



Assessment of Noise Pollution in Shahbagh of Dhaka City: Spatial Noise Mapping and Its Impact Analysis

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Abstract: Like most other pollutants, noise pollution is an inevitable consequence of modern civilization, urbanization, and industrialization. The study area is Shahbagh, a growing Dhaka divisional metropolitan area with an excellent institutional and commercial sector. Due to the presence of the best universities and medical colleges, including Dhaka University, BSMMU Hospital, BUET, and Dhaka Medical College, it covers the most sensitive areas. This study aims to quantify the level of noise pollution in Shahbagh and the neighboring communities. The data on inclusive noise was collected from fifteen central locations. Arc GIS (10.8) software and the Inverse Distance Weighting (IDW) interpolation technique were used to complete the noise mapping process. According to this study, during the evening hours, Suhrawardy Udyan had the lowest average sound level (54.19 dB) and Shahbagh Square had the highest average sound level (86.51 dB). The problems of this area with noise pollution are getting worse over time as more transportation, building construction, and other infrastructural developments, etc. According to the noise assessment study, this most significant area of this country has high levels of noise pollution, and urgent control measures need to be implemented.

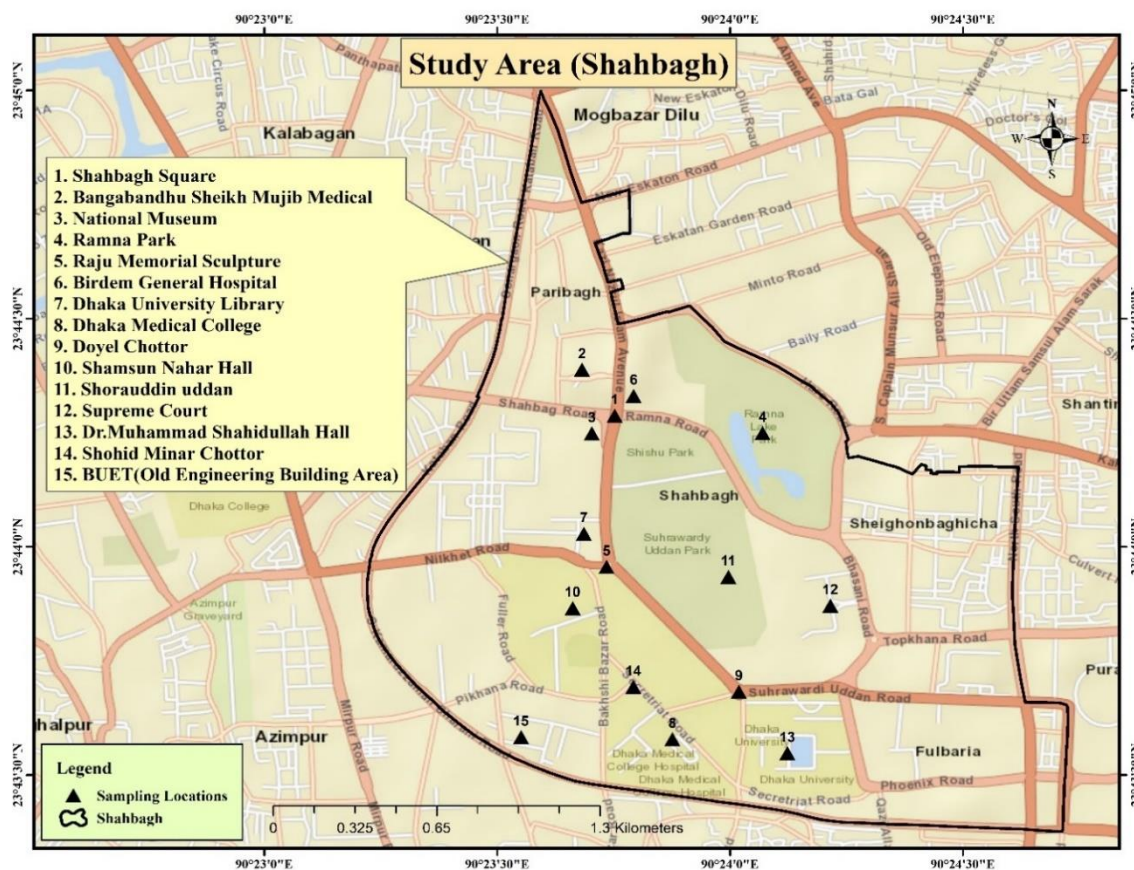
1. Introduction

Noise pollution is unwanted or excessive sound that negatively impacts human health and the environment. Noise pollution is frequent in many industrial buildings and other workplaces, but it also occurs due to human gatherings, highways, trains, buses hydraulic horns, aviation traffic, and outdoor construction operations (Arbaoui *et al.*, 2018; Berg *et al.*, 2021; Sojib *et al.*, 2021; Kanu *et al.*, 2022; Karki *et al.*, 2024). With the rise of industrialization and urbanization, noise pollution in urban areas is increasing (Nipa *et al.*, 2022). Noise is more likely to rise as society advances, the economy grows, and the population grows. Given that a large number of these routes pass through residential areas, there is a possibility that people will come into contact with noise, the silent killer (Balashanmugam *et al.*, (2013).

Dhaka is not only the capital but also a financial, commercial, and entertainment center. Its population, area, and social and economic variety have increased substantially since it became a mega city. The most crowded and polluted thana is Shhabagh, a well-known area of Dhaka. It is a significant hub for transportation as well. Many people gather in this area to engage in a variety of activities, and a wide range of activities are conducted. To maintain transportation, a vast number of vehicles are observed on the roads. To account for this, the Shhabagh neighborhood is among the most noise-sensitive in the city (Haq *et al.*, (2012).

At sound levels in the range of 110-140 dB, effects on the respiratory system, dizziness, bewilderment, loss of physical control, and other physical changes resulting from stress and nausea may be caused (Dara, 2004; Hahad *et al.*, 2019). The accepted threshold limits for sensitive areas, residential areas, mixed areas, and commercial areas are 50dB, 55dB, 60dB, and 70dB, respectively (DoE, 2006). Those with hearing loss make up about 90% of the population in low- and middle-income nations. Communication is the most evident impact of childhood hearing loss (WHO, 2017). The concern of rising noise pollution has been a major worry worldwide along with the processes of urbanization and industrialization, and Bangladesh is not an exception (Das and Basak., 2020).

The purpose of this study was to determine the amount of noise pollution impact on various types of susceptible institutions, hospitals, and sensitive areas to gain a clear view of the impact of noise pollution and to create an appropriate noise pollution map depending on noise levels (Map 1).



Map 1. Study Area of Noise Measuring Zone of Shhabagh

2. Methodology

2.1 Study Area: In the Shhabagh Thana, noise levels were monitored in fifteen central places. The inclusive noise data was taken from three shifts during the morning (8 am- 10 am), afternoon (12 pm- 2 pm), and evening (4 pm- 5 pm) on working days. The coordinates of each place where noise level data was taken were obtained using a GPS device (model: Garmin eTrex 10). There were 15 locations

(**Table 1**) chosen for noise measurement. It is situated between 23°43' and 23°44' north latitudes and 90°23' and 90°24' east longitudes. The Shahbagh Thana covers an area of 3.49 sq km. It serves as a crossroads between the two distinct sections of this city, Old Dhaka and New Dhaka. It is bordered on the north by Ramna thana, on the south by Chawkbazar model and Bangshal thanas, on the east by Paltan thana, and on the west by Kalabagan, New Market, and Lalbagh thanas (Al-Amin, 2015; BBS, 2022).

Table 1. Average Noise Data at Different Locations in Shahbagh with a Standard Value

SL no.	Location name	Category of the area	Sound Level (dB)			DoE Standard	WHO & EC (WHO 2009)
			Morning	After-noon	Evening		
1	Shahbagh Square	Mixed area	81.21	81.37	86.51	60	55
2	Bangabandhu Sheikh Mujib Medical	Sensitive area	70.47	80.70	72.76	45	45
3	National Museum	Sensitive area	68.7	71.99	68.06	45	45
4	Ramna Park	Sensitive area	58.07	64.40	65.29	45	45
5	Raju Memorial Sculpture	Mixed area	71.04	74.84	76.76	60	55
6	BIRDEM General Hospital	Sensitive area	73.94	73.07	70.64	45	45
7	Dhaka University Library	Sensitive area	57.21	64.43	67.30	45	45
8	Dhaka Medical College	Sensitive area	64.8	72.76	59.19	45	45
9	Doyel Chottor	Commercial area	76.74	77.59	69.50	70	55
10	Shamsun Nahar Hall	Residential area	57.6	58.59	62.24	50	55
11	Suhrawardy Udyan	Sensitive area	57.39	62.60	54.19	45	45
12	Supreme Court	Commercial area	56.47	59.89	66.74	70	55
13	Dr.Muhammad Shahidullah hall	Residential area	55.73	56.09	57.36	50	55
14	Shahid Minar Chottor	Mixed area	75.9	84.33	79.76	60	55
15	BUET	Sensitive area	56.49	56.47	55.01	45	45

Note: DoE= Department of Environment, WHO= World Health Organization, and EC=European Commission

2.2 Data Analysis and Interpretation

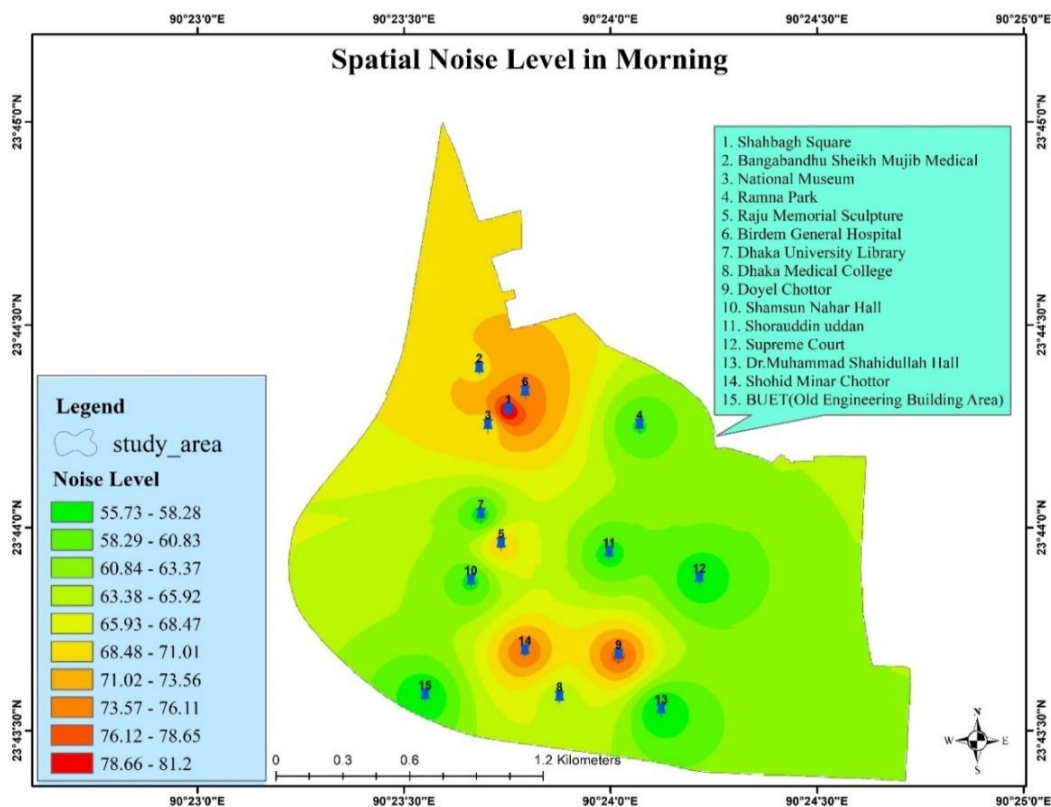
A digital sound level meter was used to collect data in this study. Measurement range is: 1) Lo = 30 dB; ii) Hi = 120 dB. The sound levels were measured using a sound meter (SKDEC-01) on a decibel (dB) scale. GIS software (Arc GIS 10.8) is utilized for data analysis and the Inverse Distance Weighting (IDW) interpolation method of the spatial analysis tool in this investigation. The data was analyzed using Microsoft Excel, and the average results are presented in **Table 1** to explain the current state of the noise level, assess the concentration of noise pollution, and identify the highly at-risk area of Shahbagh.

3. Results and Discussion

The Shahbagh road situation is deteriorating day by day due to the exponential growth in the population and the number of vehicles. In addition, inefficient traffic management, a scarcity of parking spaces, and poor road conditions have contributed to the noisy environment of the city. The noise level data at different locations of the Shahbagh thana area are presented as average data in **Table 1**. The locations are sensitive and include residential, commercial, and mixed areas of Shahbagh. The highest average level of sound (86.51 dB) was observed at Shahbagh Square, and the lowest average level of sound (54.19 dB) was observed at Suhrawardy Udyan.

3.1. Variation of Noise level: **Map 2** shows that the IDW method is used to make a spatial noise map in the morning in the Shahbagh area. The highest noise level (81.21 dB) is found in the morning (8 am – 10 am) near Shahbagh Square, and the lowest levels are (55.73 dB, 56.47 dB & 56.49 dB) near the Dr. Muhammad Shahidullah Hall, Supreme Court, and BUET.

At this time, many students are going to school, many patients are going to the hospital, and many others are going to the market or their workplaces. A large number of vehicles such as buses, rickshaws, and other automobiles are transporting them to their destinations consequently, noise levels leftovers high.



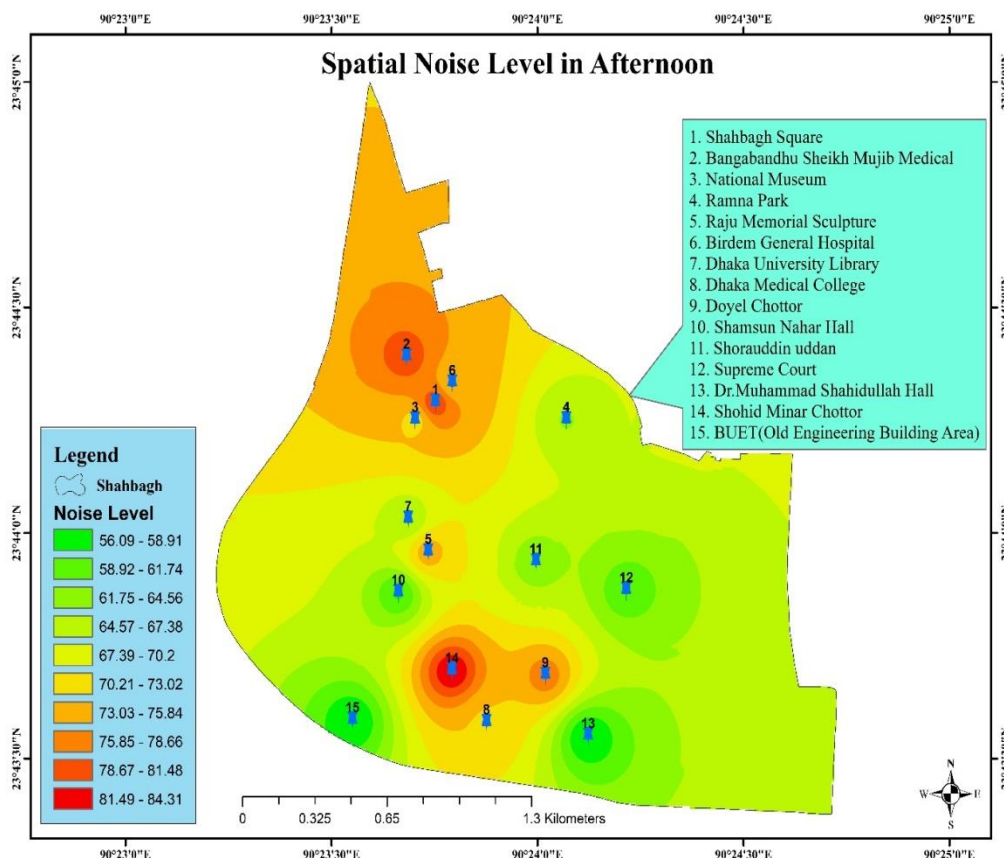
Map 2. Spatial Noise Level Mapping in Shahbagh area (Morning hours).

Map 3 shows that the highest noise level (84.33 dB) is found in the afternoon (12 pm – 2 pm) near Shahid Minar Chottor and the lowest levels are (56.09 dB & 56.47 dB) near the Dr. Muhammad Shahidullah Hall and BUET.

It is noticed that the noise level remains higher in the evening hour (4 pm - 5 pm). Noise levels are at their highest in the evening hours when traffic flow is at its peak. It is the closing hour of the

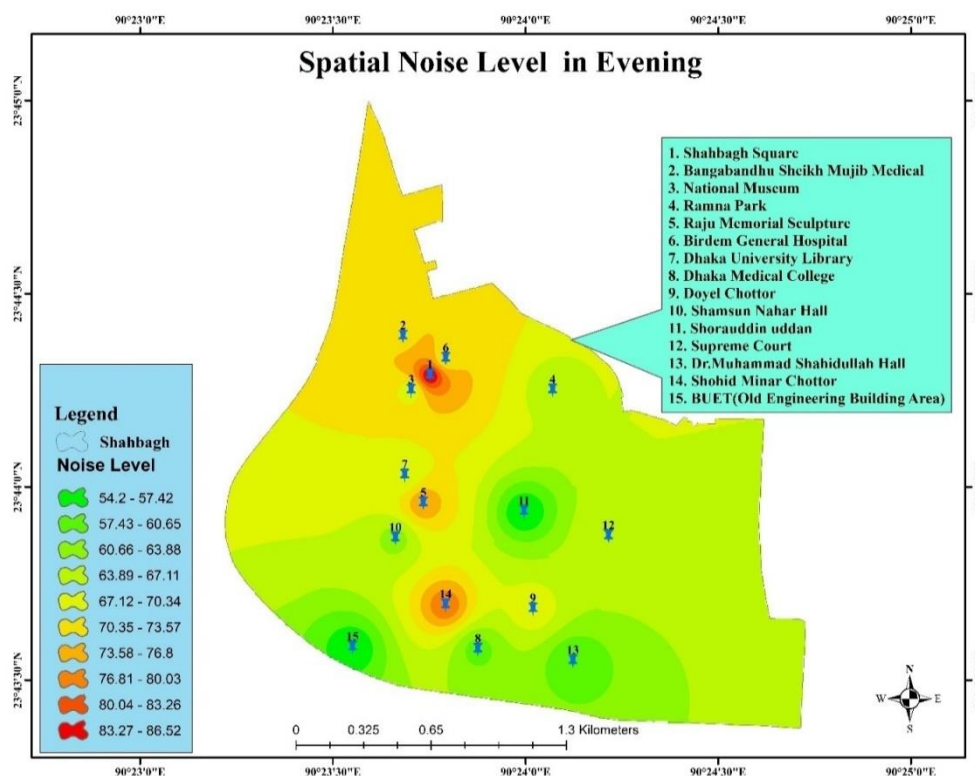
school and office sessions, and a lot of citizens come out for shopping and other activities (Mohd Napi et al., 2021; Wen et al., 2023). **Map 4** shows that the highest noise level (86.51 dB) is found in the evening (4– 5 pm) near Shahbagh Square, and the lowest levels are (54.19 dB & 55.01 dB) near the Suhrawardy Udyan and BUET.

However, it has been noticed that most hospitals, nursing homes, and educational institutions do not comply with this guideline and are instead located in commercial areas or near busy traffic roads. This area is extremely dangerous for human beings and the environment. Buses, trucks, motorbikes, traffic signals, loudspeakers, dining establishments, and crowds of people are the main sources of noise pollution.



Map 3. Spatial Noise level Mapping in Shahbagh area (Afternoon hours).

It is noticed that the noise level remains higher in the evening hour (4 pm - 5 pm). Noise levels are at their highest in the evening hours when traffic flow is at its peak. It is the closing hour of the school and office sessions, and a lot of citizens come out for shopping and other activities. **Map 4** shows that the highest noise level (86.51 dB) is found in the evening (4-5 pm) near Shahbagh Square, and the lowest levels are (54.19 dB & 55.01 dB) near the Suhrawardy Udyan and BUET. When traffic density rises due to factors like road width, cross-road traffic, and traffic composition, noise levels in the area also rise (Chauhan and Pande, 2010; Chouksey et al., 2024; Zhou et al., 2024). However, it has been noticed that most hospitals, nursing homes, and educational institutions do not comply with this guideline and are instead located in commercial areas or near busy traffic roads. This area is extremely dangerous for human beings and the environment. Buses, trucks, motorbikes, traffic signals, loudspeakers, dining establishments, and crowds of people are the main sources of noise pollution.



Map 4. Spatial Noise level Mapping in Shahbagh area (Evening hours).

Figure 1 (Comercial) depicts the variation of noise levels over time in commercial sectors of Shahbagh thana. The greatest noise level is around 77.59 dB in the afternoon at Doyel Chottor, and the lowest is around 56.47 dB in the morning at the Supreme Court Area, where the guideline value for Commercial areas should not exceed 70 dB. The noise level is higher in Doyel Chottor in commercial areas due to human gathering, lots of traffic, horns from buses and trucks, office equipment, car alarms, and construction works. The acoustical properties of the noise, such as its volume and timing, as well as other elements of the noise environment that might require cognitive processing, determine how environmental noise affects people (Miedema, (2007).

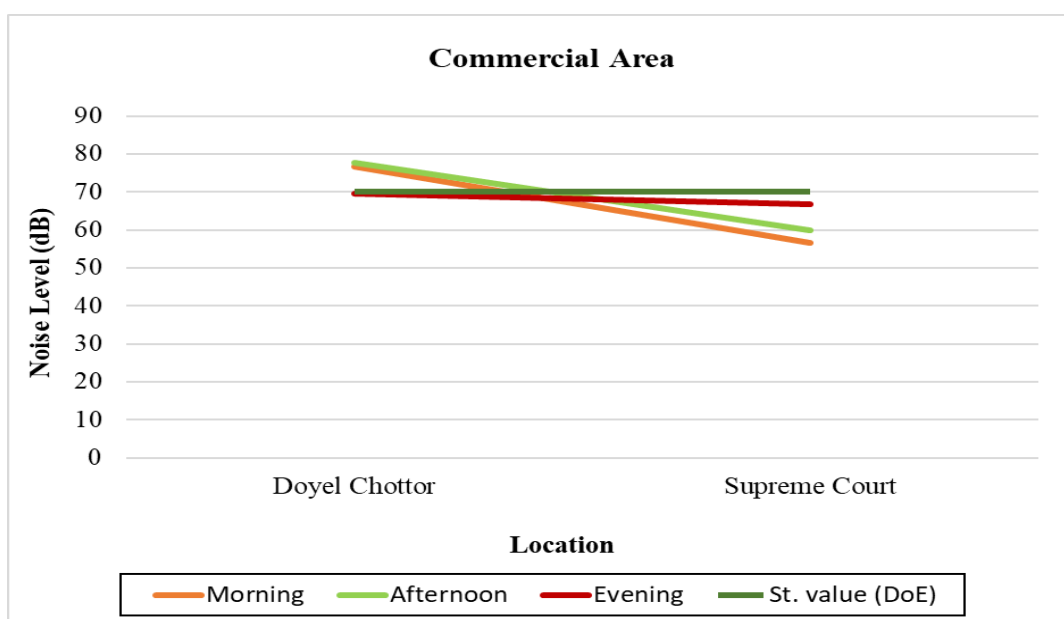


Figure 1. Variation of noise levels with time in Commercial Areas.

Figure 2 depicts a variation in noise levels over time in residential sectors of Shahbagh Thana. The average level of noise ranged is 57.6 dB, 58.59 dB, and 62.24 dB at Shamsun Nahar Hall. The average level of noise ranged is 55.73 dB, 56.09 dB, and 57.36 dB at Dr. Muhammad Shahidullah Hall. Residential areas are found less noisy on average than other areas in Shahbagh. In mixed areas, Noise levels recorded in all the sites of the mixed zone exceeded the given standard level of 60 dB. All the places selected under the mixed zone has noise level above the permissible limit set by DoE (**Figure 3**). The average level of noise ranged are 81.21 dB, 81.37 dB & 86.51 dB at Shahbagh Square. The same noise can cause different people to react annoyingly in different ways, and these individual differences can be partially attributed to variations in noise sensitivity (*Shepherd et al., 2010*). Numerous research have examined the effects of man-made noise and come to the conclusion that it may pose a threat to Earthly life. Numerous sounds made by human activity, such as traffic, crowded areas, loud music, and industrial activity, appear to constitute a sort of noise pollution that harms biodiversity (*Sordello et al., (2019)*).

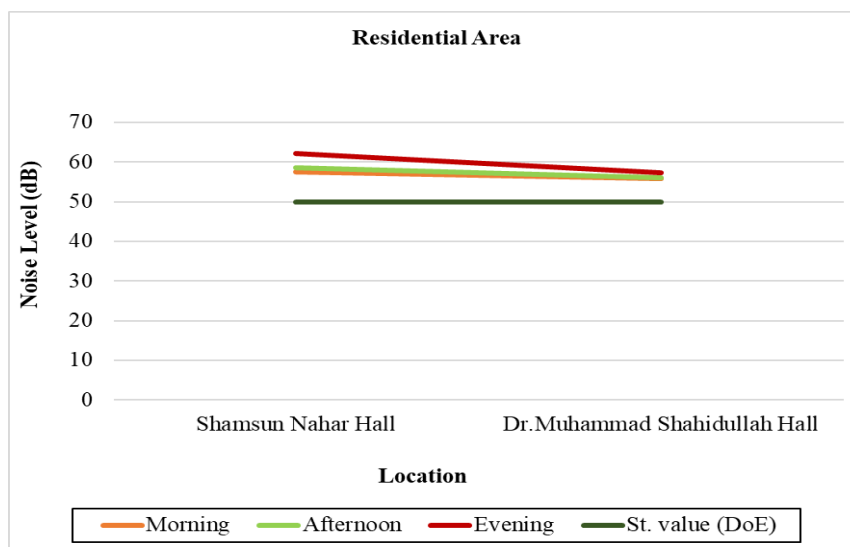


Figure 2. Variation of noise levels with time in Residential Areas.

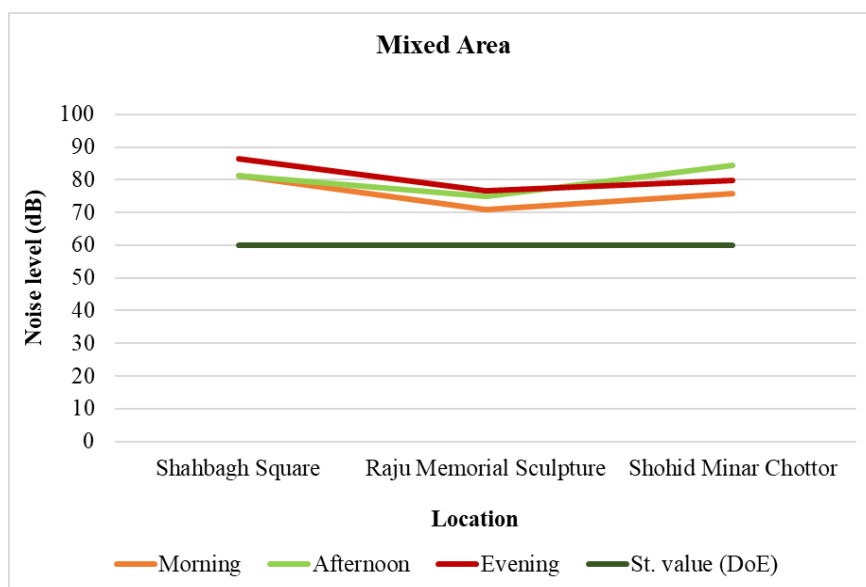


Figure 3. Variation of noise levels with time in Mixed Areas

According to the Noise Pollution (Regulation and Control) Rules, 2006, a sensitive area is defined as an area of not less than 100 meters around hospitals and educational institutions. Bangabandhu Sheikh Mujib Medical, Dhaka University Library, Dhaka Medical College, and BUET are educational institutions with noise levels ranging from 80.70 dB in the afternoon to 54.19 dB in the evening **Figure 4**. The sound intensity is high in the sensitive areas compared to the standard value. Educational institutions are susceptible to excessively high noise levels, which may cause disturbance to students and have negative health consequences. The noise level in mixed areas is increased because of the vast number of people, vehicles, horns from buses and trucks, auto motorcyclists, traffic lights, loudspeakers for miking, and other causes.

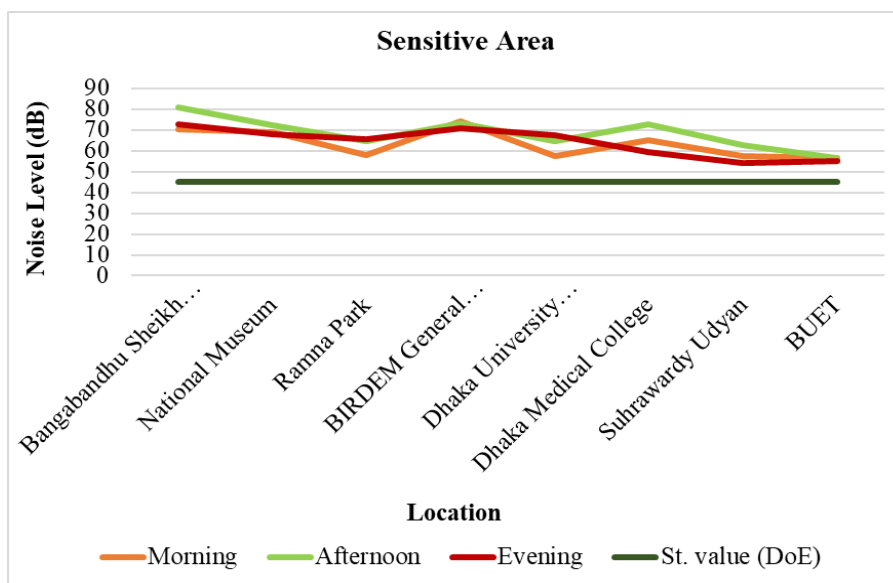


Figure 4. Variation of noise levels with time in Sensitive Areas.

4. Conclusions and Recommendations

The noise pollution scenario of Shahbagh Thana was studied using a GIS-based noise assessment at selected locations, including commercial areas, residential areas, mixed areas, and sensitive areas. From this study, it is found that the highest average level of sound 86.51 dB is observed at Shahbagh Square, and the lowest average level of sound 54.19 dB is observed at Suhrawardy Udyan in the evening hours, which is higher than the WHO standard guideline value for Bangladesh. It is also observed that the excessive level of noise in the Shahbagh is also attributed to rapid and unplanned urbanization, which has resulted in a large entrance of people from all over the region, poor management of roads and traffic, a scarcity of parking spaces, and the exponential growth of both private and public vehicles in the Shahbagh. Narrow connecting roads and the absence of flyovers and over bridges in some parts of the city all contribute to a high concentration of vehicles and a noisy environment.

Traffic noise can be decreased by restricting the number of heavy vehicles on the road, lowering the speed limit, and altering the surface layout of the routes. Hospitals and other sensitive locations can have lower noise levels through engineering control techniques like regulating the distance between the noise source and the receiver. In the context of medicine, patients, the general public, and medical staff should refrain from making unnecessary remarks. Advertisements, processions, and campaigns for elections ought to be held without microphones. While in a busy traffic area or an area with a high

population density, avoid using redundant horns. Passengers and drivers alike must abide by traffic laws. Planting trees is a useful method of reducing noise pollution. Plant components like stems, leaves, branches, and wood absorb sound waves. Succulent leaves and thick, rough bark both have a large dynamic surface area, which makes them effective sound absorbers.

Disclosure statement: *Conflict of Interest:* The authors declare that there are no conflicts of interest.

Compliance with Ethical Standards: This article does not contain any studies involving human or animal subjects.

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