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Analysis of the Noise Level at the Muhammadiyah KH. Ahmad Dahlan S. Parman Complex, Banjarmasin

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Abstract
The traffic density in Banjarmasin will have an impact on the environment such as the noise which causes health problems to humans. The noise in the school area, it will damage for concentration of students, teaching and learning activities inefficient. The purpose of this study was to determine the noise level in the College Complex of Muhammadiyah K.H Ahmad Dahlan, Banjarmasin. Measurement is carried out at 4 points and used Sound Level Meter (SLM). Noise data processing is calculated by the equivalent noise level (Leq). The results show that noise value exceeded the noise quality standard according to the Environmental Decree 1996 for noise levels in schools. The highest noise value reached 80.29 decibels while the lowest value was 63.04 decibels. Based on the results, it is necessary to reduce noise levels in this school area, so that teaching and learning activities can run properly.

INTRODUCTION

Banjarmasin is the capital of South Kalimantan Province. As the capital of the province, Banjarmasin has a high population density that will affect the level of density of traffic. The traffic density that occurs will certainly cause congestion on the road. One of the road sections that often occurs traffic congestion is on Jalan S.Parman Banjarmasin City. The results of the analysis in 2022, average daily traffic on S.Parman Street is 17,810 pce / hour with a percentage of motorbikes 66.47%. (Hardiani, Ruhaidani, & Anggarini, 2022).

The high volume of traffic will cause several impacts on the environment, one of them is noise. The noise comes from the vehicle engine, vehicle exhaust or the friction of a wheel with the road surface. Noise on human health are divided into four categories, such as psychological disorders, communication disorders, balance disorders, and deafness.

The highest volume of vehicles will cause the vehicle speed to be lower, generates high noise levels (Meylinda, Lefrandt, & Kumaat, 2020). This statement is also reinforced by Djalante (2010) in his research which states that the basic noise level of the traffic flow component and traffic speed have a considerable influence on the noise level, where the traffic flow increases, the noise level is also increasing.

Based on research from Anindiya, Maryunani, and Amin (2021), it is found that the relationship between vehicle volume and noise level can change. If the volume of vehicles increases, the resulting noise level can increase. In research done by Hartono (2018), the results showed the value of the noise level at SDN Sorogenen 1 which was getting higher when the traffic volume on Jalan Solo Km 10 peaked.

At S.Parman Street in Banjarmasin, there are 2 (two) schools located on the side of the road, it is SDN Pasar Lama 1 and Perguruan Muhammadiyah Complex. These two schools are located close to each other, with the distance of the school to S.Parman street which is approximately 50 metres. (Hardiani et al. 2022) said the

highest noise level value at SDN Pasar Lama 1 was 68.88 dB and the lowest value was 61.24 dB with the distance between the noise source and the research location was 50 metres.

According to Wedagama, Suthanaya, and Wirya (2022) in "Analysis of Traffic Flow Noise Outside and Indoors in the Simpang Lima Sunset Road Area", showed that the noise level at the same area from a distance of 10 metres result 69.87 dB and at a distance of 20 metres of 65.67 dB. So it can be seen that there is an effect of the distance of the noise source on the noise level. Nurasha (2020) in "Analysis of Noise Level in SMPN 2 Yogyakarta Environment" also found a higher noise level at the school gate of SMPN 2 Yogyakarta which is 67.1 dB compared to the noise level in front of the class of SMPN 2 Yogyakarta which is 66.15 dB.

Previous studies showed that some schools had noise levels that exceeded the required limit. (Minister of Environment 1996) regarding noise level limitation criteria for schools or similar, the maximum noise level is 55 dBa. Educational facilities that are located close to the highway certainly have risks because of high noise levels that exceed the threshold due to traffic activities (Rimantho & Cahyadi, 2015).

The high value of noise especially exceeding the required limit will certainly have an impact on the concentration of students who are conducting teaching and learning activities in the classroom. Zikri (2015) at MTS Negeri 34 Jakarta, there were 90% of students who said that noise interfered with concentration and communication in the teaching and learning activity in the classroom.

This is why it is important to know the noise level of a school. Especially if the volume of traffic that passes through the road has increased and congestion every day. Therefore, know the noise level in schools so that we can find solutions to overcome the noise level.

Based on this case, it is necessary to conduct research on the noise level at Perguruan Muhammadiyah K.H Ahmad Dahlan Banjarmasin complex. The objective of this research is to determine the condition of the noise level Perguruan Muhammadiyah K.H Ahmad Dahlan Banjarmasin complex. Is the noise level at the Perguruan Muhammadiyah K.H Ahmad Dahlan Complex in Banjarmasin classified as safe or has it exceeded the required threshold limit as happened to the noise level at SDN Pasar Lama 1.

MATERIALS AND METHODS

The data in this study consisted of primary data. Primary data is obtained by conducting research directly, it is noise level data collection. The first step of the study was to select the data collection point. The selection point was determined based on discussions with the head of the Muhammadiyah KH Ahmad Dahlan S.Parman College Complex in Banjarmasin. The location plan of the study area is shown in Figure 1.

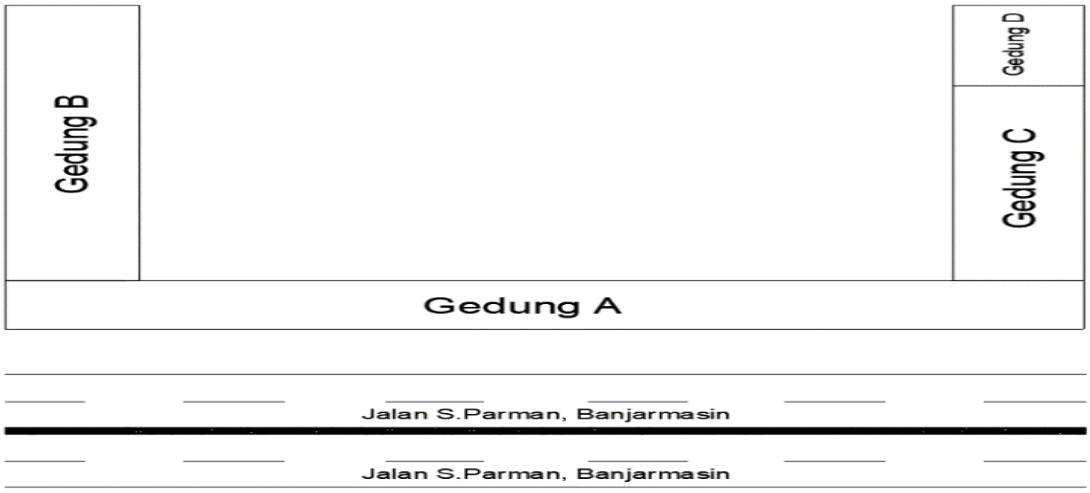

Figure 1. Location Plan of study area

Based on the preliminary survey, 4 observation points in the school area were determined, in Building A and in Building B. For details of data collection points shown in Table 1.

Table 1. Activity Plan Detail of Noise Data Collection

Data Collection Point	Day/ date	Distance from roadside (Meter)	Time
1. Building A – 2nd Floor	Monday/ 16 January 2023	21.3	08.00 – 12.00 AM
2. Gedung A – 3td Floor	Tuesday/ 17 January 2023	21.3	08.00 – 12.00 AM 02.00 – 16.00 PM
3. Gedung B – 1st Floor	Monday/ 06 February 2023	38.6	08.00 – 12.00 AM
4. Gedung B – 3th Floor	Tuesday/ 07 February 2023	38.6	08.00 – 12.00 AM 02.00 – 16.00 PM

Points 2 and 4 were collected in the morning and afternoon, because these points are also used for teaching and learning activities during the day. So data is needed to see the noise level at that hour. This research using a Sound Level Meter (SLM). Measurements were taken for 10 minutes at each interval and readings were taken every 5 seconds within a period of 4 hours per session by using frequency distribution to analyze the result of measurement.

Nowadays, there are applications that help in making noise measurements, it is Sound Meter version 3.5.1; Sound meter version 1.2; Sound Meter version 1.7.2; Noise Meter PRO version 1.0.9 and Sound Meter version 3.0. Of all these applications, the application that has the greatest measurement accuracy is Sound Meter version 3.0 (Guswantoro et al., 2021).

This research was conducted by direct observation using a simple method, using a Sound Level Meter (SLM). Measurements were taken for 10 minutes at each interval and readings were taken every 5 seconds within a period of 4 hours per session. In a study from Pristianto (2016) on noise levels during which was conducted for 12 days, using a simple method by 2 people with a sound level meter and obtained the highest value for 7 days for day time and the highest 5 days for night time.

According to Departemen Pekerjaan Umum (2005), using a Sound Level Meter that does not have a Leq calculation device is allowed, but the result must be converted so that the corresponding Leq value is obtained. Therefore, after obtaining the reading results of the SLM tool, then to determine the amount of noise level, an analysis with frequency distribution is needed. The frequency distribution components carried out in the analysis are,

1. Range (r), the diffence between the lowest and highest value
   r = Maximum Value – Minimum Value (1)
2. Magnitude of class interval (K), depends on range and number of classes.
   $k = 1 + \log(n)$ (2)
   K = No. of class log N = Logarithm of total no. of observations
3. Interval Class
   i = r/k (3)
   i= interval class, r = range, k magnitude of class interval
4. Middle point is the estimated middle of the interval class. The midpoint can be calculated using the formula:
   $Midpoint = \frac{(upper\ limit + lower\ limit)}{2}$ (4)
5. Frequency means a value is the number of times it occurs in dataset.

Noise level data was analysed by converting the actual noise level (La) to the equivalent noise level (Leq). Analysis continued by entering into the Leq formula based on the Keputusan Kementerian Lingkungan Hidup (Minister of Environment Regulation) No. 48 of 1996:

$$L_{eq} = 10\ Log\ \left[\frac{1}{T}\sum_{i=1}^{n}\left(t_i x 10^{\frac{li}{10}}\right)\right] \quad (5)$$

Leq was calculated using Equation 1.0 which expressed in dB (A) units

n = the total number of samples taken

Li = the noise level in dB (A) of the ith sample

t i = fraction of total sample time

From the results of the noise analysis at the research site, it was then checked with the quality standards of the noise level standards based on the following Ministry of Environment regulations.

Table 2. Noise Level Standard

Area	Noise Level (dBA)
1. Residential Area	55
2. Trade and services	70
3. Offices	65
4. Green open spaces	50
5. Industrial area	70
6. Government offices and public places	60
7. Recreational area	70
8. Airport, train station, and harbour	70
9. Cultural sites	60
10. hospital and other health services	55
11. School and other educational services	55
12. House of worship	55

** ministry of environment and forestry in KepMen LH No.48 year 1996*

RESULT AND DISCUSSION

Measurement of noise using Sound Level Meter (SLM) every 5 minutes during the observation, while data presented every 10 minutes, so that in 10 minutes there are 120 of noise data taken with SLM.
After the data obtained using SLM is processed with the help of frequency distribution and then calculated Leq, the noise value is obtained at the four observation locations. Table 3-6 are the results obtained from the SLM tool at point 1, at 08.00 - 08.10, then distribution frequency calculations to get the noise level.

Table 3. SLM Tool Reading Data Point 1 at 08.00 - 08.10

Minute	Frequency Second											
	5	10	15	20	25	30	35	40	45	50	55	60
1	67,3	66,4	68,1	67,3	67,3	68,0	51,7	70,9	71,5	71,6	71,7	74,1
2	71,3	71,6	71,8	70,3	73,1	72,3	71,4	71,1	71,4	72,0	71,9	71,9
3	71,6	72,4	73,5	71,5	71,5	52,2	73,2	72,2	72,3	72,1	73,0	72,7
4	71,2	72,5	71,4	72,4	72,1	73,4	72,3	72,7	73,6	72,0	72,3	70,0
5	72,6	72,0	72,9	71,7	72,0	71,4	64,9	72,3	71,7	72,1	71,7	72,2
6	71,1	71,5	71,6	71,8	72,4	71,7	71,0	73,5	72,1	72,9	71,7	73,6

Minute	Frequency Second											
	5	10	15	20	25	30	35	40	45	50	55	60
7	72,5	71,1	72,0	73,8	72,4	71,3	71,5	72,1	71,9	72,5	71,3	71,6
8	71,3	71,8	71,3	72,7	72,1	73,0	71,8	71,9	71,9	72,2	71,6	72,3
9	72,2	72,1	72,3	72,0	72,7	72,8	72,2	71,5	72,2	71,9	72,4	71,5
10	72,0	66,5	72,0	71,6	71,9	72,4	72,2	72,4	71,3	72,2	71,5	72,8

Example:

a. Total data (n) = 120
b. Max. Noise Value = 74,1
c. Min. Noise Value = 51,7
d. Range (r) = Max Noise Value – Min Noise Value
= 74,1 – 51,7
= 22,4
e. Number of class intervals (k) = 1 + log n
= 1 + log 120
= 7,86 ≈ 8 class
f. Interval (i) = r / k
= 22,4 / 7,86
= 2,84 ≈ 3

From these data, the frequency distribution is made as follows:

Table 4. Frequency Distribution Point 1 08.00 - 08.10 Am

Interval (dBa)	Median (L_i)	Frekuency (t_i)	t_i x 10 ^ 0,1 x L_i
51,7 – 54,5	53,1	2	410.676,74
54,6 – 57,5	56,1	0	-
57,6 – 60,4	59,0	0	-
60,5 – 63,4	62,0	0	-
63,5 – 66,3	64,9	1	3.106.211,21
66,4 – 69,3	67,9	7	42.881.428,11
69,4 – 72,2	70,8	73	881.930.331,02
72,3 – 75,2	73,8	37	881.563.014,26
	Total	120	1.809.891.661,34

Enter total of t_i x 10^0,1xL_i into formula to found Leq Value:

$$L_{eq} = 10\ Log\ \left[\frac{1}{T}\sum_{i=1}^{n}\left(t_i x 10^{\frac{li}{10}}\right)\right]$$

$$L_{eq} = 10\ Log\ \left[\frac{1}{T}\ x\ 1.809.891.661{,}34\right]$$

$$L_{eq} = 10\ Log\ \left[\frac{1}{120}\ x\ 1.809.891.661{,}34\right]$$

$$L_{eq} = 71{,}78\ \text{dB}$$

From the calculation, the noise level value of point 1 for 08.00 - 08.10 Am is 71.78 dB. For the calculation of the overall noise level can be seen in Figure 2 and Figure 3.

Figure 2 showed that all noise value results exceed the threshold of 55 db. At point 1 on the 2nd floor of Building A with a distance of 21.3 metres from the roadside and a height of 4.5 metres, the noise level exceeds the predetermined quality standard threshold. The highest noise level with a value of 71.93 dB was at 08.50 - 09.00, while the lowest was at 11.00 - 11.10 with a noise value of 66.34 dB.

At point 3 on the 1st floor of Building B with 21.3 metres from the roadside, a height of 8.4 metres, and an observation time of 8 hours also shows noise levels that exceed the predetermined quality standard threshold. The lowest value of noise at this point also has a value that exceeds the threshold of 65.21 dB at 10.40 - 10.50 am.

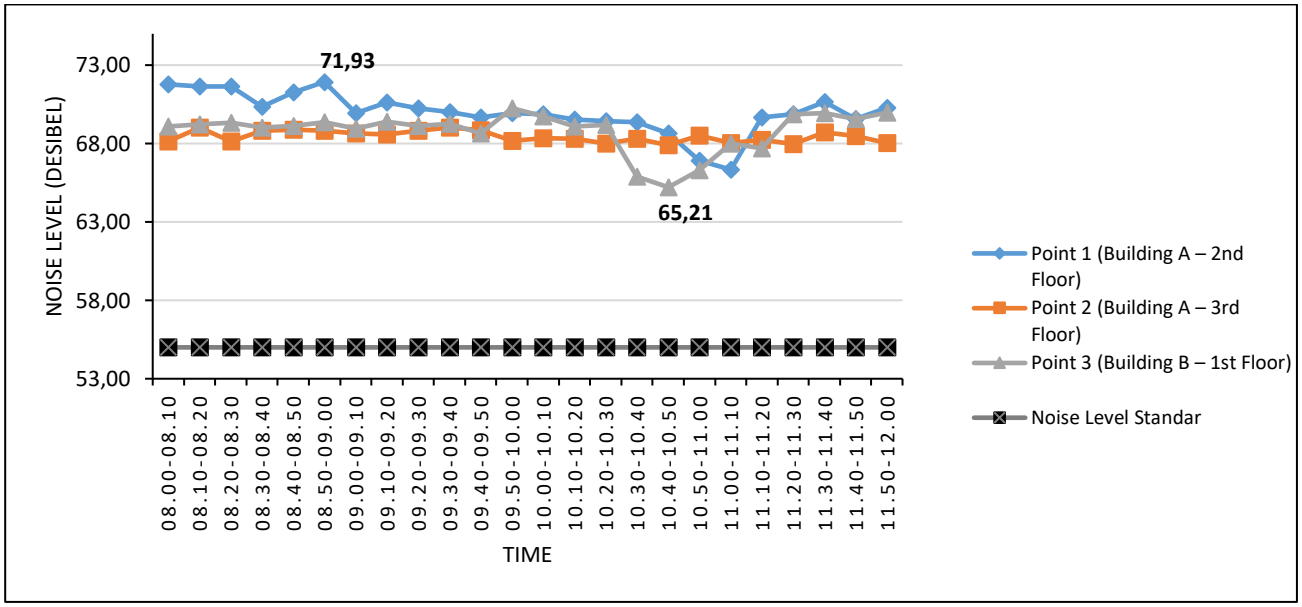

Figure 2. Noise Level at 08.00 – 12.00 AM

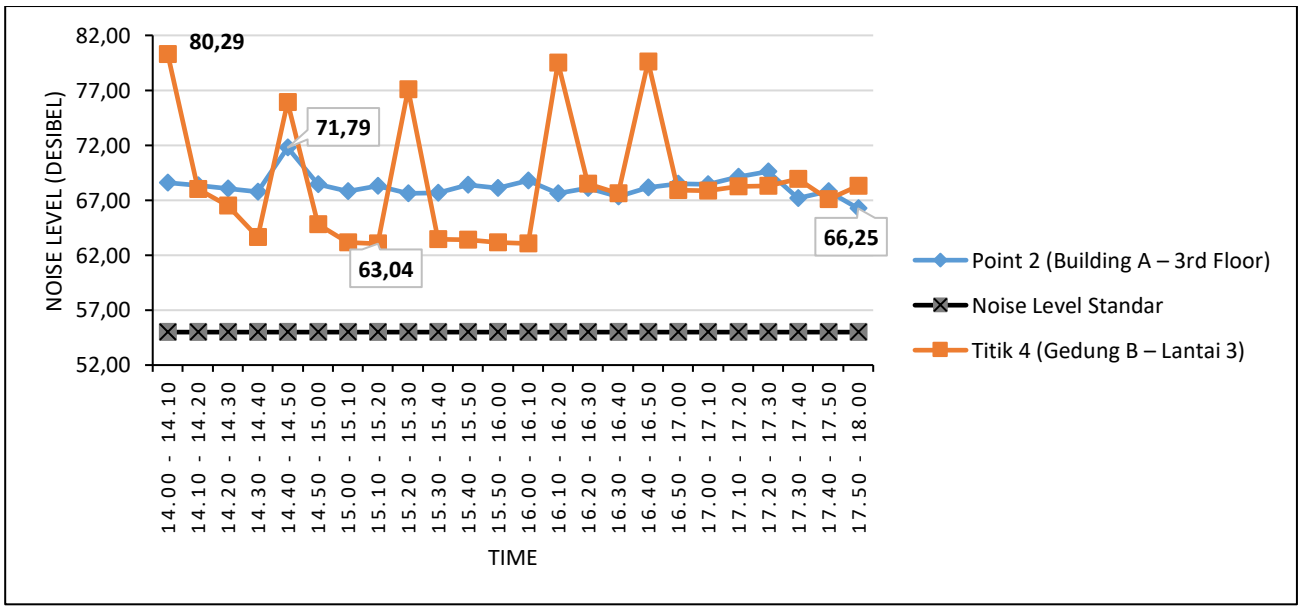

Figure 3. Noise Level at 02.00 – 06.00 PM

Figure 3 showed the noise level value at Point 2 and Point 4, taken on 02.00 – 06.00 PM. Similar to data collection at 08.00 - 12.00 AM, the noise level at this time also exceeds the required threshold. Point 3 and 4 taken at Building B which has a distance from the roadside of 38.6 metres. At point 2 (Building A- 3rd Floor) the lowest noise level on 05.50 – 06.00 PM noise value is 66.25 dB and the highest noise value on 02.40 – 02.50 PM noise value is 71.79 dB. At point 4 (Building B- 3rd Floor) the lowest noise level is at 03.10 – 03.20 PM is 63.04 dB and the highest is 80.29 dB which occurs at 02.00 – 02.10 PM

Based on Figure 2 and Figure 3, the noise values of all observation points are above the noise quality standard determined by the 1996 Minister of Environment Regulation, which is 55 dB. The highest noise value occurs at Observation Point 4 in Building B 3rd Floor with a noise value of 80.26 dB at 02.00 – 02.10 PM.
The high level of noise that exists at the location of the Muhammadiyah K.H Ahmad Dahlan College Complex in Banjarmasin can cause inefficient and disruptive learning activities; therefore, efforts are needed to reduce the noise level. One way to reduce noise is by installing natural or artificial dampers. It is impossible to reduce noise level by providing a barrier or planting trees. Therefore, the effort to reduce noise level is adding a layer of sound absorbing material as interior. The use of sound absorbers in many spaces, especially along the floor and ceiling of circulation spaces, such classroom, lobbies, foyers. The use of noise reduction partitions is also effective in reducing noise in the room (Doelle 1972).

CONCLUSION

The following conclusions are drawn from the study: (1) The minimum noise value at 4 points observation is 63.04 dB and the maximum value is 80.29 dB. (2) The noise value from the results in study area are greater than Minister of Environment Regulation for school area. (3) There is need to control the noise pollution to reduce noise level in school area to effectively teaching and learning activity

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