AN ASSESSMENT OF THE DISTANCE VARIATION OF TRAFFIC NOISE POLLUTION IN DHAKA CITY DURING PEAK AND OFF-PEAK HOURS

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ABSTRACT

The negative effects of noise pollution on healthy living in Dhaka City are not well understood and are given less consideration than they should. It is crucial to promptly investigate the increasing noise levels in cities to identify effective control measures and enhance city planning. In this work, the spatiotemporal variability of noise levels and noise pollution indices during peak and off-peak hours in Dhaka City, Bangladesh, is assessed and evaluated. 15 places have been chosen as measurement sites and values are collected from three distinct distances from the roadside (2m, 4m, and 6m) by Sound Level Meter (SLM). This study uses graphs to display the changes in noise descriptors and pollution indices. It is discovered that, regardless of the source, city dwellers near the roadside generally experienced moderately high noise during peak hours, with an average noise level of 75 dB exceeding the limit values set by the American Association of State Highway and Transportation Officials (AASHTO) for different land uses individually or in combination. At distances of 2 meters, 4 meters, and 6 meters from the roadside, the average noise levels during peak hours measure 90.50 dB, 65.91 dB, and 53.16 dB. Similarly, the associated figures for off-peak hours are 85.78 dB, 62.56 dB, and 46 dB.It is also clear that the amount of noise is reduced by increasing distance from the roadside, and that those who live closer to the road feel significantly more noise than those who live 5 to 6 meters away from the major road. A formula for measuring noise levels during peak and off-peak hours is developed, allowing the noise level at a specific distance to be determined. Finally, as for prediction, the noise level at 10 meters from the main road is calculated and the value shows that residential also institutional building has to be built at least 10 meters away from the roadside to avoid noise pollution.

Keywords: *Traffic, Distance, Noise pollution, Decibel (dB), peak hour and off-peak hour,*

1. INTRODUCTION

In many rapidly urbanizing locations, noise pollution can pose a significant environmental threat. The man-made environmental catastrophe of the 2000s, which includes loud music, people talking on the phone, traffic, and even pets barking at any time of day, is something we are ethically unable to escape (Papacostas and Prevedouros 1993). Some of those activities have entered urban society and occasionally bother us (Berglund, Lindvall et al. 1999). Similar to many other major cities in developing nations, noise pollution is a major issue in Dhaka, Bangladesh (Ahmed 1998). Here, noise is generated from various sources, including traffic, loudspeakers, crowds of people, etc (Sultana, Paul and Nessa 2020). But when those sounds go too far and give you a headache, they cease to be merely noise and start to become noise pollution. Noise is an intolerable level of sound that makes people uncomfortable, disturbs their mental and physical well-being, and could seriously harm their health. Noise pollution is now posing a hazard to residents of Dhaka City in addition to the rising levels of air and water pollution (RİYAD, Al and MAZUMDER 2020). People who live in cities, especially children, may experience considerable stress on their nervous and auditory systems due to exposure to loud noise. One of the main causes of noise pollution in cities is motorized traffic (Alam, Dikshit and Khan 2005). Frequent exposure to loud noise disrupts physical and mental tranquillity and may be harmful to health (Razzaque, Chowdhury et al. 2010). Urbanization and motorization have a strong correlation with noise pollution levels. Motorized traffic is the main cause of noise in urban areas, despite several other sources of noise, such as industries, construction sites, and careless usage of loudspeakers (Zanzabil, Ali et al.). Noise pollution was not a serious concern for Dhaka City residents during the 1970s and early 1980s. The risk of noise pollution has escalated beyond the level of tolerance with the increase in the number of motorized vehicles in the city (Ahmed 1998, Razzaque, Chowdhury et al. 2010).

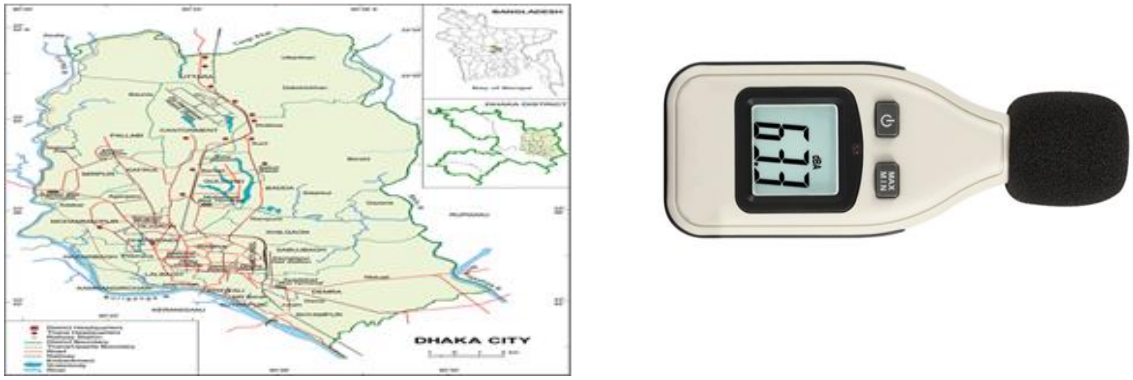
According to (Das 2001) the hearing acuity of city residents has decreased in the last 10 years. Due to noise pollution, between five and seven percent of patients at Sylhet Osmani Medical College are permanently deaf (Ahmed 1998). Noise disturbances can lead to hypertension, headaches, pharyngitis, peptic ulcers, atherosclerosis, bradycardia, and ectopic heartbeats (Papacostas and Prevedouros 1993). The purpose of the study is to examine and evaluate the severity of the noise pollution in Dhaka City. It examines the link between traffic volume and the diurnal change of noise along the roadside.

The study looks at the problem of noise pollution in connection to traffic. The paper opens with a background section on sound pollution, its effects on people, and a literature review of comparable activities taken globally as well as in Bangladesh. The purpose of this project is to collect environmental information on roads. Observing traffic noise and reserving it for further analysis, editing, and promoting its utilization for the simplest possible purpose:

- Understanding the causes of traffic-induced sound pollution at varying distances;
- Recognizing the adverse effects of sound pollution;

2. METHODOLOGY

In this investigation, sound pressure levels were counted using a Sound Level Meter (SLM). The equipment was run by a person, and every time sound levels were measured in the same way.



a. Sampling stations b. Sound Level Meter (SLM)

Figure 1: Location and Measuring instrument

15 places in Dhaka City had their noise levels recorded from 2 times on weekdays. The airport, Khilkhet, Kawla, Matikata, Kalshi, Rampura, Natun Bazar, Sawrapara, Banani Bus Stop, Mohakhali, Mohammadpur Bus Stop, and Gabtoli were included in the study. Both close to and far from the roadside, time-weighted average noise levels have been recorded. This was done to examine how distance and existing roadside barriers influenced the level of noise reduction. Daily traffic volume data were collected on both directions count basis as per Road Materials and Standard Study Bangladesh (LGED, 1998) considering the following points:

- ❖ The survey site should have sufficient vision of oncoming traffic.
- ❖ The workers should have enough shelter/safety.
- ❖ It is important to take into account any traffic seasonal variations.

Traffic noise index was also calculated to measure annoyance responses to motor vehicle noise using the following formula:

$$TNI\ (dB) = 4 \times (L_{10} - L_{90}) + (L_{90} - 30)\ (dB) \quad (1)$$

Where, L_{10} and L_{90} are the A-weighted decibel levels exceeded 10% and 90% of the time respectively (i.e. the peak and ambient levels, respectively).

a. Peak Hour b. Off-peak Hour

Figure 2: Data Collection at different location in Dhaka city

Table 1: Acceptable Noise Level (dB)

Description of Area	**Noise Level dB**		
	DOE	**FHA**	**AASHTO**
Sensitive areas such as parks, schools,Hospitals and mosques	45	60	5-60
Residential area	50	70 (Interior not exceed 55)	70 exterior
Mixed used area	60	70	55 interior
Commercial area	70	75	70
Industrial area	75	75	75

3. RESULTS AND DISSCUSION

Traffic conditions can alter over time owing to a variety of variables such as population expansion, urbanization, infrastructure development, and changes in commuting habits. To obtain the most accurate and up-to-date statistics on Dhaka's traffic rise rate,

Table 2: Traffic Volume (PCU) in Dhaka city [BRTC]

Year	2017	2018	2019	2020	2021	2022 (Sept.)
PCU (Million)	1.29659	1.46182	1.6039	1.70664	1.83716	1.95279

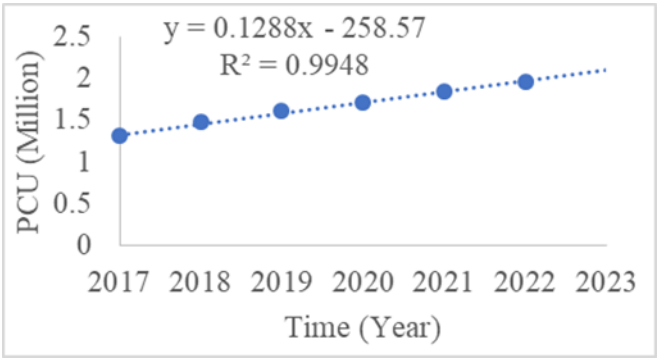


Figure 3: Traffic growth rate in Dhaka City

$$\text{PCU (Million)} = -258.57 + 0.1288X \quad (2)$$

Figure 3 shows how PCU (Million) and Time are related (Year). PCU is expanding year after year, according to its value, which is updated through September 2022. Here, a generic equation 2 is developed ~~created~~ from which the PCU for a future year can be determined. Where, X is Time (Year).

To quantify and estimate the severity of noise pollution in Dhaka City. Additionally, because the majority of schools and hospitals, which are particularly sensitive, are situated close to roadways, noise levels at these locations have been assessed at various distances in order to identify the safe distance. Azampur, Airport, Khilkhet, Kawla, Matikata, Kalshi, Rampura, Natun Bazar, Sawrapara, Banani Bus Stop, Mohakhali, Mohammadpur Bus Stop, and Gabtoli Where are some of the schools and hospitals that are close to the route included in the study.

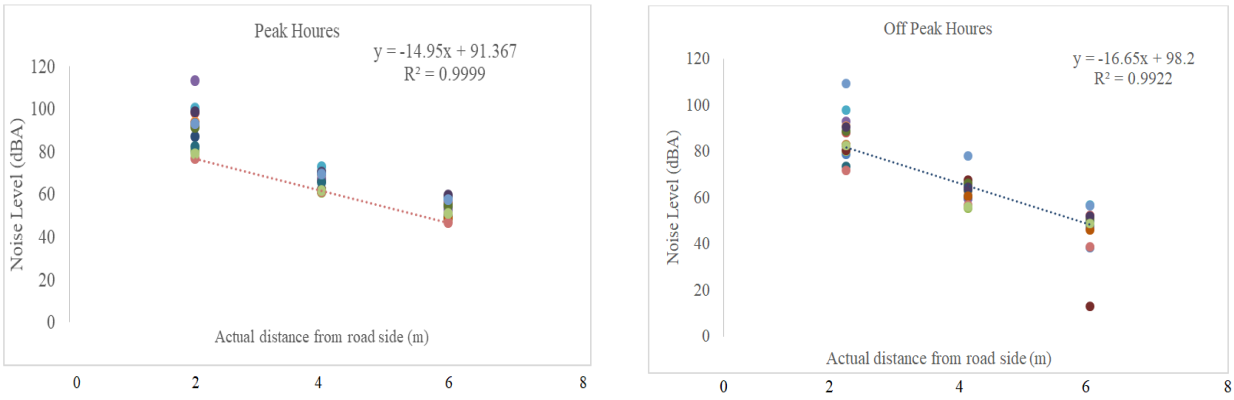
Table 3: Noise level (dB) at different locations in Dhaka City

Location Name	Peak Hour			Off-peak Hour		
	Distance from road side (m)			Distance from road side (m)		
	2	4	6	2	4	6
Kamarpara	80.10	70.20	57.20	78.40	59.20	38.00
Abdullahpur	97.90	66.20	55.80	87.80	65.5	52.10
Azampur	80.50	60.50	48.40	79.90	55.3	46.80
Airport	113.20	67.30	52.60	92.60	59.30	46.60
Khilkhet	100.00	72.50	58.30	97.50	65.2	56.70
Kawla	93.80	69.30	54.10	90.80	62.50	48.50
Matikata	86.70	61.90	54.30	82.40	63.20	49.10
Kalshi	92.80	62.10	50.40	80.10	67.30	12.80
Rampura	91.20	69.70	54.90	88.40	65.90	50.50
Natun Bazar	98.60	70.2	59.60	90.40	64.20	51.80
Sawrapara	82.20	65.6	49.10	73.10	60.30	48.10
Banani	92.70	61.20	48.80	82.50	60.3	45.60
Mohakhali	92.70	69.20	57.10	109.10	77.80	56.10
Mohammadpur	76.50	61.30	46.60	71.40	56.60	38.60
Gabtoli	78.60	61.50	50.70	82.40	55.90	48.60

The noise level information collected from 15 different places of Dhaka city shown in Table 3. These numbers were collected throughout peak hour (9.00 AM-11.00 AM). The airport sector, which was 2 meters from the main road, had the worst noise (113.20 decibels), while Mohammadpur had the quietest noise (76.50 decibels). Khilkhet area's noise level was 72.50 dB, which was lower than the average noise level of 75 dB, considering that it was 4 meters from the major road, while Azampur area's noise level was 60.50 dB. The maximum noise level measured 6 meters from main road during peak hours in Natun Bazar area was 59.60 dB, while the lowest value was recorded in Mohammadpur and it was 46.60 dB, both of which were below the average value.

These data were collected after peak hours (12:00 PM-2:00 PM). At that time, the maximum noise level in the Mohakhali area was recorded at 109.10 dB, measured at a distance of 2 meters from the main road. Mohammadpur exhibited a minimal noise level of 71.40 dB when measured at the same distance from the road. Despite a low measurement of 55.30 dB being recorded in Azampur, the noise level in the Mohakhali region remained at a maximum of 77.80 dB when measured at a distance of 4 meters from the road. For a distance of 6 meters from the main road, the maximum and minimum values were recorded at Khilkhet (56.70 dB) and Kalshi (12.80 dB), respectively.

It is apparent that the maximum noise level recorded in the Mohakhali area during off-peak hours was higher (109.10 dB) than peak hours (92.70 dB). It occurred because not all parts of Dhaka City became crowded at the same time, and Mohakhali is close to the Tejgaon Industrial Location, where there are fewer residential structures and educational institutions than in any other area. As a result, following the typical peak hour, this area starts to become a little busy.



a. Peak Hours b. Off-peak Hour

Figure 5: Noise level (dB) vs. Actual distance from road side (m)

Relationship between the Noise level (dB) and Actual distance (m) from the roadside during the peak hour is shown in Figure 5. It is evident that when one moves further away from a road's edge, the noise level decreases. Also in this case, a basic equation is produced from which noise level at any distance in the future can be estimated. Where, X is Actual distance from road side (Meters).

Peak Hours @ Noise Level (dB) = 91.367 – 14.95X (3)

Off-peak Hours @ Noise Level (dB) = 98.2 – 16.65X (4)

4. CONCLUSIONS

The level of noise decreases with distance from the roadside, and that people who live closer to the roadside have to deal with a more noise than those who live 5 to 6 meters from the main road. Finally, the prediction of the noise level shows that 10 meters could be considered a safe distance from the main road to avoid noise pollution for the residents.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to the Department of Civil Engineering at European University of Bangladesh for providing us with on-going inspiration, sound advice, and strong encouragement, especially in solving the issues we encountered while carrying out this study.

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