Schools Traffic Noise Pollution Levels Along Federal Roads in Muallim District, Perak, Malaysia

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Abstract. This article aims to identify the school traffic noise level along federal roads in Muallim District, Perak, namely SMK Khir Johari (SMKKJ), SMK Agama Slim River (SMKASR) and SMK Dato' Zulkifli Muhammad (SMKDZ). Data were collected during school hours and on weekends, from 7 September to 13 September 2019 and three times a day, 7.00 -8.00 am, 9.00 -10.00 am and 12.00 -1.00 pm. Data was collected using Digital Sound Level Meter AS804, which was mounted on a tripod approximately one meter high from the road surface to prevent road sound reflection. Sound recordings were performed using decibel scale weights (dBA) and values for Max (Maximum Noise Level), Min (Minimum Noise Level), Leq (Average Overall Noise) with five minutes time delay and descriptive analysis. The findings show all stations values exceeded the standards set by the Malaysia Department of Environment (DOE) (60 dBA). SMKKJ shows the Min value is 57.7 dBA, the Max value is 94.5 dBA and Leq 76.1 dBA during working hours. In conclusion, the study showed that all stations recorded high noise during working hours and non-working hours surpass the standard set by DOE during the day. The need for the Malaysian Ministry of Education to assess and plan to reduce this noise level through short-term and long-term measures.

1. Introduction
Environmental issues especially air, water and noise pollution are global issues that are often the display of the world all the time. Environmental issues have become a focus in society nowadays, due to their impact on the human environment ([1] Nasir et al., 2020). Nevertheless, it is very sad that noise pollution is often taken lightly and not given full attention compared to other environmental pollutants. this is because this noise pollution is a local problem making it not taken seriously by those responsible ([2] Nasir et al., 2021). Although this issue will harm the environment, especially humans if exposed for too long to this noise. This noise pollution is often associated with the rapid development, industrial centres, increasing the number of vehicles on the road as well as increasing the number of traffic lights has further increased traffic noise pollution in a place especially in downtown areas, settlements and in quiet zones such as educational institutions, hospitals and libraries [2]. Therefore, if we look at the infrastructure in Malaysia every day is increasing due to the growth and economic development that has been enjoyed in recent years ([3] Mohmadisa & Suhaily Yusri, 2005; [4] Nasir et al., 2021).

In general, humans are not able to see and touch the form of sound but can still be heard by the human ear near or far. The sound is produced through the concept of vibrating objects that produce waves and these waves are known as sound waves, which result from the surrounding molecules vibrating and produce waves because of the movement of sound through air and waves ([5] Mohmadisa et al., 2015; [4] Nasir et al., 2021. Therefore, the Department of Environment ([6] DOE, 2000; [7] DOE, 2019) has set permissible noise standards in a place such as in the city, where DOE has set on during the day the prescribed noise is 65 dBA while at night 55 dBA, While sensitive areas such as schools, hospitals and libraries are 60 dBA during the day and 55 dBA at night for existing land uses [7].This article will use the standard 60 dBA during the day for existing land use.
In a study [8] Poddar (2017) said in a study of reducing and controlling noise pollution. Noise pollution occurs due to various aspects, especially aspects of the life of the Indian community itself, namely in terms of family ceremonies, religious ceremonies, community celebrations, partying, gathering and so on. Noise pollution is only considered when the noise or pollutants cannot be controlled and cause serious health problems to the local population. According to Rohayu et al., [9] (2015) who studied the level of traffic noise and its impact on the teaching-learning environment of schools in Kuala Terengganu city centre said that the current rapid development has had a positive impact by causing the development in various sectors such as industry, transportation, information technology development and so on. Meanwhile, Mohmadisa et al., [5] (2015) conducted a study on traffic noise pollution conducted in Selangor, entitled Traffic Noise Pollution in Selected Settlement Areas of the Northern Corridor of Selangor. This study tries to relate the rapid development that is happening now has led to developments in various sectors such as industry, transportation, information technology development and so on, especially in Selangor which gives various effects, especially noise pollution [10].

Knowledge of the environment and its impact on humans is also very important nowadays. Environmental pollution will directly impact human behaviours ([11] [12] and if exposed in the long run will make the generation problematic. This article attempts to study the level of noise pollution in school areas that will disrupt the teaching process and learning. The louder the sound the more interrupted the process will be.

2. Methods

Study area

Muallim District has a history related to transportation in Malaysia. Before the construction of the North-South Highway which connected the north of the Peninsula with the south, the Federal Road was created which connected the north to the south. Everyone who wants to go to Kuala Lumpur from the north needs to go through this Federal Road. Even the first toll in Malaysia begins in this district. Along this road, there are 3 secondary schools taken in this study, namely SMK Khir Johari (SMKKJ), SMK Agama Slim River (SMKASR) and SMK Dato’ Zulkifli Muhammad (SMKDZ). These three schools were selected as stations for data observation because of the location of the school closest to Jalan Persekutuan. The selection of this school is based on its location which is in the downtown area which is known to have a busy traffic route every day, especially on weekdays. The location of the school is as in Table 1 and Figure 1. The observation station is in front of the school where the sending and picking up activities of students are done in front of the federal road.

| Schools name                                    | Latitude  | Longitude  |
|------------------------------------------------|-----------|------------|
| SMK Khir Johari (SMKKJ)                         | 3.695196  | 101.516848 |
| SMK Agama Slim River (SMKASR)                   | 3.794351  | 101.435217 |
| SMK Dato’ Zulkifli Muhammad (SMKDZ)             | 3.836977  | 101.398417 |
The data used is noise data observed in the field. Traffic noise observations are recorded using a measuring instrument known as the AS804 Digital Sound Level Meter. The device is mounted on a tripod approximately one meter high from the road surface to prevent the reflection of sound from the road surface that will affect the data performed. The device will be placed on the shoulder of the road during the observation process. It was placed within one meter of the road shoulder while the microphone was pointed towards the road to trap the sound of passing vehicles at each study location. Recordings were performed using decibel weights A (dBA) and using Max (Maximum Noise Level), Min (Minimum Noise Level), Leq (Equivalent or average noise level) and a set time of five minutes for each observation made at a study location. The number of days taken is for seven days (a week), which starts on September 9, the same day as Monday until September 15, 2019 (Sunday). Data will be collected during working hours and non-working hours, i.e., weekends to see how much difference in traffic noise levels at that time. Data observation will be done for three days starting at 7.00 am-8.00 am, 9.00 am-10.00 am and 12.00 noon-1.00 noon using a special measuring device. The setting of the observation time between 7 to 1 pm is the time when the teaching and learning process is being actively carried out for the morning.

Analysis
The analysis used is descriptive and the standard used to determine the noise level is from the Department of Environment (DOE) (2019) which does not exceed 60 dBA for sensitive areas such as schools and hospitals. Table 2 shows the standard values used by DOE (2019) for existing land use areas. For sensitive areas such as schools, the standard used on daytime money is no more than 60 dBA and nighttime 55 dBA. However, the standards used by DOE are different according to the type of development and for existing development, the standards used as in Table 2 DOE.
Table 2. Recommended permissible sound level (L_{eq}) by receiving land use for existing built-up areas as stated in the second schedule

| Receiving Land Use Category | L_{eq} Day 7.00 am - 10.00 pm | L_{eq} Night 10.00 pm - 7.00 am |
|-----------------------------|-------------------------------|-------------------------------|
| Low-Density Residential, Noise Sensitive Receptors, Institutional (School, Hospital, Worship). | 60 dBA | 55 dBA |
| Suburban and Urban Residential, Mixed Development | 65 dBA | 60 dBA |
| Commercial Business Zones. | 70 dBA | 65 dBA |
| Industrial Zones | 75 dBA | 75 dBA |

3. Results and Discussion

Daily noise level

Minimum daily traffic noise

Table 2 shows the dBA values for each day obtained by combining three observations. Most stations showed high values despite measurements to a minimum. The average value exceeds the DOE standard which is more than 76 dBA. The highest value is in SMKDZ. Only SMKASR stations showed a minimum value for 7 days less than the DOE standard (62 dBA) with values obtained by other stations only slightly above the DOE standard. The maximum value for the minimum observation shows that all stations exceed the value of 90 dBA and are far from the standard value of DOE. The standard deviation shows a value of more than 8 dBA which indicates the existence of uneven values for each day of observation. Meaning there is a high value on one day and on another day the value is low.

| Station | Schools Day | Weekend | Ave | Min | Max | SD |
|---------|-------------|---------|-----|-----|-----|----|
|         | Ave | Min | Max | SD |
|         | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| SMKKJ   | 77 | 87 | 67 | 75 | 84 | 90 | 73 | 79 | 67 | 90 | 8  |
| SMKASR  | 80 | 91 | 63 | 67 | 83 | 88 | 62 | 76 | 62 | 91 | 12 |
| SMKDZ   | 77 | 88 | 68 | 86 | 89 | 91 | 66 | 80 | 66 | 91 | 10 |

Maximum daily traffic noise

Table 3 shows the observed values for the maximum amount of noise per day. On average for 7 days the observation was more than 80 dBA which exceeded the DOE standard. The highest averages were at SMKKJ and SMKDZ stations (87 dBA). Minimum values indicate values above DOE standards as well. The lowest minimum value is in SMKASR (63 dBA), and the highest is in SMKKJ (79 dBA). As for the maximum value, it shows that all stations are over 90 dBA with the highest being in SMKDZ (95 dBA).
Table 4. Daily maximum noise levels

| Station | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Ave | Min | Max | SD |
|---------|------|------|------|------|------|------|------|-----|-----|-----|----|
| SMKKJ   | 85   | 94   | 82   | 89   | 91   | 79   | 89   | 87  | 79  | 94  | 5  |
| SMKASR  | 87   | 96   | 81   | 82   | 94   | 63   | 69   | 82  | 63  | 96  | 12 |
| SMKDZ   | 85   | 92   | 85   | 91   | 95   | 68   | 91   | 87  | 68  | 95  | 9  |

Daily Leq level of noise
Table 4 shows the noise Leq by on average exceeding the standard (60 dBA). The highest value for the average is 83 dBA (SMKKJ) and the lowest is 76 dBA (SMKASR). The lowest mean value was also at the SMKASR station (66 dBA). For the highest value, SMKKJ and SMKASR stations are the lowest (87 dBA). The standard deviation shows that the SMKKJ station shows a Leq value that is approximately the same for each day with a value of only 4 dBA. This shows that SMKKJ experiences a high value daily. This may be closely related to the activities of residents who go out in the evenings on weekdays to go sightseeing or spend time with family. This is similar to the study conducted at Taman Universiti Skudai, Johor which recorded a higher level of traffic noise in the evening due to the fact that the population is more active in the evening [13].

Table 5. Leq noise (average noise) daily

| Station | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Ave | Min | Max | SD |
|---------|------|------|------|------|------|------|------|-----|-----|-----|----|
| SMKKJ   | 80   | 86   | 76   | 81   | 87   | 86   | 83   | 83  | 76  | 87  | 4  |
| SMKASR  | 74   | 82   | 70   | 76   | 87   | 78   | 66   | 76  | 66  | 87  | 7  |
| SMKDZ   | 80   | 83   | 74   | 89   | 91   | 81   | 77   | 82  | 74  | 91  | 6  |

Noise level by day and observation time
Table 5 shows the basic statistics of each station mean observation, namely S1 (SMKKJ), S2 (SMKASR) and S3 (SMKDZ). A variety of values was obtained for each day of data collection (Monday to Sunday) of 7 days. Also, the variation of values according to data collection hours are 7-8 am, 9-10 am and 12-1 noon. Diversity is also seen from the perspective of working days and non-working days. This is to see if the sound value is constant or not. Overall, observation 1 (O1) made between 7 to 8 am, shows that the average is still above the DOE standard with values exceeding 60 dBA. Compared to the mean value which shows that although the value is above the standard but is close to the standard value which is below 66 dBA. While the maximum value of this time exceeds the standard between 74 dBA and 84 dBA. The standard deviation value also indicates the value at this O1 is not too much. This indicates that the values obtained between the station and the day are the same. Meaning the noise at O1 time is the same at each station and on each day. For working days, the average value of this time breaks the standard which is below 72 dBA. And the lowest value is 61 dBA (Monday, S1) and the highest value is 84 dBA (S1, Thursday). For non-working days, the average value is between 62 dBA and 71 dBA. And the lowest value is between 61 dBA and 66 dBA. The highest value was between 63-79 dBA. This shows that there is an impact of traffic on the noise value which on working days the noise value will be higher than on non-working days. The same situation is also shown for the 2nd (O2) and third (O3) observations. The average values of the entire observations and days showed values ranging from 61 dBA (S2, O2) to 74 dBA (S1, O3).

Table 6. Mean noise by day and observation time

| Day / Time / Station | Observation time 1 (O1) 7-8am (dBA) | Observation time 1 (O2) 9-10am (dBA) | Observation time 1 (O3) 12-1pm (dBA) |
|---------------------|-------------------------------------|-------------------------------------|-------------------------------------|
|                     | S1 | S2 | S3 | S1 | S2 | S3 | S1 | S2 | S3 |
| Working             |    |    |    |    |    |    |    |    |    |
| Monday              | 61 | 75 | 67 | 68 | 61 | 76 | 76 | 70 | 74 |
| Tuesday             | 80 | 65 | 70 | 58 | 58 | 76 | 68 | 63 | 67 |
| Wednesday           | 67 | 67 | 69 | 73 | 69 | 66 | 79 | 58 | 60 |
Table 6 shows the maximum noise values. On average for the entire observation and day showed that the noise level ranged from 81 dBA (S2, O3) to 87 dBA (S3, O1; S3, O2). Minimum values range from 62 dBA (S2, O2) to 79 dBA (S1, O2). The maximum value is between 88 dBA (S1, O2) to 100 dBA (S3, O3). A maximum value of up to 100 dBA is a bad value for school students and if continued will cause many problems such as hearing loss and stress.

According to Mohd Jailani [14], among the vehicle components that have the greatest impact in contributing to high noise emissions are heavy vehicles such as lorries and buses.

Table 7. Max noise by day and observation time

| Day / Time / Station | Observation time 1 (O1) 7-8am (dBA) | Observation time 1 (O2) 9-10am (dBA) | Observation time 1 (O3) 12-1pm (dBA) |
|----------------------|--------------------------------------|--------------------------------------|--------------------------------------|
|                      | S1  | S2  | S3  | S1  | S2  | S3  | S1  | S2  | S3  |
| Working Days         |     |     |     |     |     |     |     |     |     |
| Monday               | 77  | 87  | 77  | 88  | 85  | 89  | 84  | 80  | 85  |
| Tuesday              | 86  | 89  | 91  | 87  | 91  | 92  | 84  | 86  | 88  |
| Wednesday            | 89  | 89  | 85  | 79  | 79  | 85  | 82  | 81  | 85  |
| Thursday             | 95  | 87  | 86  | 80  | 82  | 89  | 89  | 79  | 100 |
| Friday               | 85  | 83  | 89  | 84  | 95  | 89  | 91  | 94  | 95  |
| Weekend              |     |     |     |     |     |     |     |     |     |
| Saturday             | 69  | 94  | 93  | 88  | 88  | 91  | 79  | 78  | 81  |
| Sunday               | 73  | 67  | 91  | 88  | 62  | 74  | 73  | 69  | 66  |
| All Days             |     |     |     |     |     |     |     |     |     |
|                      | 82  | 85  | 87  | 85  | 83  | 87  | 83  | 81  | 85  |
| Min                  | 69  | 67  | 77  | 79  | 62  | 74  | 73  | 69  | 66  |
| Max                  | 95  | 94  | 93  | 88  | 95  | 92  | 91  | 94  | 100 |
| SD                   | 9   | 9   | 6   | 4   | 11  | 6   | 6   | 8   | 11  |
| Working Days         |     |     |     |     |     |     |     |     |     |
| Ave                  | 86  | 87  | 85  | 84  | 86  | 89  | 86  | 84  | 90  |
| Min                  | 77  | 83  | 77  | 79  | 79  | 85  | 82  | 79  | 85  |
| Max                  | 95  | 89  | 91  | 88  | 95  | 92  | 91  | 94  | 100 |
| SD                   | 6   | 2   | 5   | 4   | 7   | 2   | 4   | 6   | 7   |
Where S1 – SMKKJ, S2- SMKASR, S3-SMKDZ

Table 7 shows the prolonged mean value (Leq). On average, Leq values range from 72 dBA (S2, O2) to 78 dBA (S3, O1; S3, O2). This indicates that the S3 station (SMKDZ) is experiencing noise values that exceed the DOE standard for a long time and needs to be considered as a method of reducing the traffic noise to reach the classroom. The mean value of Leq is between 58 dBA (S2, O3) which is still below the standard to 72 dBA (S3, O1; S1, O2). The maximum value is between 77 dBA (S1, O3) to 89 dBA (S1, O1). SMKKJ and SMKDZ are indeed experiencing noise pollution from traffic and most of the values obtained either days or hours of observation show high values. The high max value in the evening is due to heavy vehicles such as trailers and large lorries passing in front of the school. This is because, this heavy vehicle does indeed have a very loud engine and horn noise and it hurts the ears. Not only that, but heavy vehicle drivers also often sound the horn at will regardless of the school area as one of the areas that sensitive [9].

| Working Days | Observation time 1 (O1) 7-8am (dBA) | Observation time 2 (O2) 9-10am (dBA) | Observation time 3 (O3) 12-1pm (dBA) |
|--------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Monday       | Ave 69 81 72 78 73 82             | Ave 76 78 77 74 75 84             | Ave 80 75 79                     |
| Tuesday      | Ave 83 77 80 72 75 84             | Ave 76 77 74 75 82 75             | Ave 76 72 72                     |
| Wednesday    | Ave 78 78 77 76 74 75             | Ave 80 70 72                      | Ave 80 70 72                     |
| Thursday     | Ave 89 76 78 79 72 82             | Ave 79 77 82                      | Ave 79 77 82                     |
| Friday       | Ave 77 80 81 81 81 78             | Ave 84 77 85                      | Ave 84 77 85                     |
| Weekend      | Ave 64 79 81 73 71 76             | Ave 68 74 75                      | Ave 68 74 75                     |
|              | Ave 68 64 79 79 59 69             | Ave 68 66 58                      | Ave 66 67 58                     |
| All Days     | Ave 75 76 78 77 72 78             | Ave 77 73 76                      | Ave 77 73 76                     |
|              | Min 64 64 72 72 59 69             | Min 68 67 58                      | Min 68 67 58                     |
|              | Max 89 81 81 81 81 84             | Max 84 77 85                      | Max 84 77 85                     |
|              | SD 9 6 3 3 6 5                   | SD 6 4 9                         | SD 6 4 9                         |

Where S1 – SMKKJ, S2- SMKASR, S3-SMKDZ
4. Conclusion
The conclusion can be seen that the noise level recorded at each station is very high, especially the data observations done at noon. Therefore, the average for the station is above 70 dBA and has exceeded the standard set by the DOE at 60 dBA during the day for the existing sensitive areas. SMKKJ and SMKDZ are at risk of traffic noise pollution. This is also due to the location of the school being close to federal roads and being in a major municipal area. Therefore, the authorities should play a role in reducing traffic noise pollution in quiet zone areas such as housing, hospitals, and schools especially. The Ministry of Education Malaysia (MOE) can adopt methods such as the construction of walls at the school boundary with the road or adopt the buffer zone method by making 1 minimum distance between the road and the school building. In addition, plants can also be placed in the zone area to reduce noise intrusion into the school area. Even more extreme measures can be taken with school relocation if this noise pollution increases.

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