as in Table 4 below.

Table 4. Mapping of Alternative Data and Criteria (Decision Matrix)

	C1	C2	C3	C4	C5	C6
A1	66	44	274	51	593	81
A2	67	46	300	40	580	75
A3	70	45	287	34	456	72
A4	69	45	265	33	232	87
A5	62	47	293	44	240	97
A6	61	47	307	36	261	86

4.1. *MOORA Normalization Matrix*

In the normalization matrix calculation process, equation (1) is used to determine the value of each criterion in each alternative.

Criteria 1 (C1)

$$r_{11} = \frac{66}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}409$$
$$r_{21} = \frac{67}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}415$$
$$r_{31} = \frac{70}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}434$$
$$r_{41} = \frac{69}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}427$$
$$r_{51} = \frac{62}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}384$$
$$r_{61} = \frac{61}{\sqrt{66^2+67^2+70^2+69^2+62^2+61^2}} = 0{,}378$$

Criteria 2 (C2)

$$r_{12} = \frac{44}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}393$$
$$r_{22} = \frac{46}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}411$$
$$r_{32} = \frac{45}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}402$$
$$r_{42} = \frac{45}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}402$$

$$r_{52} = \frac{47}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}420$$
$$r_{62} = \frac{47}{\sqrt{44^2+46^2+45^2+45^2+47^2+47^2}} = 0{,}420$$

Criteria 3 (C3)

$$r_{13} = \frac{270}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}388$$
$$r_{23} = \frac{300}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}425$$
$$r_{33} = \frac{287}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}407$$
$$r_{43} = \frac{265}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}376$$
$$r_{53} = \frac{293}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}415$$
$$r_{63} = \frac{307}{\sqrt{270^2+300^2+287^2+265^2+293^2+307^2}} = 0{,}435$$

Criteria 4 (C4)

$$r_{14} = \frac{51}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}518$$
$$r_{24} = \frac{40}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}407$$
$$r_{34} = \frac{34}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}346$$
$$r_{44} = \frac{33}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}335$$
$$r_{54} = \frac{44}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}447$$
$$r_{64} = \frac{36}{\sqrt{51^2+40^2+34^2+33^2+44^2+36^2}} = 0{,}366$$

Criteria 5 (C5)

$$r_{15} = \frac{593}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}572$$
$$r_{25} = \frac{580}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}559$$
$$r_{35} = \frac{456}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}440$$
$$r_{45} = \frac{232}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}224$$
$$r_{55} = \frac{240}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}231$$
$$r_{65} = \frac{261}{\sqrt{593^2+580^2+456+232^2+240^2+261^2}} = 0{,}252$$

Criteria 6 (C6)

$$r_{16} = \frac{81}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}396$$
$$r_{26} = \frac{75}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}367$$
$$r_{36} = \frac{72}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}352$$
$$r_{46} = \frac{87}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}426$$
$$r_{56} = \frac{97}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}475$$
$$r_{66} = \frac{86}{\sqrt{81^2+75^2+72^2+87^2+97^2+86^2}} = 0{,}421$$

The following are the results of the normalization matrix calculation.

Table 5. MOORA Normalization Matrix

	C1	C2	C3	C4	C5	C6
A1	0,409	0,393	0,388	0,518	0,572	0,396
A2	0,415	0,411	0,425	0,407	0,559	0,367
A3	0,434	0,402	0,407	0,346	0,440	0,352
A4	0,427	0,402	0,376	0,335	0,224	0,426
A5	0,384	0,420	0,415	0,447	0,231	0,475
A6	0,378	0,420	0,435	0,366	0,252	0,421

4.2. MOORA Optimization Matrix

The optimization matrix is also called a weighted matrix. In this step, the normalization matrix value is multiplied by each criterion's weight. The following is the result of the optimization matrix.

Table 6. MOORA Optimization Matrix

	C1	C2	C3	C4	C5	C6
A1	0,041	0,059	0,097	0,104	0,086	0,059
A2	0,041	0,062	0,106	0,081	0,084	0,055
A3	0,043	0,060	0,102	0,069	0,066	0,053
A4	0,043	0,060	0,094	0,067	0,034	0,064
A5	0,038	0,063	0,104	0,089	0,035	0,071
A6	0,038	0,063	0,109	0,073	0,038	0,063

The final step in the MOORA method is to calculate the reduction of the Benefit criteria data with the Cost criteria data. This stage implements equation (2).

Table 7. Yi Value

	Max (C1)	Minimum (C1+C2+C3+C4+C5)	Yi (Max-Min)
A1	0,041	0,405	-0,364
A2	0,041	0,388	-0,347
A3	0,043	0,350	-0,307
A4	0,043	0,319	-0,276
A5	0,038	0,362	-0,324
A6	0,038	0,346	-0,308

The following are the results of the MOORA score calculation and ranking based on the total score.

Table 8. MOORA Score and Ranking

Code	Location Point	Total	Rank
A1	Point 1: Jl. Raya Tlogomas - Tanggul Mas	-0,364	6

A2	Point 2: Jl. Gajayana - Dinoyo	-0,347	5
A3	Point 3: Jl. Veteran - Sutami	-0,307	2
A4	Point 4: Jl. MT Haryono - Soekarno Hatta	-0,276	1
A5	Point 5: Jl. Ahmad Yani - LA Sucipto	-0,324	4
A6	Point 6: Jl. Raden Panji Suroso - Blimbing	-0,308	3

In the MOORA evaluation of environmental conditions at six locations, the lowest score was obtained for Point 4, on Jl. MT Haryono - Soekarno Hatta, which ranked first, represented the best environmental conditions compared to the other five locations. Meanwhile, the lowest score was Point 1, Jl. Raya Tlogomas - Tanggul Mas, representing the area with the lowest environmental conditions based on humidity, temperature, dust particulates, CO_2, CO, and noise.

4.3. *SAW Normalization Matrix*

The SAW method is used as a comparison to the previously used MOORA method. This method is very simple, it performs calculations by weighting each given criterion.

The first step in the SAW method is the normalization process. This process is influenced by the weighting of the benefit and cost criteria. Equation (1) is used to calculate the benefit normalization, and Equation (2) is used to calculate the cost normalization.

Criteria 1 (C1)

$$r_{11} = \frac{66}{\mathrm{Max}(66;67;70;69;62;61)} = 0,943$$
$$r_{21} = \frac{67}{\mathrm{Max}(66;67;70;69;62;61)} = 0,957$$
$$r_{31} = \frac{70}{\mathrm{Max}(66;67;70;69;62;61)} = 1,000$$
$$r_{41} = \frac{69}{\mathrm{Max}(66;67;70;69;62;61)} = 0,986$$
$$r_{51} = \frac{62}{\mathrm{Max}(66;67;70;69;62;61)} = 0,886$$
$$r_{61} = \frac{61}{\mathrm{Max}(66;67;70;69;62;61)} = 0,871$$

Criteria 2 (C2)

$$r_{12} = \frac{Min(44;46;45;45;47;47)}{44} = 1,000$$
$$r_{22} = \frac{Min(44;46;45;45;47;47)}{46} = 0,957$$
$$r_{32} = \frac{Min(44;46;45;45;47;47)}{45} = 0,978$$
$$r_{42} = \frac{Min(44;46;45;45;47;47)}{45} = 0,978$$
$$r_{52} = \frac{Min(44;46;45;45;47;47)}{47} = 0,936$$
$$r_{62} = \frac{Min(44;46;45;45;47;47)}{47} = 0,936$$

Criteria 3 (C3)

$$r_{13} = \frac{Min(270;300;287;265;293;307)}{270} = 0,967$$
$$r_{23} = \frac{Min(270;300;287;265;293;307)}{300} = 0,883$$
$$r_{33} = \frac{Min(270;300;287;265;293;307)}{287} = 0,923$$
$$r_{43} = \frac{Min(270;300;287;265;293;307)}{265} = 1,000$$
$$r_{53} = \frac{Min(270;300;287;265;293;307)}{293} = 0,904$$
$$r_{63} = \frac{Min(270;300;287;265;293;307)}{307} = 0,863$$

Criteria 4 (C4)

$$r_{14} = \frac{Min(51+40+34+33+44+36)}{51} = 0,647$$
$$r_{24} = \frac{Min(51+40+34+33+44+36)}{40} = 0,825$$
$$r_{34} = \frac{Min(51+40+34+33+44+36)}{34} = 0,971$$
$$r_{44} = \frac{Min(51+40+34+33+44+36)}{33} = 1,000$$
$$r_{54} = \frac{Min(51+40+34+33+44+36)}{44} = 0,750$$
$$r_{64} = \frac{Min(51+40+34+33+44+36)}{36} = 0,917$$

Criteria 5 (C5)

$$r_{15} = \frac{Min(593;580;456;232;240;261)}{593} = 0,391$$
$$r_{25} = \frac{Min(593;580;456;232;240;261)}{593} = 0,400$$
$$r_{35} = \frac{Min(593;580;456;232;240;261)}{593} = 0,509$$
$$r_{45} = \frac{Min(593;580;456;232;240;261)}{593} = 1,000$$
$$r_{55} = \frac{Min(593;580;456;232;240;261)}{593} = 0,967$$
$$r_{65} = \frac{Min(593;580;456;232;240;261)}{593} = 0,889$$

Criteria 6 (C6)

$$r_{16} = \frac{Min(81;75;72;87;97;86)}{81} = 0,889$$
$$r_{26} = \frac{Min(81;75;72;87;97;86)}{75} = 0,960$$

$$r_{36} = \frac{Min(81;75;72;87;97;86)}{72} = 1{,}000$$
$$r_{46} = \frac{Min(81;75;72;87;97;86)}{87} = 0{,}828$$
$$r_{56} = \frac{Min(81;75;72;87;97;86)}{97} = 0{,}742$$
$$r_{66} = \frac{Min(81;75;72;87;97;86)}{86} = 0{,}837$$

The following are the results of the normalization matrix.

Table 9. SAW Normalization Matrix

	C1	C2	C3	C4	C5	C6
A1	0,943	1,000	0,967	0,647	0,391	0,889
A2	0,957	0,957	0,883	0,825	0,400	0,960
A3	1,000	0,978	0,923	0,971	0,509	1,000
A4	0,986	0,978	1,000	1,000	1,000	0,828
A5	0,886	0,936	0,904	0,750	0,967	0,742
A6	0,871	0,936	0,863	0,917	0,889	0,837

The next step is to calculate the preference value. This process involves adding the weights of each criterion.

$$V_1 = (0{,}10)(0{,}943) + (0{,}10)(0{,}957) + (0{,}10)(1{,}000) + (0{,}10)(0{,}986) + (0{,}10)(0{,}886) + (0{,}10)(0{,}871) = 0{,}808$$

$$V_2 = (0{,}10)(1{,}000) + (0{,}10)(0{,}957) + (0{,}10)(0{,}978) + (0{,}10)(0{,}978) + (0{,}10)(0{,}936) + (0{,}10)(0{,}936) = 0{,}829$$

$$V_3 = (0{,}10)(0{,}967) + (0{,}10)(0{,}883) + (0{,}10)(0{,}923) + (0{,}10)(1{,}000) + (0{,}10)(0{,}904) + (0{,}10)(0{,}863) = 0{,}898$$

$$V_4 = (0{,}10)(0{,}647) + (0{,}10)(0{,}825) + (0{,}10)(0{,}971) + (0{,}10)(1{,}000) + (0{,}10)(0{,}750) + (0{,}10)(0{,}917) = 0{,}969$$

$$V_5 = (0{,}10)(0{,}391) + (0{,}10)(0{,}400) + (0{,}10)(0{,}509) + (0{,}10)(1{,}000) + (0{,}10)(0{,}967) + (0{,}10)(0{,}889) = 0{,}861$$

$$V_6 = (0{,}10)(0{,}889) + (0{,}10)(0{,}960) + (0{,}10)(1{,}000) + (0{,}10)(0{,}828) + (0{,}10)(0{,}742) + (0{,}10)(0{,}837) = 0{,}886$$

Table 10. SAW Preference Value

	Preference Value (V_i)	Rank
A1	0,808	6
A2	0,829	5
A3	0,898	2
A4	0,969	1
A5	0,861	4
A6	0,886	3

In evaluating environmental conditions using the MOORA and SAW method, most aspects were categorized as Cost because they are criteria that have a negative impact. Therefore, the final calculation yielded the highest score, representing the alternative data with the least conducive environmental conditions for the surrounding community.

Table 11. Comparison of MOORA and SAW results

	MOORA Score	MOORA Rank	SAW Score	SAW Rank
A1	-0,364	6	0,808	6
A2	-0,347	5	0,829	5
A3	-0,307	2	0,898	2
A4	-0,276	1	0,969	1
A5	-0,324	4	0,861	4
A6	-0,308	3	0,886	3

A comparison of the use of these methods yielded the same ranking. This indicates that the calculations for both MOORA and SAW provide accurate results in determining environmental conditions in Malang City.

This evaluation and ranking are expected to provide further information to the public and relevant parties to contribute to minimizing environmental impacts in Malang City. This is especially true for several locations with low scores that require attention.

5. CONCLUSION

a. Through the analysis of the MCDM method, specifically MOORA and SAW, a ranking of locations with good environmental conditions was obtained as follows: (1) Point 4: Jl. MT Haryono - Soekarno Hatta; (2) Point 3: Jl. Veteran – Sutami; (3) Point 6: Jl. Raden Panji Suroso – Blimbing; (4) Point 5: Jl. Ahmad Yani - LA Sucipto; (5) Point 2: Jl. Gajayana – Dinoyo; (6) Point 1: Jl. Raya Tlogomas, Tanggul Mas.
b. The location with the highest score was Jl. MT Haryono - Soekarno Hatta with a total MOORA score of -0.276 and SAW score of 0,969, indicating relatively more conducive environmental conditions than other locations. Conversely, the location with the

lowest score was Jl. Raya Tlogomas - Tanggul Mas, with a MOORA score of -0.364 and SAW score of 0,808, indicating the lowest environmental quality among the six locations analyzed.

c. The evaluation using the MCDM ranking system is expected to provide important information, especially regarding several locations that require attention regarding environmental care zones, such as Point 1: Jl. Raya Tlogomas, Tanggul Mas. Locations with the lowest scores are expected to receive special attention from residents and the relevant government to better protect the environment, especially by minimizing existing environmental impacts.

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