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Assessment of Traffic Noise Pollution in Jamalpur Sadar, Mymensingh, Bangladesh

Mahmudul Hasan, Alim Miah*, Rased Hasan Sojib

Department of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam University, Mymensingh, Bangladesh

Email address:

alimjkkniu@outlook.com (Alim Miah), mahmudultamim36@gmail.com (Mahmudul Hasan),
rasedhasansojib662@gmail.com (Rased Hasan Sojib)

*Corresponding author

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Abstract: Noise pollution is becoming a significant concern for cities worldwide. This study aims to evaluate the traffic noise pollution levels in different zones of Jamalpur city, conducted in 2023. Twenty-one samples were collected from 21 distinct locations, covering five vulnerable zones including industrial, mixed, commercial, residential and sensitive zones on both working and non-working days, during morning, afternoon, and evening. The Sound Level Meter (Model: Lutron SL-4033SD) was utilized to measure the noise levels. The study employed Geographic Information Systems (GIS) with the Inverse Distance Weighting (IDW) technique to map the city's noise pollution. Results indicate that all studied areas exhibited noise levels surpassing the maximum acceptable level. The Gate Par area registered the highest average sound level (87.85 dB) during morning hours, while the sensitive area exhibited the lowest average sound level (61.15 dB). The highest value of sound level according to sensitive area, residential area, commercial area, mixed area and industrial area is 78.2(dB) at evening, 73.25(dB) at afternoon, 87.85(dB) at morning, 84.65(dB) at evening and 80.85(dB) at evening. The study concludes that Jamalpur Sadar has significantly higher ambient noise levels compared to the established standards, primarily in densely populated areas with heavy traffic and excessive vehicle horn honking. Consequently, the study recommends the implementation of preventive measures in excessively noisy areas and strongly suggests that proper implementation of the existing laws helps to mitigate and reduce the noise pollution situation in the study area.

Keywords: Traffic, Noise Pollution, Sound Level Meter, IDW, Public Awareness

1. Introduction

Noise pollution has an adverse effect on physical as well as mental wellness, causing difficulties such as increased stress, hypertension, hearing loss, insomnia, and adverse behavioral changes. Noise is derived from the Latin word "nausea," which means "unwanted sound" or "unwelcome or unpleasant sound" [5]. Noise pollution is a worry not just in rich countries, but also in developing countries such as Bangladesh, and it ought to be addressed and studied in the context of auditory environmental deterioration. Road vehicle noise disturbs more people than any other kind of noise and has been growing rapidly over the last few decades. On a daily basis, millions of individuals are afflicted by noise pollution. The volume of sound is measured on a logarithmic scale and represented by the decibel (dB) unit. The most common health problem it causes is Noise Induced Hearing Loss (NIHL) [9]. Unwanted sound (noise) can damage cerebral health. Noise levels of 75 dBA and above cause blood vessel constriction and boost blood pressure; the lung function is also impacted, resulting in ephemeral breathing [6]. An additional response involves an elevation in metabolic rate, which, when coupled with the inhibition of digestive system functioning and the emergence of heightened muscular tension, contributes to the overall impact [3]. The health implications of these conditions are pertinent across all age demographics, notably exerting a pronounced influence on the pediatric population. Commercial noise, which has surged concomitant with the rise in vehicular density, presently represents a familiar soundscape concern even within the milieu of developing

nations. There's no work about traffic noise pollution of Jamalpur Sadar area. It's fascinated me to conduct this design in that area. So, it's veritably important to find out the problems associated with the business noise. Among various sources of noise, road traffic noise stands out as a pervasive disruptor affecting a larger populace than any other source, and its escalation has been notably rapid in recent decades [2]. Noise generated by transportation represents a significant urban challenge on a global scale in contemporary times [8]. The outdoor sources play a fatal role in disturbing the environment and public-health. The Major sources of noise pollution in Jamalpur Sadar is bus, truck, baby-taxi and other three-wheeler-vehicles, automobiles, motorbikes, trains, all create excessive noise. Besides, the hydraulic horns used by buses and trucks, loud speakers, generators, brick-breaking machines, whistle of trains, sirens of emergency vehicles, lightning, high sound of welding factories, building construction activities and the machines used in any construction works create high level of sound pollution [7]. The purpose of this research is to investigate and analyze noise pollution levels in major areas in Jamalpur Sadar. The main objective is to identify the significant sources of noise pollution and, as a result, create a noise map representing the sound levels in this area.

2. Materials and Method

2.1. Study Area

As shown in Figure 1, the present analysis was conducted at 21 different locations within Jamalpur Sadar, including residential, educational, hospital, traffic, and government zones. Located between the latitudes of 24°42' and 24°58' north and the longitudes of 89°52' and 90°12' east.

2.2. Sampling Locations

Noise levels were determined in twenty-one major places across Jamalpur Sadar. On typical working days, comprehensive noise data was collected throughout three shifts: morning (8 AM - 10 AM), afternoon (12 PM - 2PM), and evening (4 PM - 5 PM). Fishari Mor, Gate Par, Mohila College, Sherpur Bypass, Louis Village, Bottola, 5 Rastar Mor, Azom Chattar, Kompopur, General Hospital Gate, Fozdari Mor, Sherpur Bridge, Vocational Mor, Doyamoyee Mor, Tamaltola Mor, Shokal Bazar, Bokultola Mor, Zilla School, High School Mor, and Power Plant are among the data collection points chosen. Map-1 shows the geographical extent of this investigation.

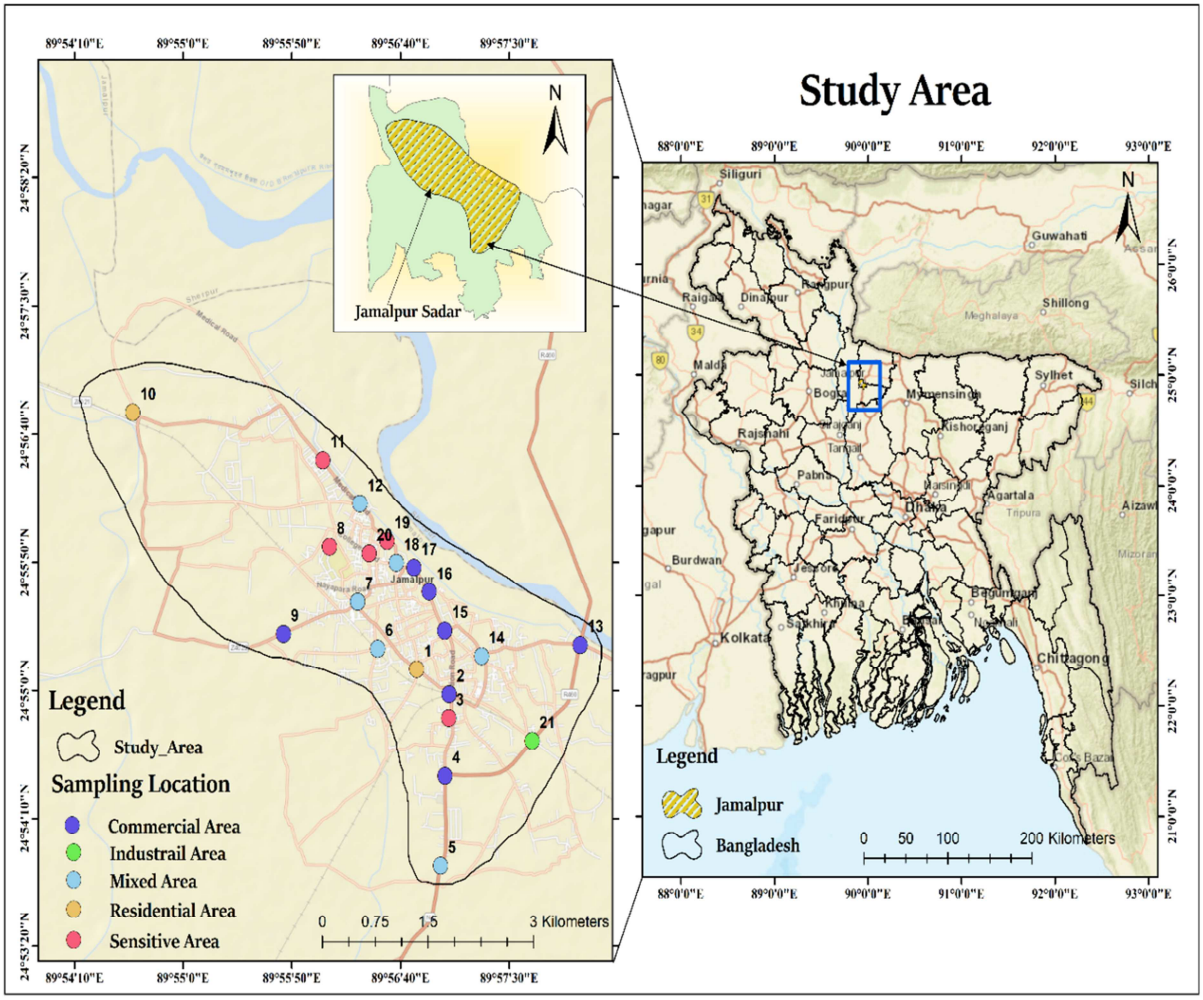

Figure 1. *Map of the Study area (Jamalpur Sadar).*

2.3. Instruments Used

i). Sound level meter: A sound meter is an instrument that measures sound pressure levels. Levels of noise intensity were measured by digital sound level meter 'Lutron SL-4033SD'. Measurement range of 30 to 130 dB(A) figure 2 with an accuracy of ±1.5 dB (A and C) and resolution 0.1 dB. It is mainly used in noise pollution studies for the measurement of different kinds of sound levels, especially for industrial, environmental, and commercial.

ii). GPS: Utilizing the Garmin eTrex 10 Geographical Positioning System (GPS) device, coordinates for each site where noise levels were measured were acquired.

iii). ArcGIS: ArcGIS 10.8 software was employed in this research to conduct spatial analysis within the boundaries of Mymensingh city. The software applied the Inverse Distance Weighting (IDW) interpolation technique for the analysis. By utilizing available data within the specified area, the software extrapolates values for locations without recorded measurements. [8].

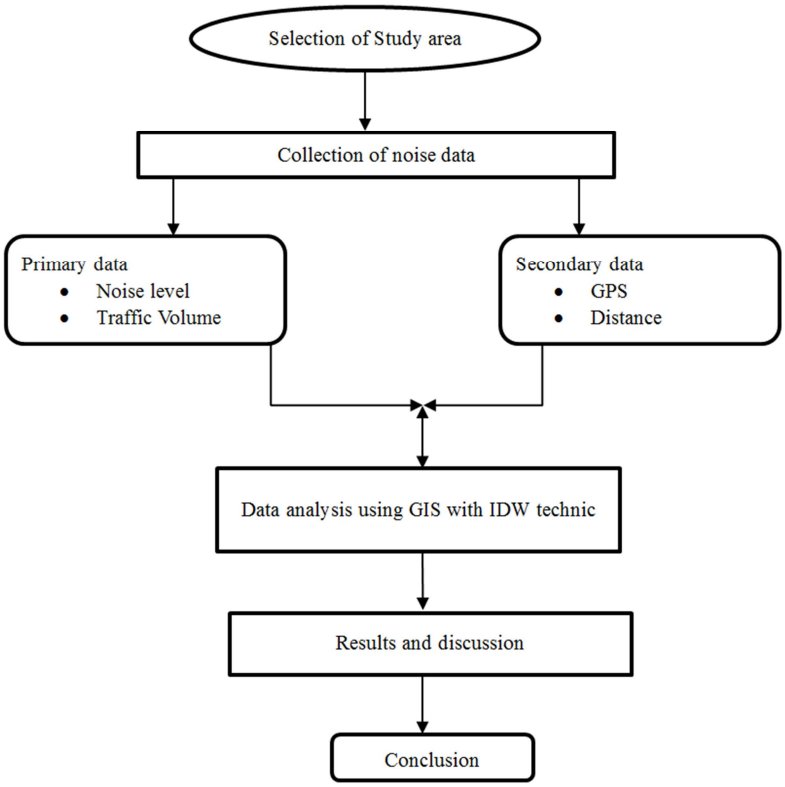

Figure 2. *Methodology of the Study.*

3. Results and Discussion

The analyses of 21 stations of different locations are presented in Table 1. The various noise pollution sources are attributed to the human gathering, vehicular traffic, particularly auto-rickshaw, and frequent use of the hydraulic-pressure horns by buses and trucks. This study also found that the high noise level occurs during the daytime as people travel to and from schools, markets, and workplaces.

Table 1. *Noise levels (dB) at different locations of Jamalpur Sadar.*

SI No.	Location name	Category of the Area	Morning average (dB)	Afternoon average (dB)	Evening average (dB)	DoE, 2006	WHO and EC (WHO, 2009)
1	Fishari Mor	Residential	67.05	73.25	70.4	50	55
2	Gate par	commercial	87.85	76.05	80.25	70	55
3	Mohila college	sensitive	69.45	76.7	67.95	45	45
4	Sherpur Bypass	commercial	72.85	74	75.15	70	55
5	Louis village	Mixed	67.55	74.6	71.3	60	-
6	Bottola	Mixed	69.85	71.8	70.7	60	-
7	5 Rastar mor	Mixed	75.35	80.95	80.05	60	-
8	Govt. Ashek Mahmud college	sensitive	60.15	61.2	64.8	45	45
9	Azom Chattar	commercial	75.5	77.2	69.7	70	55
10	Kompopur	Residential	67.5	65.85	71.35	50	55
11	General Hospital gate	sensitive	65.85	70.7	72.9	45	45

SI No.	Location name	Category of the Area	Morning average (dB)	Afternoon average (dB)	Evening average (dB)	DoE, 2006	WHO and EC (WHO, 2009)
12	Fozdari mor	Mixed	75.25	70.4	66.5	60	-
13	Sherpur bridge	commercial	76.45	82.9	83.3	70	55
14	Vocational mor	Mixed	73.3	81.3	84.65	60	-
15	Doyamoyee mor	commercial	76.85	84.8	79.5	70	55
16	Tamaltola mor	commercial	76.3	75.9	79.85	70	55
17	Shokal Bazar	commercial	71.75	77.8	72.65	70	
18	Bokultola mor	Mixed	73.85	76	82.2	60	-
19	Zilla school	sensitive	72.95	77.95	76.1	45	45
20	High school mor	sensitive	74.75	72.45	78.2	45	45
21	Power plant	Industrial	68.3	72.2	80.85	75	65

[Note: DoE = Department of Environment (Bangladesh), W.H.O = World Health Organization10, E.C. = European Commission]

From Table 1 the highest level of sound was observed from the Gate par at the morning is about 87.85 dB. It was also observed at noon that this high level of noise pollution is because of the huge human gatherings, vehicular traffic, and pressure horns by buses, tracks, train. The lowest average noise level of 60.2 dB was found in the Govt. Ashek Mahmud college in the morning. So, the noise levels fluctuate between 60.2 dB and 87.85 dB. It was observed that human gatherings increase in the level of noise pollution. Because of the heavy gatherings of humans in commercial areas noise levels were also high compared to other areas. At all locations, the highest noise levels were found at the afternoon and evening.

Figure 3 shows that the highest noise level (87.9 dB) was found in the morning (9 AM – 10 AM) near Gate par and the lowest level was found in the morning (9 AM – 10 AM) near Govt. Ashek Mahmud college. Within the illustration, areas with the most elevated noise levels are delineated by regions shaded in deep red, while regions shaded in green indicate areas with the lowest levels of noise.

Figure 4, In afternoon hours (1 PM-2 PM), the highest noise level (84.8 dB) was found in Doyamoyee mor and the lowest noise level (61.2 dB) in Govt. Ashek Mahmud college.

Map 5 provides the spatial noise mapping on Evening at working days by using IDW. The highest average noise value (84.7 dB) was observed at Vocational mor in the period of Evening. The lowest average noise level (64.8 dB) was found at Govt. Ashek Mahmud college and the second lowest noise level (66.5 dB) was found at Fozdari mor in the period of Evening.

The fraction of inversely influenced noise decreases noticeably as the radial distance rises, as seen in Figures 4-6. According to the data analysis shown in the figures, the locations coloured in red and green respectively suffer the highest and lowest levels of noise level. Noise pollution levels drop when one moves from darker to brighter areas.

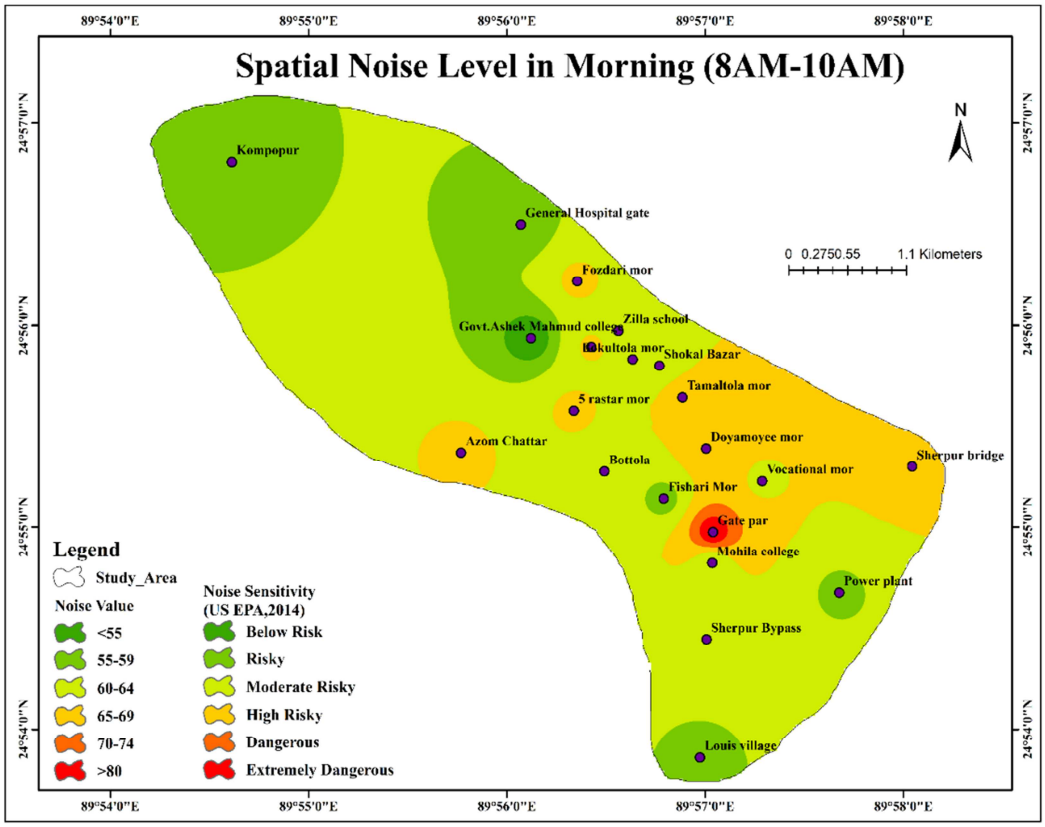

Figure 3. *Spatial Noise Mapping in the Morning in Jamalpur Sadar.*

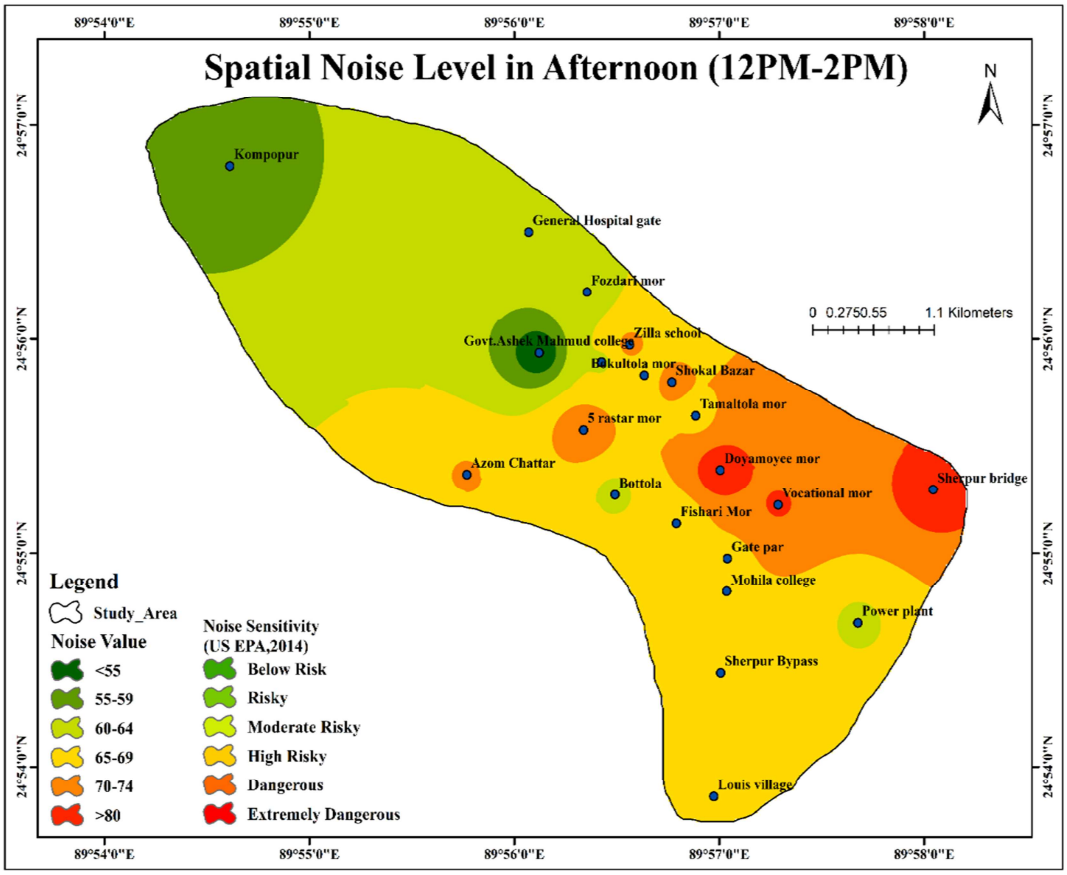

Figure 4. *Spatial Noise Mapping on Afternoon.*

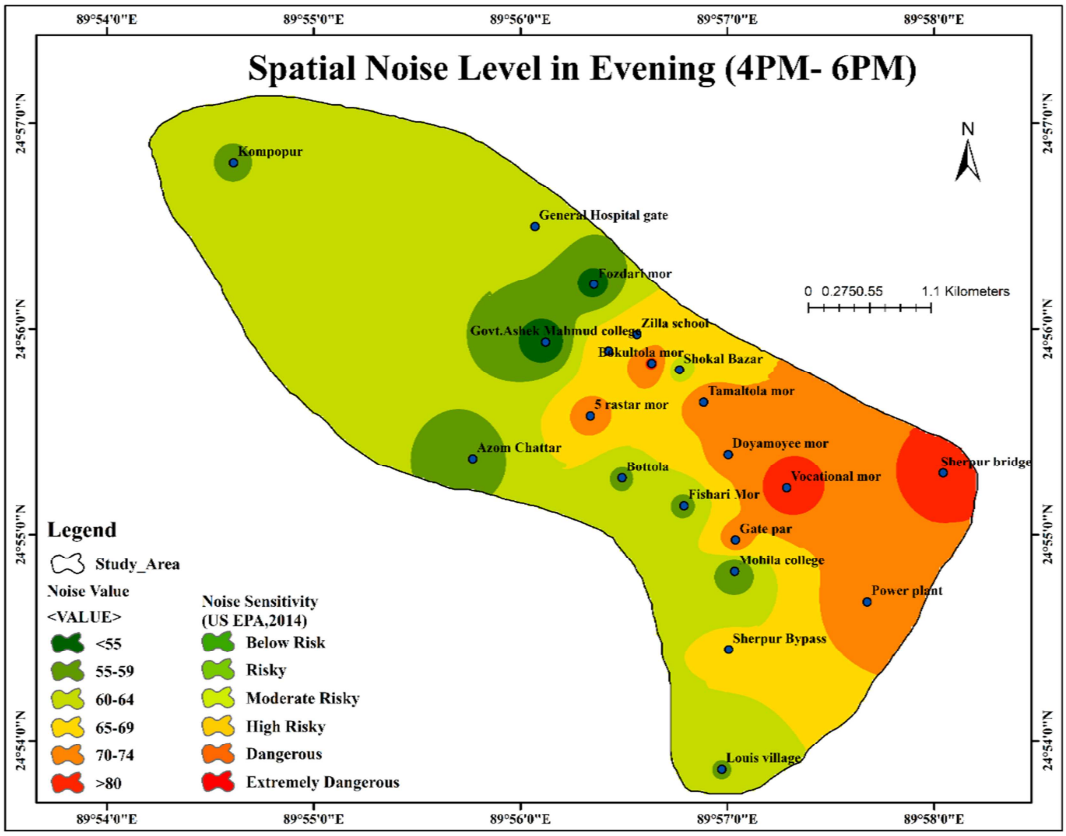

Figure 5. *Spatial Noise Mapping in the Evening.*

The obtained Spatial Analytic Maps showed that Jamalpur Sadar's noise level is higher than the acceptable limits and it is hazardous for human health and the environment. The maps showed the worst noise-affected areas in Jamalpur Sadar.

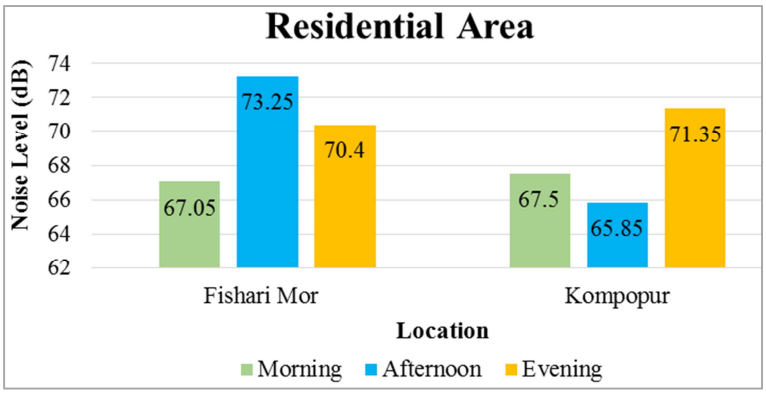

Figure 6. *Noise Level in Residential Area.*

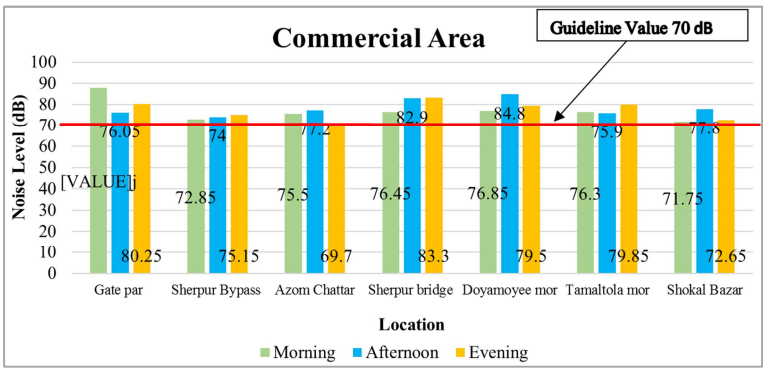

Figure 7. *Noise Level in Commercial Area.*

Illustrated in Figure 6 (in dB) is the fluctuation of noise levels across residential sectors. The peak noise level, reaching 73.25 dB, was observed during the afternoon at Fishari Mor. Subsequently, the second-highest reading of 71.35 dB was identified during the evening in Kompopur city. Conversely, the quietest measurement of 67.05 dB was recorded during the morning at Fishari Mor. Importantly, despite the Department of Environment's (DoE) stipulated standard value for mixed zones being 50 dB, all measured noise levels exceeded this benchmark.

Noise levels in the commercial areas (Figure 7) were monitored at various times and showed substantial fluctuations. Notably, noise levels at Gate Par exceeded the 70 dB guideline at 87.85 dB in the morning, 76.05 dB in the afternoon, and 80.25 dB in the evening. During the same times, Sherpur Bypass showed levels of 72.85 dB, 74 dB, and 75.15 dB. Sherpur Bridge showed readings of 76.45 dB, 82.9 dB, and 83.3 dB, whereas Azom Chattar recorded 75.5 dB, 77.2 dB, and 69.7 dB. There were additional results from Doyamoyee Mor of 76.85 dB, 84.8 dB, and 79.5 dB, Tamaltola Mor of 76.3 dB, 75.9 dB, and 79.85 dB, and Shokal Bazar of 71.75 dB, 77.8 dB, and 72.65 dB. It is noteworthy that all observed noise levels were higher than expected.

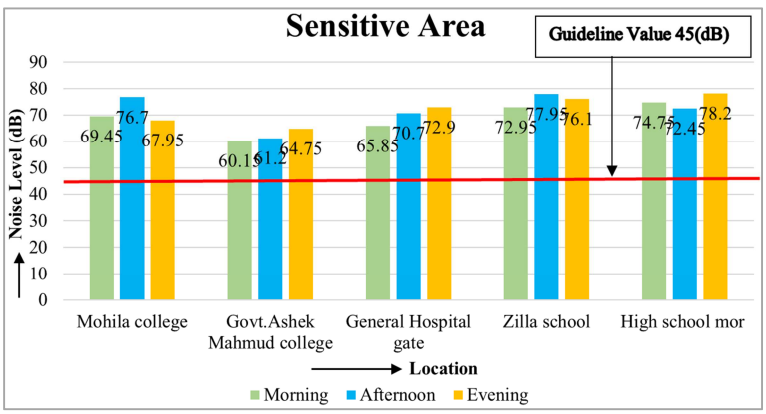

Figure 8. *Noise Level in Sensitive Area.*

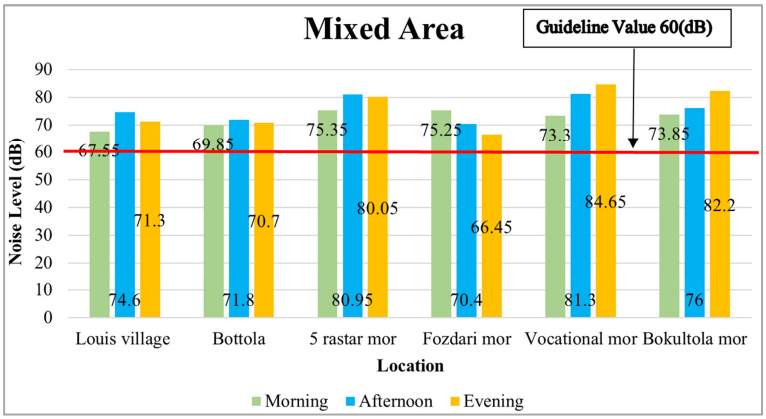

Figure 9. *Noise Level in Mixed Area.*

Figure 8 illustrates the dynamic variation in noise levels over time in the quiet or sensitive areas of Jamalpur Sadar. At High School Mor, the evening noise measurement was the highest, peaking in at around 78.2 dB. On the other hand, the morning location near Govt. Ashek Mahmud College had the lowest measured noise level, measuring about 60.15 dB. Notably, educational facilities with noticeable enhanced noise levels include Mohila College, General Hospital Gate, and Zilla School, enhancing the auditory experience.

The time evolution of noise levels in mixed zones is shown in Figure 9. At Vocational Mor, the peak noise level was recorded for the evening, reaching 84.65 dB. As a result, Louis Village had the lowest noise level during the morning hours, registering 67.55 dB. It is notable that all measured noise levels surpassed the Department of Environment's (DoE) recommended standard value of 60 dB for mixed zones. Concerns regarding potential impacts of noise pollution in these mixed-use zones are raised by this variation.

Figure 10 presents a comparison between the guidelines outlined in the Noise Pollution (Regulation and Control Rules) of 2006 and the recorded highest noise pollution levels in distinct zones, including sensitive, residential, mixed, and commercial areas. The data illustrates a substantial deviation from Bangladesh's established noise level standards, underscoring the severity of noise pollution in the Jamalpur Sadar area. This heightened noise pollution predominantly stems from significant human congregations and vehicular congestion. Consequently, the urban population experiences a range of adverse effects such as elevated blood pressure, disruptions in sleep patterns, mental health disorders, and cardiovascular ailments.[7].

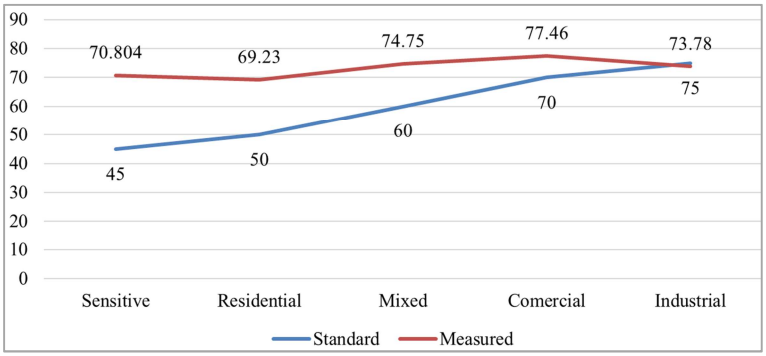

Figure 10. *Comparison between standard and measured noise level.*

Noise Pollution Effect Analysis

Effect Analysis: As previously said, Jamalpur Sadar is one of the nation's emerging metropolitan centers. It includes residential areas, parks, commercial centers, healthcare facilities, academic institutions, and more. A conclusion has been made that the levels of noise pollution in Jamalpur Sadar exceed the acceptable limits set by the Department of Environment (DoE), the World Health Organization (WHO), and the Environmental Commission (EC) after careful study of diverse facts, information, and opinions. The increased level of noise pollution is having a negative impact on people's well-being, the environment, and their psychological balance. The influence also affects animal and plant life, causing disturbances in biodiversity [11]. Effect of noise pollution level by the areas we studied-

1) Very Loud: The noise levels recorded at Fishari Mor, Gate Par, 5 Rastar Mor, Fozdari Mor, Sherpur Bridge, Doyamoyee Mor, and Tamaltola Mor in Jamalpur Sadar consistently register as "very loud" (exceeding 75 decibels). This excessive noise persists throughout the morning, noon, and evening, consistently breaching the permissible noise limits. This poses a significant and pressing threat to human well-being. Notably, the noise level at Gate Par is of particular concern due to its

exceptionally high intensity.

2) Loud: Noise level of Fishari Mor, Mohila College, Sherpur Bypass, Louis village, Bottala, Azom Chattar, Kompopur, General Hospital gate, Powerplant are loud (65> to >75). But the problem is the noise level always remains above the acceptable noise level. As a result, the people who live here are in a big threat of health. Especially the elder and neonatal people are in danger.
3) Moderate: The noise level of Ashek Mahmud College is in moderate (<60). The noise level remains a little bit high at afternoon. Not so much health hazardous.

Upon reviewing the noise levels across the areas we examined, a prominent observation emerged: the heightened noise pollution is intricately linked to the prevalence of various chronic ailments, particularly cardiovascular diseases. Notably, the most immediate and severe repercussion of sound pollution is the impairment of hearing, which can lead to profound hearing loss [4]. Some other problems are a disturbance in speech or verbal communication, sleep disturbance, mental health disturbance, impaired task performance, negative social behavior, and anxiety [10]. Newborn babies and pregnant women also suffer if there are sound pollutants near their residence and working area. Sick and in some cases disabled babies can be born. Students are one of the worst sufferers of noise pollution. Students in educational institutions and their residence, they suffer from headache, lack of attention, hamper in the study, insomnia, anxiety and so many of other physical and mental problem [1]. Living in such a polluted environment changes the psychological environment of the people of that area. They seem to be more aggressive than the people of other unpolluted areas [4]. They get aggressive easily and this is one of the main causes of sociological imbalance. Social imbalance can sometimes so harmful that it can take one's life easier.

4. Conclusions

This comprehensive study on the assessment of traffic noise pollution in Jamalpur Sadar, Mymensingh, Bangladesh, underscores the significant impact of noise pollution on both the physical and mental well-being of the local population. With a focus on the adverse effects of noise pollution, the paper examined various aspects including its sources, levels, and spatial distribution across different zones within the city. The findings emphasize the urgent need for effective noise management strategies in Jamalpur Sadar. The study revealed that noise pollution levels consistently exceed acceptable limits across various residential, commercial, and sensitive areas. The primary sources of noise pollution are vehicular traffic, particularly auto-rickshaws and buses, along with the widespread use of hydraulic-pressure horns. This study is particularly relevant in the context of developing countries like Bangladesh, where urbanization and increased vehicular density have contributed to escalating noise pollution levels. The assessment of noise pollution effects showed a wide range of health implications, including increased stress, hypertension, hearing loss, insomnia, and behavioral changes. Noise pollution affects the physiological wellbeing of individuals, leading to increased aggression, sociological imbalance [12]. The study highlighted the impact on vulnerable populations such as newborns, pregnant women, and students. The noise-induced disruption of daily life, cognitive functioning, and social dynamics underscores the urgency for effective noise mitigation measures. Through the utilization of sound level meters, GPS devices, and spatial analysis tools, this study mapped the noise pollution levels across different times and zones, providing valuable insights for urban planners and policymakers. The visual representation of noise levels through maps indicates critical areas that require immediate attention. This paper highlights the pressing need for comprehensive noise management strategies in Jamalpur Sadar to alleviate the adverse effects of noise pollution on public health and overall quality of life. The findings serve as a foundation for future policy development, urban planning, and community engagement initiatives aimed at creating a more peaceful and sustainable acoustic environment for the residents of Jamalpur Sadar and other similar urban areas. The following steps should be taken to prevent noise pollution in order to create a livable environment for human being-Noise Barriers: Install noise barriers such as soundproof walls, fences, or acoustic panels in areas where noise is a significant issue. These barriers help absorb or deflect sound waves, reducing noise levels [13]. Landscaping: Use dense vegetation, trees, and shrubs to create natural barriers that block or absorb sound. Plants with thick foliage can act as effective sound absorbers, helping to reduce noise pollution [14]. Noise Regulations: Advocate for stricter noise regulations in your community or workplace. Proper Maintenance: Regularly maintain machinery, vehicles, and appliances to ensure they operate at optimal noise levels. Lubricate moving parts, fix loose or rattling components, and replace worn-out or noisy equipment [15] Design Considerations: Incorporate noise reduction strategies during the design phase of buildings and infrastructure. Include noise-reducing features like acoustic ceilings, soundproof windows, and insulation materials to create a quieter environment [16].

ORCID

Alim Miah: https://orcid.org/0009-0008-4118-6581

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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