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Assessing the Noise Pollution Level in Cumilla District Town, Bangladesh

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Abstract

The goal of this study was to assess the noise pollution level in Cumilla District Town, Bangladesh. 7 different zones and 58 locations were selected in Cumilla District Town based on land use. The noise levels were determined by using a sound level meter (REED SD-4023) from January 01, 2021, to April 30, 2021. Multiple samples were collected from each sampling location. The noise level in individual sites has been recorded three times per day. The mean noise level and Leq of Cumilla District Town were determined to be 73.84 dBA and 95.35 dBA, respectively. The highest mean noise level was found in Shasonghacha Bus Stand (87.14 dBA), whereas the lowest mean noise level was discovered in Cumilla Government College (61.38 dBA). Furthermore, the mean noise level ranking of various land uses in Cumilla District Town was Road Intersections (77.79 dBA) > Commercial Area (77.72 dBA) > Mixed Areas (77.68 dBA) > Residential Area (73.14 dBA) > Industrial Area (72.97 dBA) > Silent Area (70.25 dBA) > Village Area (67.42 dBA). Noise level exceeds its standard limit. Consequently, individuals may have both physical and psychological health problems, resulting in an unhappy existence.

Keywords: Noise Pollution; Cumilla District Town; Land Use; Noise Standard

1. Introduction

The proliferation of undesirable or damaging sounds in the environment is known as noise pollution. These noises have the potential to disturb daily routines, induce mental stress, and result in long-term health issues for both humans and animals. Noise pollution in Cumilla City is becoming a bigger issue, which is attributed to the city's high population density and quick urbanization. Significant factors include loudspeakers used at public events, construction noise, industrial noise, and heavy traffic congestion. The continuous honking of automobiles, construction activity, and noise from marketplaces and factories all contribute to an increasingly disruptive atmosphere. Constant noise has a detrimental impact on people's quality of life and leads to health problems such as headaches, fatigue, stress, hearing loss, diminished job ability, and sleep difficulties [1-3]. Furthermore, urban people' neurological and auditory systems, especially those of children, can be severely strained by prolonged exposure to loud noise levels. Motorized vehicles are the primary source of noise pollution in urban areas [4].

The danger of getting sick from noise and air pollution is very high for traffic police personnel, especially at intersections with lots of cars [5–11]. They often have hearing loss and psychosocial problems [12–15]. Noise pollution is still a major issue in the vibrant metropolis despite several government initiatives to control it. Since coughing is a very severe nuisance of the upper respiratory tract, most traffic police personnel wear masks to protect themselves from the harmful effects of air pollution. The majority of people are still unaware of how noise impacts their hearing, therefore this is a gradual process that takes time to become apparent. In a systematic manner, the World Health Organization (WHO) identified 25 risk factors for the global illness burden caused by occupational noise [16].

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One or both ears may have complete or partial occupational hearing loss as a result of one's job [17]. It addresses both traumatic acoustic damage and noise-induced hearing loss (NIHL). High levels of occupational noise are still a problem everywhere in the world. For example, more than 30 million workers in the United States of America (USA) are subjected to hazardous noise levels [18]. 12–15% of the German workforce, or 4-5 million individuals, were exposed to noise levels that the WHO considered harmful [19]. Even while almost every occupational activity involves noise, several tasks—the most important of which are piloting commercial aircraft, handling specific types of materials, and performing impact operations—are associated with exceptionally high noise levels. Manufacturing, transportation, mining, construction, agriculture, and the military are the occupations most at risk for noise-induced hearing loss (NIHL). The situation is getting better in developed countries as preventative measures are taken as a result of increased public knowledge of the risk. Studies show that mean noise levels significantly surpass the occupational threshold recommended in many industrialized countries, notwithstanding the paucity of data for developing countries [20–23].

There are both auditory and non-auditory health effects of noise. Numerous populations operating in environments with loud, high-frequency noise have been the subject of extensive research on these effects [24-28]. The auditory effects of vehicle noise on traffic police officers have never been studied in India [11]. Cumilla District Town's traffic police are essentially in the same situation. Denying this group of workers hearing protection equipment might be one of the explanations. Only then should traffic cops be interested in learning about the health risks. There has not been much concern regarding noise's impact and potential harm since most people do not think it is a severe environmental pollutant. According to medical professionals, if a person stays at a loud level of 80 dBA for more than 15 minutes, they may suffer from temporary or permanent hearing loss.

Noise pollution in our country may not seem like a big problem right now. However, it is prudent to take the possibility into account. If the government disregards the public interest, noise problems might rapidly get worse. In order to determine the overall severity of the problem, the relationship between noise levels and different land uses, and the geographical distribution of noise levels throughout the city, this study examined the noise pollution levels in many Cumilla District Town areas.

2. Methodology

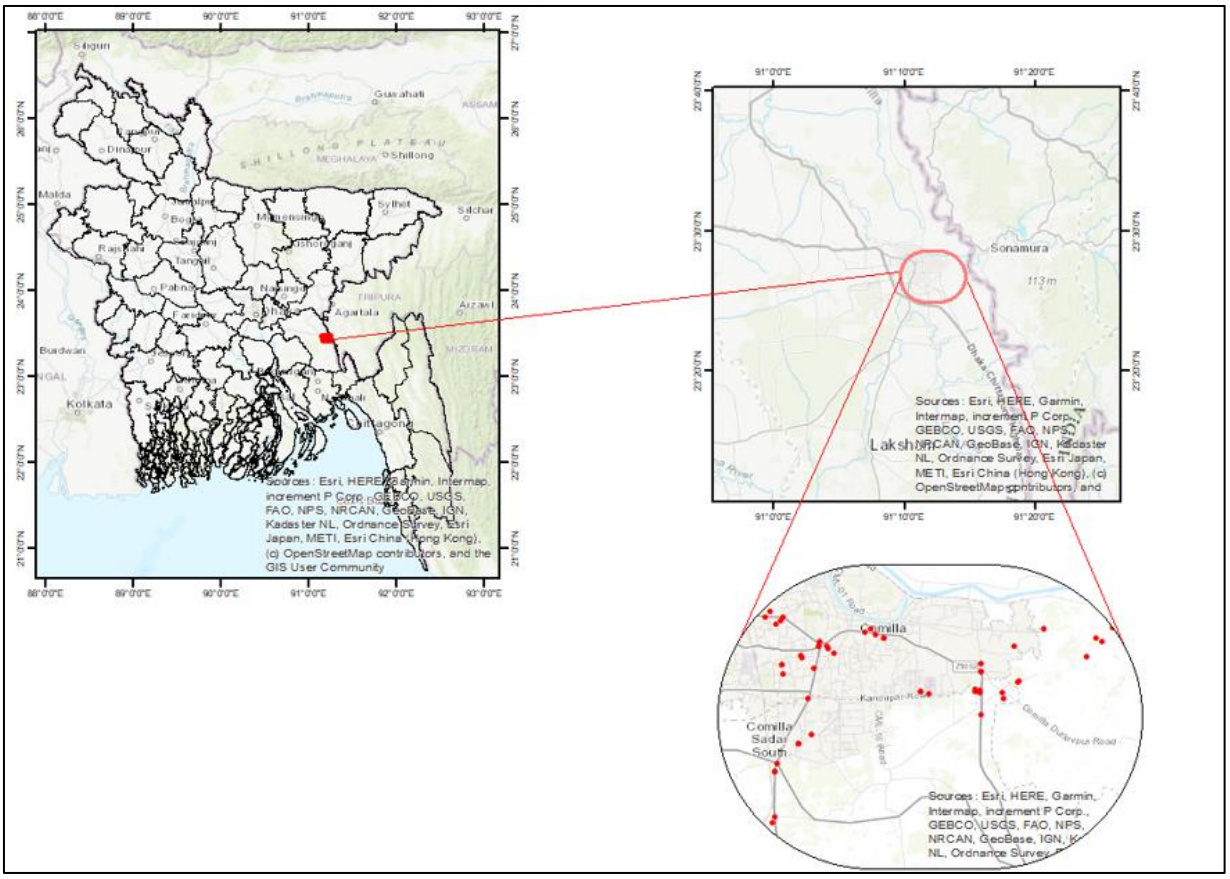

Figure 1 Study Area of Cumilla District Town

The research is classified as primary data-based. Cumilla District Town has 58 sites and 7 distinct zones based on land use. Cumilla is one of the major cities in Bangladesh. It is 142 km (373 km by road) away from the capital city Dhaka and an old port on the Kirtankhola River, on the northern shore of the Bay of Bengal in southern Bangladesh. It is now the headquarters of both the Cumilla Division and the Cumilla District. Cumilla is one of the oldest municipalities in Bangladesh, which was established in the year 1876. It was turned into a city corporation on 25 July 2002. The city consists of 30 wards and 50 mahallas. The area of the town is 45 km^2. Previously, Cumilla was the headquarters of the Greater Cumilla district. It lies on latitude 22° 41' 59.99" N and longitude 90° 21' 59.99" E.

2.1. Study Area

The area under study in the present research is Cumilla District Town (Figure 1). Cumilla District Town's selection was influenced by its recent history of high tourist demand, rapid urbanization, and a significant increase in the number of automobiles and enterprises. Background noise levels in the town are often two to three times higher than those found elsewhere. Both the environment and human health may be harmed by such loudness. Town areas with higher automobile traffic than others were of particular relevance to our study. A noise level meter (REED SD-4023) was used to measure the ambient sound pressure level in the pertinent area. The survey was done during working days. The measurement was taken at the main traffic intersection in the city. The traffic zone's sound pressure level was measured using A-weighting.

2.2. Data Collection

Noise levels in Cumilla District Town were monitored with the REED SD-4023 sound level meter from January 1, 2021, to April 30, 2021. This SD series sound level meter allows you to select a sampling rate between 1 and 3600 seconds and measures across three distinct ranges. Users may rapidly generate an Excel file containing raw data using an SD card (up to 16 GB) and select a preferred sampling rate, without the need for software. Optional accessories comprise a power adapter and tripod for prolonged, continuous observation, as well as software for personal computers that enables users to watch real-time data.

2.3. Measuring Procedure and Analysis

The data record function preserves the maximum and minimum values. Pressing the REC button once will display a "REC" indicator on the screen, signifying the commencement of the Data Record feature. The "REC" indicator will be shown on the screen. 1. Upon pushing the REC button once, the display will indicate the maximum value along with the "REC. MAX." symbol. Activating the Hold Button once will initiate the memory function continuously, displaying a "REC." indicator, so enabling the removal of the maximum value. Upon pressing the REC button a second time, a "REC. MIN." indicator and the minimum number will be displayed on the screen, as outlined in step 2. Upon a single press of the Hold Button, the display will indicate "REC," and the memory function will operate continuously, permitting the erasure of a small quantity. 3. After 2 seconds of engaging the REC button, you may terminate the memory recording function. The present reading will be reinstated on the display. The data was collected at a height of 1.5 meters above ground while situated alongside the road. In measuring the actual sound level, we ensured the exclusion of any noise barriers. The sampling length for each station was 5 minutes, with data recorded every second. The captured data was stored on a microSD card. Data analysis was conducted using both IBM SPSS version 20 and Microsoft Excel version 2010. In compliance with several ArcGIS v.10 standards, the data is presented in diverse tables and graphs. The study area and the noise buffering map were both developed utilizing version 2.1.

3. Results and discussion

The mean noise level and Leq of Cumilla District Town were found to be 73.84 dBA and 95.35 dBA.

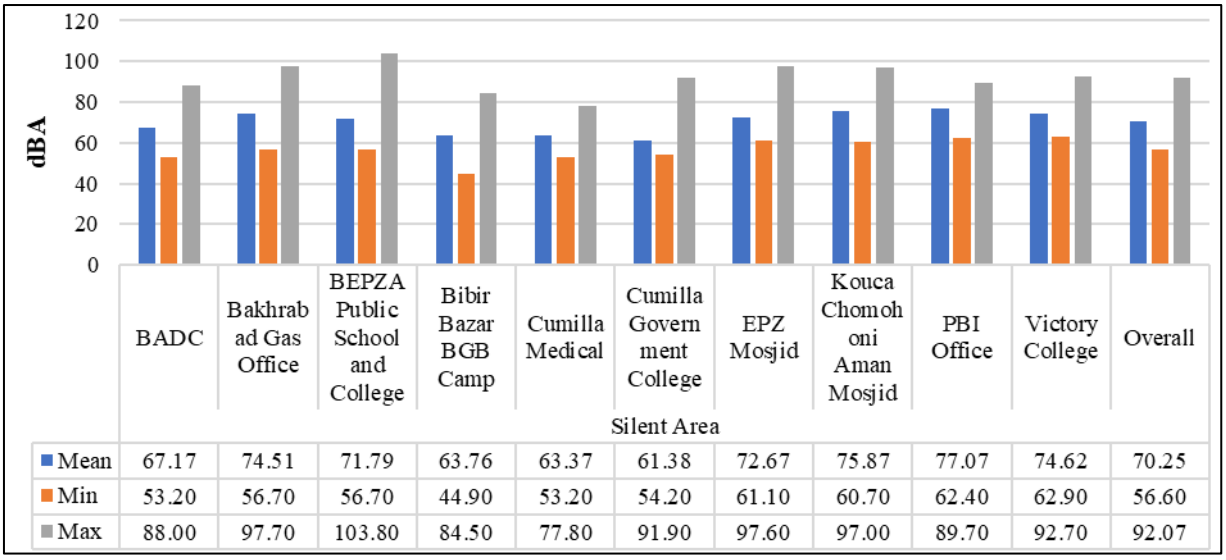

Figure 2 Noise Level (dBA) in Silent Areas

Analysis of data from 10 points in the silent area of Cumilla City shows that, as illustrated in Figure 2, the maximum noise recorded was 103.80 dBA at Bepza Public School and College, which is nearly twice the standard daytime noise level for the Silent Area and about two and a half times the nighttime level. The minimum noise level was recorded in the Bibir Bazar BGB Camp, which was 44.90 dBA, higher than the tolerable daytime level. Additionally, the mean noise level in the silent zone was found to be 70.25 dBA. The analysis also found that the highest mean noise level was 77.07 dBA in the PBI office area, and the lowest mean noise level was 61.38 dBA in the area of Cumilla Government College.

Figure 3 Noise Level (dBA) in Residential Areas

Figure 3 displays the noise levels of 9 locations in the residential area of Cumilla City. The mean noise level in the residential area was found to be 73.14 dBA. Furthermore, the maximum noise level was recorded at Cumilla Town Hall, which was 120.10 dBA, and the minimum noise level was recorded at Badortola, which was 53.60 dBA. Moreover, the highest mean noise level was found to be 81.80 dBA in the Jamtola area and the lowest mean noise level was 63.67 dBA in the Kasharipotti area.

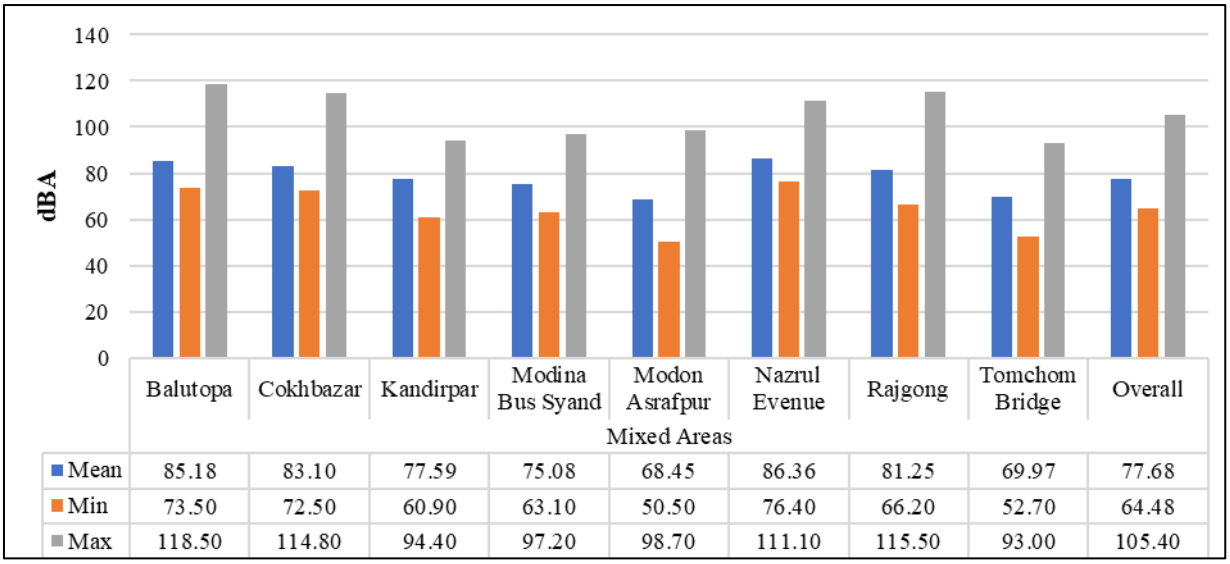

Figure 4 Noise Level (dBA) in Mixed Areas

Figure 4 illustrates the noise levels of 8 locations in the mixed areas of Cumilla City. The mean noise level in the mixed areas was recorded at 77.68 dBA. Furthermore, the maximum noise level was discovered to be 118.50 dBA at Balutopa and the minimum noise level was found to be 50.50 dBA at the Modon Asrafpur area. Hence, the maximum noise level is significantly higher than the standard noise level for the mixed area. Moreover, the highest mean noise level was reported at 86.36 dBA at Nazrul Avenue, whereas the lowest mean noise level was found to be 68.45 dBA at the Modon Asrafpur area.

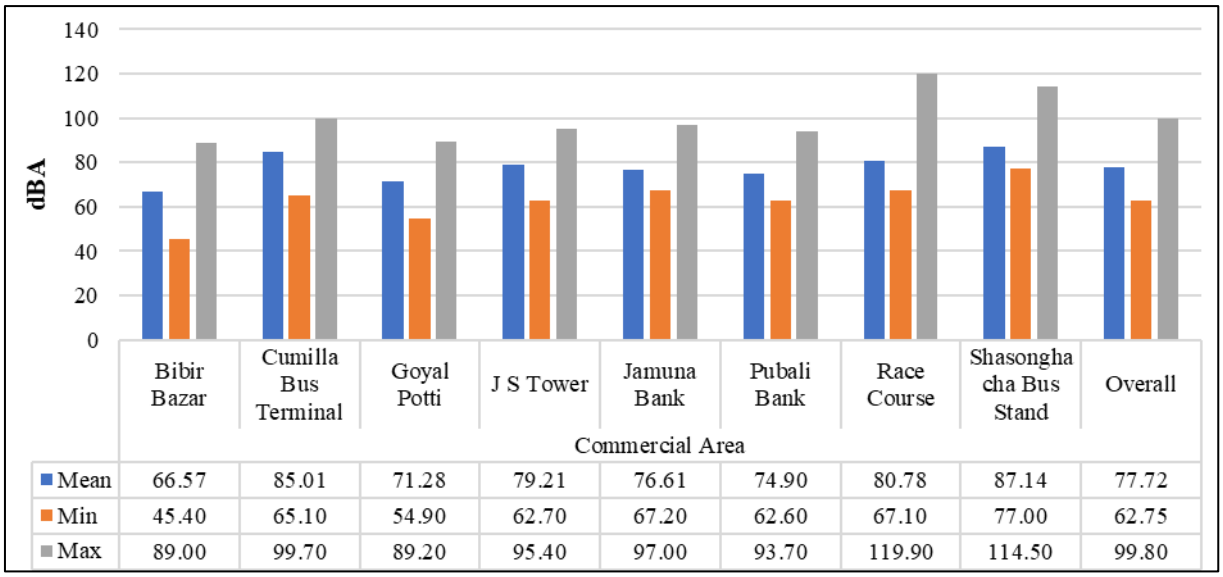

Figure 5 Noise Level (dBA) in Commercial Areas

In Figure 5, the noise levels of 8 locations in the commercial area of Cumilla District were explored. The mean noise level in the commercial area was found to be 77.72 dBA. The maximum noise level was found in Race Course (119.90 dBA), while the minimum noise level was found in Bibir Bazar (45.40 dBA). Moreover, the highest mean noise level was recorded in Shasonghacha Bus Stand (87.14 dBA), whereas the lowest mean noise level was discovered in Bibir Bazar (66.57 dBA).

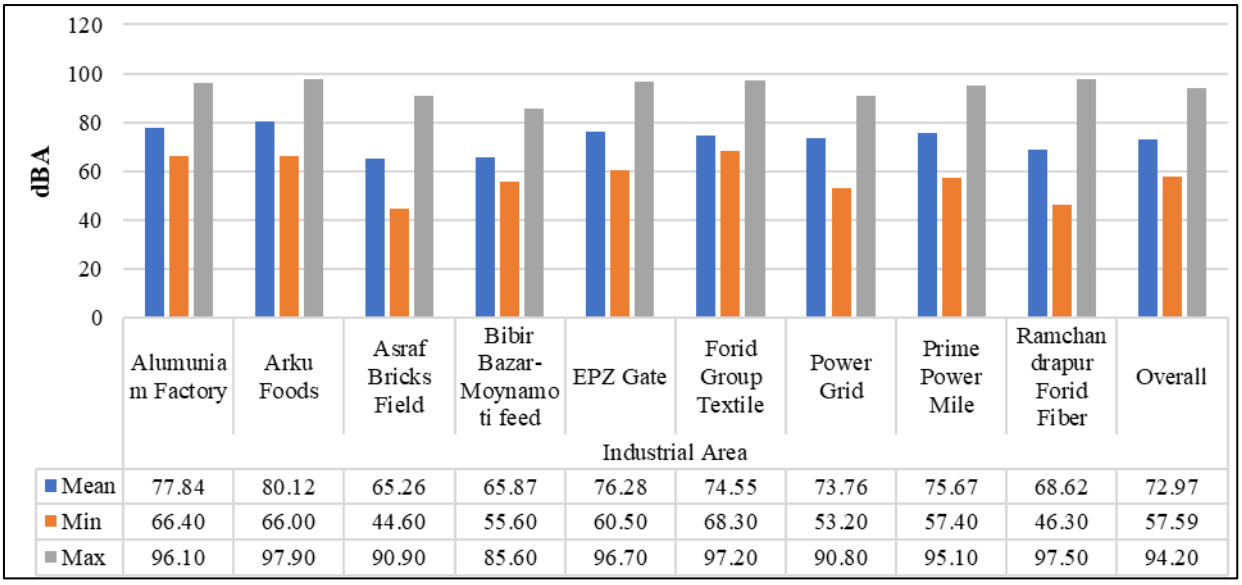

Figure 6 Noise Level (dBA) in Industrial Areas

Figure 6 shows noise levels at 9 locations in the industrial area. The mean noise level in the industrial area was found to be 72.97 dBA. Furthermore, the maximum and minimum noise levels were found in Asraf Brick Fields (99.90 dBA and 44.60 dBA). Moreover, the highest mean noise level was observed in Arku Foods (80.12 dBA) and the lowest mean noise level was observed in Asraf Brick Fields (65.26 dBA).

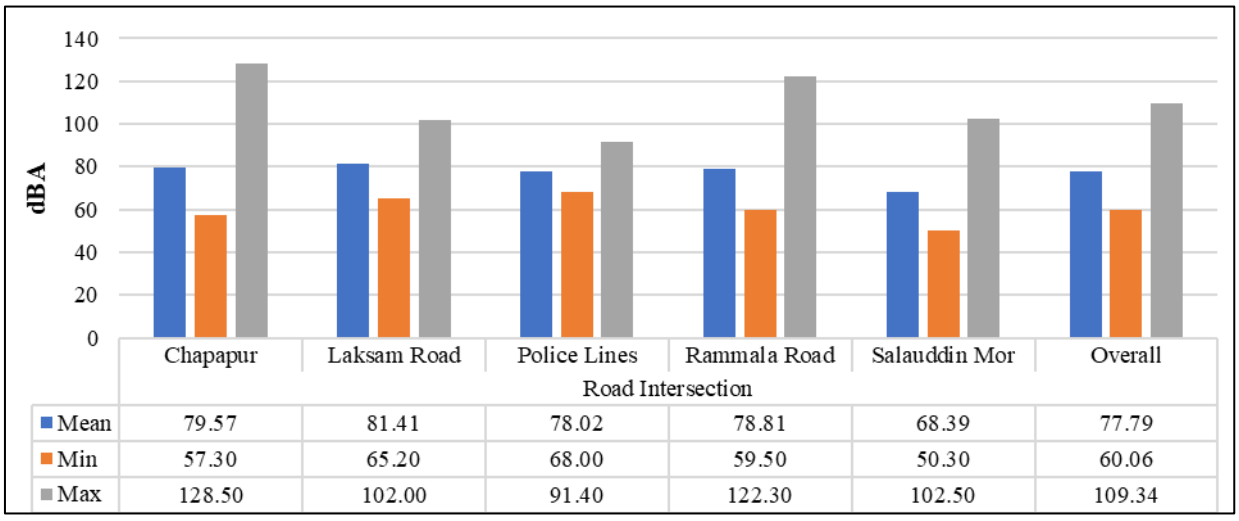

Figure 7 Noise Level (dBA) in Road Intersections

Figure 7 depicts the noise levels at 5 locations in the road intersection. The mean noise level in the road intersection was found to be 77.79 dBA. Additionally, the maximum noise level was recorded at Chapapur (128.50 dBA), while the minimum noise level was found in Salauddin Mor (50.30 dBA). Moreover, the highest mean noise level was found in Laksam Road (81.41 dBA), whereas the lowest mean noise level was found in Salauddin Mor (68.39 dBA).

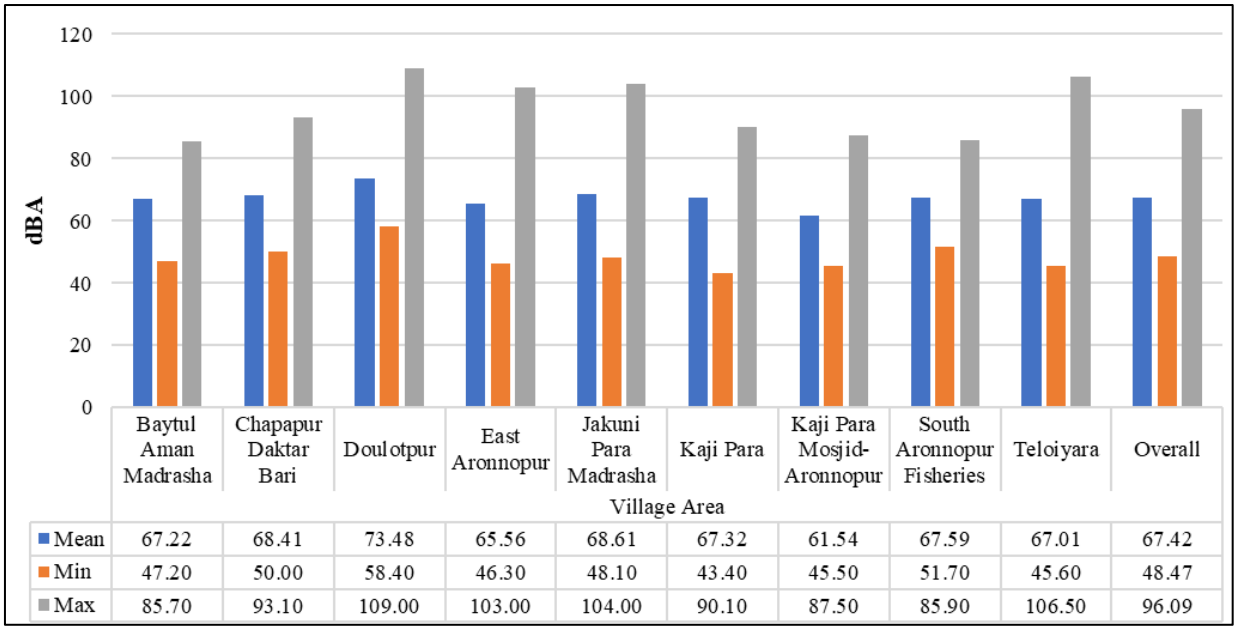

Figure 8 Noise Level (dBA) in Village Areas

Figure 8 represents the noise levels at 9 locations in the village area. The mean noise level in the village area was found to be 67.42 dBA. Furthermore, the maximum noise level was found in Doulotpur (109.00 dBA) and the minimum noise level was observed in Kaji Para (43.40 dBA). Moreover, the highest mean noise level was reported in Doulotpur (73.48 dBA), and the lowest mean noise level was found in Kaji Para Mosjid-Aronnopur (61.54 dBA).

Table 1 Dispersion of Noise Quality in Different Land Use in Cumilla City

Land Use (N)	Mean	Minimum	Maximum	Standard Deviation	Range	Median	Ranking
Silent Area (10)	70.25	44.90	103.80	9.30	58.90	69.10	6
Residential Area (9)	73.14	53.60	120.10	10.10	66.50	71.75	4
Mixed Areas (8)	77.68	50.50	118.50	10.82	68.00	79.30	3
Commercial Area (8)	77.72	45.40	119.90	10.54	74.50	78.55	2
Industrial Area (9)	72.97	44.60	97.90	9.63	53.30	72.80	5
Road Intersections (5)	77.79	50.30	128.50	9.44	78.20	77.70	1
Village Area (9)	67.42	43.40	109.00	10.40	65.60	68.00	7
Overall (58)	73.84	43.40	128.50	10.71	85.10	73.50	-

Table 1 presents the descriptive statistics for the noise quality of the study. The study encompasses 7 distinct land uses. The higher ranges are found in the Road Intersection (78.2 dBA), and the area is almost the equivalent of the Commercial area (74.5 dBA), and lower ranges are observed in the Industrial area (53.30 dBA). From the comparison of mean, standard deviation, and coefficient of variation, it was observed that the highest variation is in the commercial area, which means that due to the various commercial activities in this zone, the noise level varies a lot.

Table 2 Post-hoc Analysis

(I) Land Use	(J) Land Use	Mean Difference (I-J)	Standard Error	Sig.
Silent Area	Mixed Areas	-7.42411*	0.29597	0
	Residential Area	-2.89140*	0.28206	0
	Commercial Area	-7.46836*	0.29082	0

	Industrial Area	-2.72169*	0.2755	0
	Road Intersection	-7.54349*	0.30346	0
	Village Area	2.82930*	0.27747	0
Mixed Areas	Silent Area	7.42411*	0.29597	0
	Residential Area	4.53271*	0.30211	0
	Commercial Area	-0.04425	0.31031	0.887
	Industrial Area	4.70242*	0.29599	0
	Road Intersection	-0.11938	0.32218	0.711
	Village Area	10.25341*	0.29783	0
Residential Area	Silent Area	2.89140*	0.28206	0
	Mixed Areas	-4.53271*	0.30211	0
	Commercial Area	-4.57696*	0.29708	0
	Industrial Area	0.16971	0.28209	0.547
	Road Intersection	-4.65209*	0.30946	0
	Village Area	5.72070*	0.28402	0
Commercial Area	Silent Area	7.46836*	0.29082	0
	Mixed Areas	0.04425	0.31031	0.887
	Residential Area	4.57696*	0.29708	0
	Industrial Area	4.74667*	0.29085	0
	Road Intersection	-0.07513	0.31746	0.813
	Village Area	10.29766*	0.29272	0
Industrial Area	Silent Area	2.72169*	0.2755	0
	Mixed Areas	-4.70242*	0.29599	0
	Residential Area	-0.16971	0.28209	0.547
	Commercial Area	-4.74667*	0.29085	0
	Road Intersection	-4.82180*	0.30348	0
	Village Area	5.55099*	0.2775	0
Road Intersection	Silent Area	7.54349*	0.30346	0
	Mixed Areas	0.11938	0.32218	0.711
	Residential Area	4.65209*	0.30946	0
	Commercial Area	0.07513	0.31746	0.813
	Industrial Area	4.82180*	0.30348	0
	Village Area	10.37279*	0.30528	0
Village Area	Silent Area	-2.82930*	0.27747	0
	Mixed Areas	-10.25341*	0.29783	0
	Residential Area	-5.72070*	0.28402	0
	Commercial Area	-10.29766*	0.29272	0
	Industrial Area	-5.55099*	0.2775	0

	Road Intersection	-10.37279*	0.30528	0

* The mean difference is significant at the 0.05 level

Table 2 presents significant differences among the 7 types of land use. For certain land uses, the mean differences are notably lower, with significance assessed at the 0.05 level.

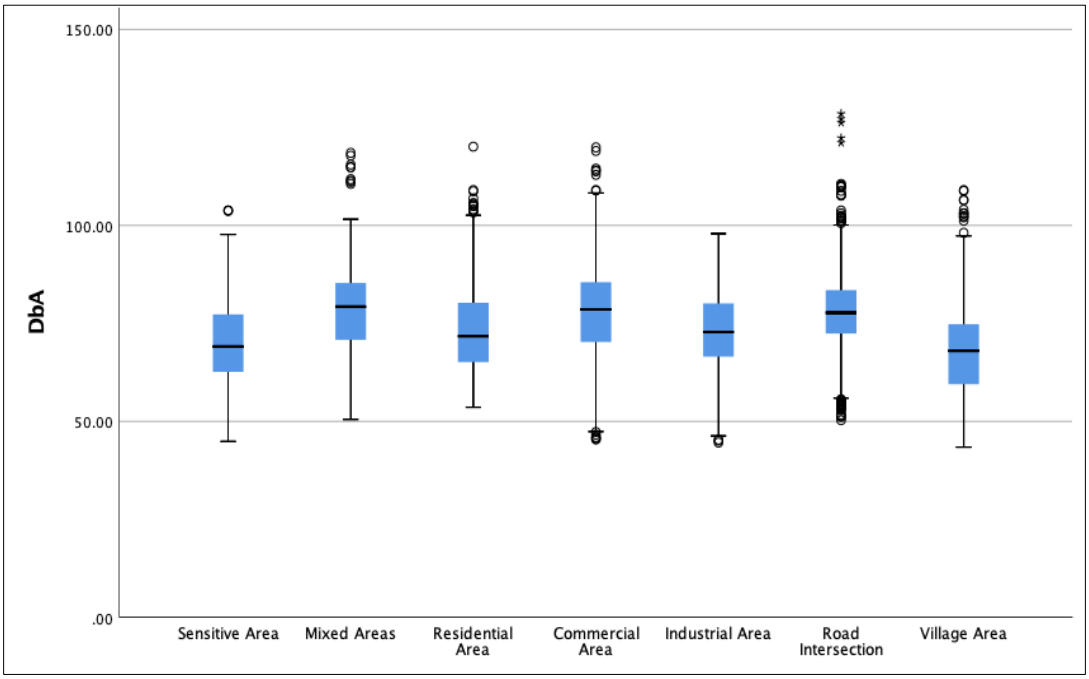

Figure 9 Mean Noise Pollution Level (dBA) in Cumilla City

The whisker box plot (Figure 9) shows mean noise pollution in Cumilla city. A horizontal black line marks the median. The lower boundary of the box indicates the 25th percentile. The 75th percentile can be found at the box's upper edge. The whisker represents the maximum (upper whisker) and minimum value (lower whisker). Points above the whiskers indicate outliers.

Table 3 Comply with Noise Standard [29]

Land Use	**Location**	**Standard (Day Time)**	**Within Standard (%)**
Silent Area (10)	BADC	50	0%
	Bakhrabad Gas Office		0%
	BEPZA Public School and College		0%
	Bibir Bazar BGB Camp		3.31%
	Comilla Medical		0%
	Cumilla Government College		0%
	EPZ Mosjid		0%
	Kouca Chomohoni Aman Mosjid		0%
	PBI Office		0%
	Victory College		0%
Mean			0.33%
	Badortola	55	0.81%

Residential Area (9)	Chapapur Adorsho Sohor		0%
	Cumilla Town Hall		0%
	East Racecourse		0%
	Housing State		0%
	Jamtola		0%
	Kasharipotti		0.32%
	North Bagichagao		0%
	Takur Para		0%
Mean			0.13%
Mixed Areas (8)	Balutopa	60	0%
	Cokhbazar		0%
	Kandirpar		0%
	Modina Bus Syand		0%
	Modon Asrafpur		29.53%
	Nazrul Evenue		0%
	Rajgong		0%
	Tomchom Bridge		15.32%
Mean			6%
Commercial Area (8)	Bibir Bazar	70	64.82%
	Cumilla Bus Terminal		5.01%
	Goyal Potti		47.35%
	J S Tower		11.71%
	Jamuna Bank		14.29%
	Pubali Bank		38.92%
	Race Course		2.91%
	Shasonghacha Bus Stand		0%
Mean			23.13%
Industrial Area (9)	Alumuniam Factory	75	43.36%
	Arku Foods		23.35%
	Asraf Bricks Field		80.83%
	Bibir Bazar-Moynamoti feed		91.95%
	EPZ Gate		42.58%
	Forid Group Textile		67.58%
	Power Grid		46.44%
	Prime Power Mile		49.67%
	Ramchandrapur Forid Fiber		72.76%
Mean			58%
All Mean			17%

Table 3 demonstrates that 17% of areas in Cumilla District Town belonged to the noise standard among 5 land uses. 0.33% of the areas in the silent zone met the noise standard across 10 locations, 0.13% of the areas in the residential zone met the noise standard across 9 locations, 6% of the areas in the mixed zone met the noise standard across 8 locations, 23.13% of the areas in the commercial zone met the noise standard across 8 locations, and 58% of the areas in the industrial zone met the noise standard across 9 locations.

The standard listed in Bibir Bazar BGB Camp is 3.31%, which stands highest for silent areas. In residential areas, the highest ratio was found in Badortola, which was 0.81%. The mixed area data represent 29.53%, reported highest at Moddhom Asrafpur, and in the commercial area, 64.82% were within the limit, found highest at Bibir Bazar; also in the industrial area, the highest, 72.76%, was reported at Ramchandrapur Farid Fiber.

The current study examined 7 land uses, although only 5 were incorporated into the Sound Pollution (Control) Rules—2006. Consequently, in the comparison of all land uses with noise standards, village areas and road intersections were excluded from consideration.

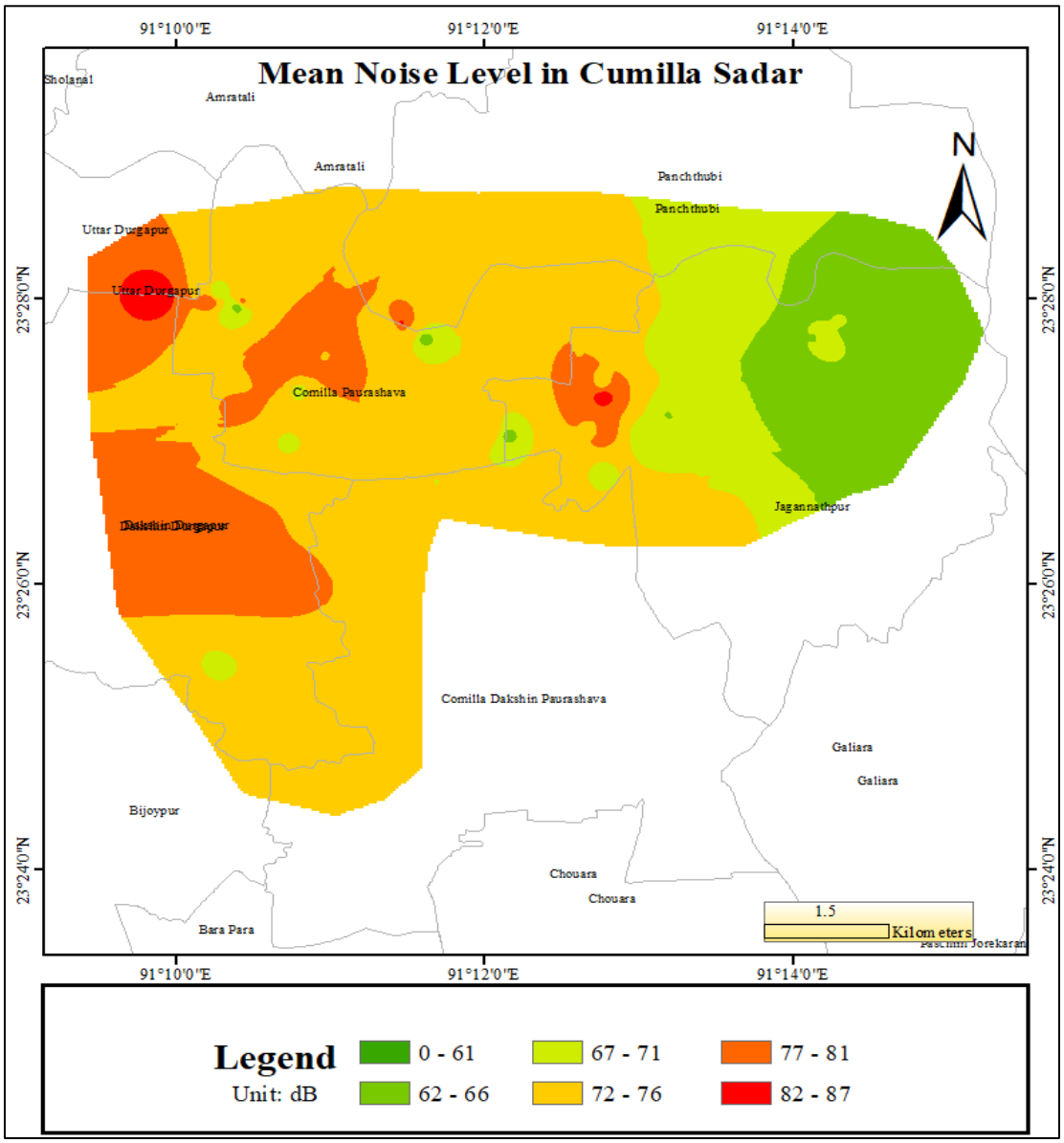

Figure 10 Spatial Map of Mean Noise Pollution

Figure 10 shows the noise level at different places in Cumilla City. Yellow areas are limited, while rising higher levels are shown in orange and red. The noise was found to be higher (78-81 dBA).

Noise pollution may result in many health consequences. Excessive noise can cause irritation and, as research indicates, increases the risk of ischemic heart disease and hypertension, sleep disturbances, hearing impairment, tinnitus, and cognitive deficits, with accumulating evidence of additional health consequences, including negative birth outcomes and mental health disorders

Abbreviations

- AC: Alternating Current
- CAPS: Center for Atmospheric Pollution Studies
- dBA: A-weighted Decibel
- DoE: Department of Environment
- GB: Gigabyte
- GIS: Geographic Information System
- Govt: Government
- Leq: Equivalent Continuous Sound Pressure Level
- Ltd: Limited
- MAX: Maximum
- MIN: Minimum
- NIHL: Noise-Induced Hearing Loss
- PC: Personal Computer
- REC: Record
- SD: Secure Digital
- SPSS: Statistical Package for the Social Sciences
- WHO: World Health Organization

4. Conclusions

Noise pollution levels exceed the national guidelines in all areas evaluated in our study, and this increase significantly contributes to both acute and chronic diseases. As a result, individuals may have both physical and mental health issues, leading to a detrimental quality of life. The mean noise level and Leq of Cumilla District Town were measured at 73.84 dBA and 95.35 dBA, respectively. Cumilla District Town's mean noise level ranking was Road Intersections (77.79 dBA) > Commercial Area (77.72 dBA) > Mixed Areas (77.68 dBA) > Residential Area (73.14 dBA) > Industrial Area (72.97 dBA) > Silent Area (70.25 dBA) > Village Area (67.42 dBA). Nevertheless, the highest mean noise level was recorded at Shasonghacha Bus Stand (87.14 dBA), while the lowest mean noise level was observed at Cumilla Government College (61.38 dBA). The rising number of cars and tourists has been progressively raising the noise level in Cumilla District Town recently. Many people ignore the negative effects of noise pollution on human health; hence, it is not considered a major sort of pollution. Like in the rest of Bangladesh, noise pollution is a significant but sometimes ignored issue in Cumilla. The government, media, and NGOs must collaborate to improve the living conditions in Bangladesh by coordinating their efforts. We cannot afford to waste time or energy delaying action to reduce noise pollution, especially since many of its sources are unnecessary. Given its magnitude and the human suffering it produces, we cannot keep ignoring the issue of noise pollution any more. We must all take this issue seriously and start addressing it for the sake of our children's future and the health, sanity, and welfare of the populace. Whether we are general people, NGO staff, or media members, everyone should have the responsibility to reduce noise pollution. More research is needed to track noise pollution in Cumilla District Town to guarantee sustainable living.

Compliance with Ethical Standards

Acknowledgements

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Disclosure of conflict of interest

The authors assert that they do not have any conflict of interest with this study. They are satisfied with their position.

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