Influence motor cycle density on noise sound at the highway

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ABSTRACT

Bogor Regency is a buffer zone for the city of Jakarta. Bogor Regency is directly adjacent to the north with DKI Jakarta and Bekasi City and Depok City. The two cities are satellite cities directly adjacent to Jakarta. In 2017 and 2018, the addition of roads in Indonesia was only less than 0.1% - 0.2%/year, while the growth of motorized vehicles was more than 10%/year. This is very disproportionate to the addition of roads in our country. Based on the study above, research on motorized vehicles was carried out in front of the Nurul Hidayah Mosque, which is located on Jl. Salabenda-Semplak, Bogor Regency. The density of motorcycles, private cars, public transport cars and freight cars has a significant effect on noise. From all analysis calculations, the largest equation is obtained on the third day of the second point of the study SLM2, with a contribution of 22.12%. The following calculation is obtained, $y = 54.01 + 0.04x1 + 0.32x2 – 0.22x3 + 0.12x4$. This means that if there is no decrease in the density of motorbikes, the noise level in SLM2 is 54.021 dB_A. The density of motorbikes, private cars, public transport cars and freight cars also has a significant effect on noise, the second largest equation is obtained on the fourth day of research at the third point with a contribution of 21.24%. The calculation of the equation below is obtained, $y = 55.02 + 0.03x1 – 0.07x2 + 0.02x3 – 0.01x4$. The meaning of the above equation is that if there is an increase in the density of motorcycles and public transport cars, the noise in SLM3 is 55,021 dB_A.

Keywords: motorcycle; Nurul Hidayah mosque; noise; sound level meters; monitoring point.

INTRODUCTION

Road conditions have developed according to the growth of vehicles passed as a result of population growth, economic growth and the number of vehicles. Every motorized vehicle, whether it's a motorcycle, private car, public passenger, car transporting goods such as trucks with 4 axles, will cause sound with varying noise levels. The sound that arises in a vehicle is influenced by the engine and exhaust model of the vehicle in question. Automotive technicians have tried to minimize noise from vehicles by creating more sophisticated automotive technology, but noise on certain road sections will still be formed as a result of the accumulation of each vehicle noise and also the distance of buildings on that road segment. Road sections in cities in Indonesia are generally not too wide, the development of road improvements such as road widening is not proportional to the development of vehicles. On the Salabenda road section, the growth in the number of vehicles is not proportional to the development of road segments to serve these vehicles. The road in front of the Nurul Hidayah Salabenda Mosque is a road with a high density, especially during rush hour with various types of vehicles passing from small vehicles to large goods transport vehicles where the distance from the Musholla to the road is estimated to be less than 10 (ten) meters. The purpose of this study is to obtain how much noise is generated by vehicles on the Salabenda-Semplak road section and analyze whether the noise is still below the permitted noise level standard (Buchari, 2007; Ganda CF et.al, 2019; Karimah H, Akbardin J , 2019; Hidayati N, 2007).

Noise requirements are shown in a very specific form. This form is a study related to traffic density in front of public places (Syaiful S, Mudjanarko SW, 2019; Syaiful S, Pratama Y, 2019; Syaiful S, Hariyadi D, 2019). The public place that is the object of research is a mosque in Kemang District, Bogor Regency. This mosque is only 9.5 (nine point five) meters from the shoulder of the road. It is very close, so it will be a concern for us as observers of roads that are

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close to public facilities. This facility will be very influential in the form of roadside research (Syaiful S et.al, 2020; Syaiful S, 2020; Syaiful S, Fadly A, 2020; Syaiful S et.al, 2021; Syaidul S et.al, 2021; Syaiful S et.al, 2022). Noise that causes an impact on occupants around this road will be of particular concern. A very appropriate step in reducing noise is to create a noise barrier in front of buildings that are directly connected to the road (Syaiful S et.al, 2021; Syaiful S et.al, 2022; Syaiful S et.al, 2022).

This reduction of noise sources is in accordance with research submitted by Syaiful et.al (2022) that noise sources will affect very suitable traffic conditions. This traffic effect on the effect of a more complete noise source. The excess of this influential noise source is determined in a clear form so that it will get very precise conditions.

Sources of noise due to the sound of motorized vehicles will affect the occupants in it. The occupants here are the mosque which is located very close to the edge of the main road. It is this influence that will be anticipated by having a sound source from motorized vehicles. Motorized vehicles cannot be prevented, but can be anticipated. By planting protective trees, rather high walls or providing a soundproof room in the mosque building. The soundproof room in question is a very soundproof room by obtaining and implementing a soundproof room (Syaiful S, 2022; Syaiful S, 2022; Oyar TZ, 2000).

Traffic flow

The thing that really plays a role in the noise on the road is traffic which is interpreted as the activity of passing vehicles, whether motorized or not, people and animals on the road. This means that the traffic component includes humans as road users, vehicles and roads that are interrelated and influence one another. Motorized vehicles are vehicles that are driven by machines such as motorbikes, cars, buses and trucks while non-motorized vehicles are vehicles that are driven by animals such as horse carriages or by humans such as rickshaws (Suwarjoko PW, 2002).

Based on the carrying capacity of the road is arranged in various classes as follows:

1. Class I roads, namely arterial roads that are traversed by motorized vehicles including loads with a width of not more than 2500 millimeters, a length of not more than 18000 millimeters and the heaviest axle load of more than 10 tons.
2. Class II roads, namely arterial roads that are passed by motorized vehicles including loads with a width of not more than 2500 millimeters, a length of not more than 18000 millimeters and the heaviest axle load of not more than 10 tons.
3. Class III A roads, namely arterial or collector roads that can be passed by motorized vehicles including loads with a width not exceeding 2500 mm, a length not exceeding 18000 mm and a maximum permitted axle load of 8 tons.
4. Class III B roads, namely collector roads that can be passed by motorized vehicles including cargo with a width of not more than 2500 millimeters, a length of not more than 12000 millimeters and the heaviest permissible axle load of 8 tons.
5. Class III C roads, namely roads that can be passed by motorized vehicles including cargo with a width that does not exceed 2100 millimeters, a length that does not exceed 9000 millimeters and the heaviest load permitted is 8 tons (Suwarjoko PW, 2002).

Vehicle density

Every traffic activity from one place to another will be traveled in unity of time, the faster the journey the shorter the time taken. Likewise with motorized vehicles, the distance traveled in per unit time by the vehicle is called the vehicle density.

Noise

Noise is unwanted sound/sound which arises from an activity and disturbs the calm, the ear's hearing limit. Noise is unwanted sound from a business or activity at a certain level and time which can cause disturbances to human health and environmental comfort (Ministry of Environment, 1996).

Types of environmental noise as follows:

1. The amount of noise, is all the noise in a certain place in a certain time unit.
2. Specific noise, is noise among the amount of noise that can be clearly distinguished for acoustic reasons. Often the source of the noise can be identified.
3. Residual noise, is the noise that remains after removing all specific noise from the amount of noise in a certain place at a certain time.
4. Background noise, is all other noise when focusing on a particular noise.

According to the nature and sound spectrum, noise is divided into:

1. Continuous noise with a wide frequency spectrum.
2. This noise is relatively constant within the limits of approximately 5 dBA for a continuous 0.5 second period.
3. Continuous noise with a narrow frequency spectrum.
4. This noise is also relatively constant, but only has certain frequencies (at frequencies of 500, 1000 and 4000 Hz) for example secular saws, gas valves.
5. Intermittent noisy.
6. This noise does not occur continuously but there are periods of relative calm, for example traffic noise and noise at airports.
7. Impulsive noise.
8. This noise has a change in sound pressure exceeding 40 dBA in a very fast time and usually shocks the hearing, for example the sound of gunshots, the sound of exploding fireworks.
9. Repetitive impulsive noise, the same as impulsive noise that occurs repeatedly. For example the sound of a forging machine.

Some things that happen as a result of noise are as follows:

1. Effects that occur in the body:
   a. Hearing loss.
      Temporary threshold changes due to noise. Permanent threshold changes due to noise.
   b. Physiological disorders.
   Increased discomfort or stress, increased blood pressure, headache ringing sound.
2. Psychological consequences.
   a. Emotional breakdown.
      Annoyance, confusion.
   b. Lifestyle disorder.
      Sleep disturbance, rest disturbance, loss of concentration at work, reading and so on.
   c. Hearing disorders.
      Interfere with the ability to listen to conversations (live or telephone), listen to television (Ministry of State for the Environment, 1996).

Noise due to traffic can be determined by the following equation:

1. Basic Noise Level (BNL)
   L10 42,2 + 10 Log Q^{dBA} ……..…….....……..(1)

With: L10 = base noise level in 1 hour.
Q = traffic flow.

2. Correction factor BNL
   Correction of average density (V) and percentage of heavy vehicles (P) by
   $$C1 = 33\log(V + 40 + \frac{500}{V} + 10\log\ (1 + \frac{5p}{V}) \text{-} 68{,}8\ ^{dB(A)}$$ …….……(2)

3. Correction of the road gradient (G) is expressed by:
   C2 = 0,3 G $^{dB(A)}$ …… …….....(3)

4. Correction of the condition between the sound source and the receiver is stated by:
   a. The condition of more than 50% hardened or does not absorb sound.
   $$c3 = -10\log\ (\frac{d'}{13{,}5})^{dB(A)}$$ …….....…….(4)

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b. Conditions of more than 50% natural sound absorption (grass)

$$c3 = -10 \log \left(\frac{d'}{13,5}\right) \text{dB} + 5.2 \log \left(\frac{3h}{d+3,5}\right) dB_{(A)} \quad \text{.....(5)}$$

for 1<h ((d+3,5)/3)

$$c3 = -10 \log \left(\frac{d'}{13,5}\right) dB_{(A)} \quad \text{.....(6)}$$

for h > ((d+3,5)/3)

With:

h = the height of the receiving point from the sound source (m)
d' = length of line of sight from sound source to receiver (m)
d = distance of sound source and receiver (m)

RESEARCH METHODS

Time and Place of Research

Field data collection was carried out for three months from July 2020 to September 2020 with 4 days per week, namely Monday, Tuesday, Saturday and Sunday.

Research Place

The place and location of this research is in front of the Nurul Hidayah Mosque in Salabenda on the Salabenda-Semplak Bogor highway.

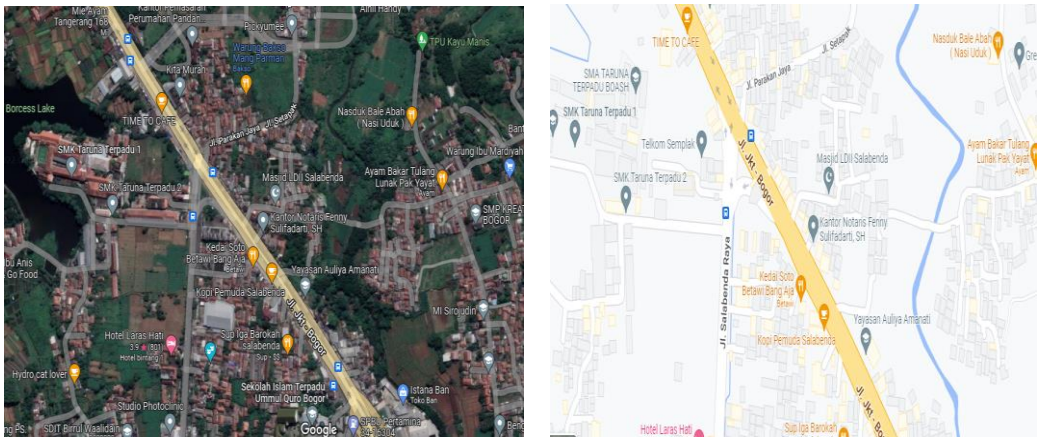

Figure 1. Research location map

Ingredients

The material used in this study is in the form of a data form to retrieve traffic data for motorbikes, private cars, public transport and freight transport as well as noise data taken from the measurement results of the Sound Level Meter (SLM) noise tool used.

Tool

For the main equipment and supporting equipment in this study are:

1. Sound Level Meter (SLM), as the main tool for calculating noise that occurs at a certain place and time. The SLM that is used has fruit, among others:
   a. SLM 1, SLM Manual merk Krisbow, type KW06-291,
   b. SLM 2, SLM Manual merk Krisbow, type KW06-291, and
   c. SLM 3, SLM Outo merk Extech, type HD600.

2. Meter roller, as a tool to measure the distance between the SLM point and the road and the walls of the Nurul HIdayah Mosque.
3. Digital camera, to document all processes in the ongoing research.
4. Tally or manual counting tool, as a tool to count the number of vehicles passing on the highway.
5. Laptop, as an aid in data collection and processing data obtained from the field.
6. Stationery along with note takers in the field, to assist in recording everything obtained during data collection in the field.

The research method is presented in Figure 2 below:

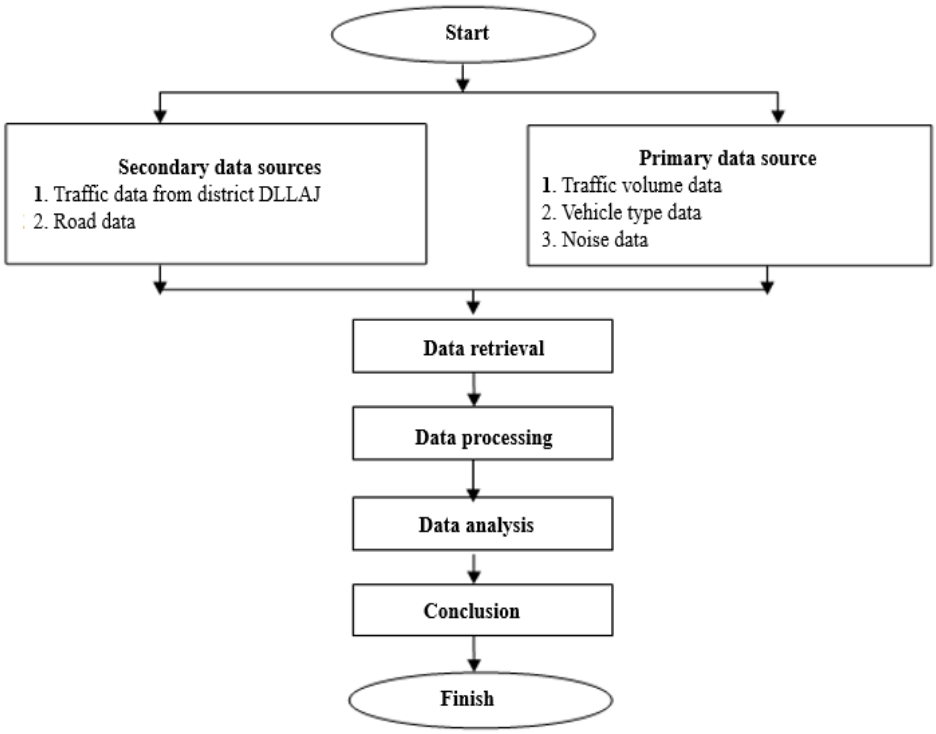

Figure 2. Research flowchart

RESULTS AND DISCUSSION

Results traffic volume data

This traffic data is obtained from the results of the calculation of the Equivalence of Passenger Cars (EMP). The use of this calculation is intended to make it easy to analyze traffic with the passenger car unit factor (SMP) for each motorized vehicle according to the Department of Public Works, Directorate of Highways (1997), for urban roads are as follows:

1. Heavy Vehicles (HV) = 1.30
2. Light Vehicles (LV) = 1.00
3. Motorcycles (MC) = 0.40
5. Non-motorized vehicles = 1.00

In practice, the grouping is divided into two groups, namely motorcycles and light vehicles, where motorcycles (MC) have a value of 0.40 and light vehicles are included (private cars, public transportation and goods transport) with an EMP of 1.00.

Density Processing Results

The results of processing motorized vehicle density data are displayed as an example of calculation as follows:

Density motorcycle (D) = speed (U) x volume (Q)
= km/vehicle

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Example validation:

If:

Speed	= 35,20 km/hours
Volume	= 2.021,11 hours/vehicle
Density	= 71.143,072 km/vehicle

Correlation Test

Correlation testing is used to find the relationship between two or more independent variables which are jointly connected with the dependent variable, so that the magnitude of the contribution of the independent variable which is the object of research to the dependent variable is known.

Table 1. Interpretation of the value of r

No	Velue r	Implementation of value r
1	0	Not correlated
2	0, 01 – 0,20	Very low
3	0, 21 – 0,40	Low
4	0, 41 – 0,60	Rather low
5	0, 61 – 0,80	High enough
6	0, 81 – 0,99	Hight
7	1	Very hight

Source: Usman H, 1995

Monday's Statistical Data Results

Discussion using a distance of 0.00m with SLM1

In the results of data processing using SPSS 22, the noise level (y) is obtained with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on the level 95% confidence. The following presents the results of the equation representing the 0.00m distance using SLM1: y = 77.30 - 0.06x1 - 0.21x2 + 0.01x3 + 0.02x4.

Discussion with a distance of 2.30 m using SLM2

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of a distance of 2.30 m using SLM2 is: y = 70.13 + 0.02x1 - 0.21x2 - 0.11x3 + 0.31x4.

Discussion with a distance of 9.50m using SLM3

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of 9.50m using SLM 2 is: y = 58.10 + 0.03x1 - 0.11x2 + 0.12x3 + 0.21x4.

Tuesday's Statistical Data Analysis

Discussion using a distance of 0.00m with SLM1

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of 0.00m distance using SLM1 is: y = 70.24 - 0.01x1 + 0.48x2 - 0.01x3 - 0.10x4.

Discussion with a distance of 2.30 m using SLM2

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of 2.30m using SLM2 is: y = 68.21 - 0.05x1 + 0.21x2 + 0.04x3 - 0.22x4.

Discussion with a distance of 9.50m using SLM3

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of the 9.50m distance using SLM 2 is: y = 59.41 + 0.01x1 + 0.09x2 + 0.03x3 - 0.08x4.

Saturday Statistical Data Analysis

Discussion using a distance of 0.00m with SLM1

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of 0.00m distance using SLM 2 is: y = 63.21 + 0.05x1 + 0.03x2 + 0.42x3 + 0.15x4.

Discussion with a distance of 2.30 m using SLM2

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), public transport cars (MAU/x3 and freight cars (MAB/x4) based on a 95% confidence level. The following shows the results of the equation which represents the condition of a 2.30m distance using SLM 2 is: y = 54.01 + 0.04x1 + 0.32x2 – 0.22x3 + 0.12x4.

Discussion with a distance of 9.50m using SLM3

Noise level (y) with the density of motorbikes (SPM/X1), private transport cars (MAP/x2), density of public transport cars (MAU/x3), freight cars (MAB/x4) based on a 95% confidence level. The following presents the results of the equation representing the 9.50m distance using SLM3: y = 55.92 + 0.03x1 + 0.08x2 – 0.05x3 +0.13x4.

Sunday Statistical Data Analysis

Discussion using a distance of 0.00m with SLM1

In the results of data processing using SPSS 22, the noise level (y) is obtained with the density of motorbikes (SPM/X1), the density of private cars (MAP/x2), the density of public transport cars (MAU/x3), the density of freight cars (MAB/x4) based on the 95% confidence level. The following presents the results of the equation representing the condition of 0.00m distance using SLM 1: y = 70.21 + 0.02x1 + 0.01x2 – 0.04x3 + 0.21x4.

Discussion with a distance of 2.30 m using SLM2

Noise level (y) with the density of motorbikes (SPM/X1), the density of private transport cars (MAP/x2), the density of public transport cars (MAU/x3) and the density of freight cars (MAB/x4) based on a 95% confidence level. The following presents the results of the equation representing the condition of the 2.30m distance using SLM2: y = 60.32 + 0.01x1 + 0.04x2 – 0.01x3 – 0.11x4.

Discussion with a distance of 9.50m using SLM3

Noise level (y) with the density of motorbikes (SPM/X1), the density of private transport cars (MAP/x2), the density of public transport cars (MAU/x3). The density of freight cars (MAB/x4) is based on a 95% confidence level. The following shows the results of the equation representing the condition of the 9.50m distance using SLM3: y = 55.02 + 0.03x1 – 0.07x2 + 0.02x3 – 0.01x4.

Discussion of research results

Based on the results obtained, the above equation conditions are calculated in the form of table 2 below.

Table 2. Recapitulation of research results

No	Equality	Noise value if the number of 0 vehicles (dB_A)	Discussion of research results

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1	Monday		The lowest
	Distance 0.00m SLM1		noise level
	y = 77.30 - 0.06x1 - 0.21x2 + 0.01x3 + 0.02x4.	77,30	value on SLM3
	Distance 2.30m SLM2		is 58.10 dB_A
	y = 70.13 + 0.02x1 - 0.21x2 - 0.11x3 + 0.31x4.	70,13	
	Distance 9.50m SLM3		
	y = 58.10 + 0.03x1 - 0.11x2 + 0.12x3 + 0.21x4.	58,10	
2	Tuesday		The lowest
	Distance 0.00m SLM1		noise level
	y = 70.24 - 0.01x1 + 0.48x2 - 0.01x3 - 0.10x4.	70,24	value on SLM3
	Distance 2.30m SLM2		is 59.41 dB_A
	y = 68.21 - 0.05x1 + 0.21x2 + 0.04x3 - 0.22x4.	60,21	
	Distance 9.50m SLM3		
	y = 59.41 + 0.01x1 + 0.09x2 + 0.03x3 - 0.08x4.	59,41	
3	Saturday		The lowest
	Distance 0.00m SLM1		noise level
	y = 63.21 + 0.05x1 + 0.03x2 + 0.42x3 + 0.15x4.	63,21	value on SLM2
	Distance 2.30m SLM2		is 54.01 dB_A
	y = 54.01 + 0.04x1 + 0.32x2 – 0.22x3 + 0.12x4.	54,01	
	Distance 9.50m SLM3		
	y = 55.92 + 0.03x1 + 0.08x2 – 0.05x3 +0.13x4.	55,92	
4	Sunday		The lowest
	Distance 0.00m SLM1		noise level
	y = 70.21 + 0.02x1 + 0.01x2 – 0.04x3 + 0.21x4.	70,21	value on SLM3
	Distance 2.30m SLM2		is 55.02 dB_A
	y = 60.32 + 0.01x1 + 0.04x2 – 0.01x3 – 0.11x4.	60,32	
	Distance 9.50m SLM3		
	y = 55.02 + 0.03x1 – 0.07x2 + 0.02x3 – 0.01x4.	55,02	

Based on the results from table 2 above, it can be concluded that the further away from the sound source, the lower the noise level. The closer to the sound source, the clearer and more pronounced the noise it will generate. Table 2 above shows the same thing so that this research is very valid to apply, but it needs other discussions and other research to improve research results that are even more thorough.

CONCLUSION

Calculation of the density of motorbikes, private cars, public transport cars and freight cars has a significant effect on noise. Analysis calculations obtained the largest equation on the third day of the second point of SLM2 research with a contribution of 22.12%. The following calculation is obtained, y = 54.01 + 0.04x1 + 0.32x2 – 0.22x3 + 0.12x4. This means that if there is no decrease in the density of motorbikes, the noise level in SLM2 is 54,021 dB_A. The density of motorbikes, private cars, public transport cars and freight cars also has a significant effect on noise, the second largest equation is obtained on the fourth day of research at the third point with a contribution of 21.24%. The calculation of the equation below is obtained, y = 55.02 + 0.03x1 – 0.07x2 + 0.02x3 – 0.01x4. The meaning of the above equation is that if there is an increase in the density of motorcycles and public transport cars, the noise in SLM3 is 55.02 dB_A.

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