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Research Article

Evaluation of Noise Pollution in Barisal, a Coastal City of Bangladesh

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Abstract

The purpose of this research was to evaluate the noise pollution level in different zones of Barisal City. 7 different zones and 56 locations were selected in Barisal City based on land use. We tracked the noise levels in Barisal City using a sound level meter (REED SD-4023) from January 01, 2021, to April 30, 2021. Multiple samples were collected from each sampling site. The noise level at each location has been recorded three times per day. The Leq was determined to be 95.18 dBA, and the mean noise level was 73.86 dBA. Furthermore, the Leq and mean noise levels in Silent, Mixed, Residential, Commercial, Industrial, Road Intersection, and Village Area were 76.57 dBA and 65.48 dBA, 82.17 dBA and 75.36 dBA, 88.10 dBA and 72.35 dBA, 97.28 dBA and 69.39 dBA, 84.13 dBA and 71.89 dBA, 82.08 dBA and 71.89 dBA, and 92.69 dBA and 69.79 dBA, respectively. The hierarchy in various land uses based on mean noise level was Mixed Area > Residential Area > Industrial Area and Road Intersection > Village Area > Commercial Area > Silent Area. The three highest noise-polluted areas were Khansons Textile Ltd. (109.68 dBA), Barisal Bus Terminal (106.82 dBA), and Kaladema (101.24 dBA), whereas the three lowest noise-polluted areas were Sadar Road (59.24 dBA), Guthia Mosjid (67.35 dBA), and Jahanara Israil School and College (69.62 dBA), based on Leq. Nonetheless, we noted that the noise levels surpassed the National Standard Level at all sites examined in this study.

Keywords

Noise Pollution, Land Use, Noise Standard, Barisal City, Bangladesh

1. Introduction

Noise represents any superfluous disruption within a beneficial frequency range. Noise pollution refers to harmful or disruptive sounds in the environment that negatively affect human health, animals, and overall quality of life. In the city of Barisal in southern Bangladesh, noise pollution is a major problem due to rapid urbanization, increasing car traffic, and industrial operations. A study [1] explored that the Nathullabad region of Barisal City exhibited the highest noise pollution level at 86.5 dBA, while the Kaunia Abasik area of Barisal City recorded the lowest at 67.8 dBA. The study also found that noise pollution is at a severe stage in commercial areas (82 dBA), industrial areas (80.4 dBA), mixed areas (81.3 dBA), residential areas (72.7 dBA), and Silent areas (72.5 dBA).

Noise pollution has several consequences that can result in significant physical and psychological health problems, in-

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cluding hearing impairment, sleep disruptions, heightened stress, hypertension, and cardiovascular disease [2-4]. Prolonged exposure may also result in mental health issues, such as anxiety and depression. Furthermore, continuous exposure to elevated noise levels can induce significant stress on the auditory and neural systems of urban residents, especially children. Students who are stressed out seem more inclined to do things that are bad for their health, such as putting things off, using drugs, drinking too much, and smoking [5].

Motorized vehicles provide a primary source of noise pollution in metropolitan environments [6]. Moreover, noise can disrupt wildlife by obstructing communication, navigation, and reproduction. The traffic police engaged in controlling traffic, particularly at heavy traffic intersections, belong to the high-risk group to be affected by the health hazards of noise and air pollution [7-13]. They frequently suffer from diminished hearing functions and have psychological difficulties [14-17]. The World Health Organization (WHO) evaluated the worldwide illness burden attributable to industrial noise and recognized 25 risk variables systematically [18].

Working can cause hearing loss, which can be bilateral or unilateral, or even complete or partial [19]. It encompasses traumatic acoustic damage and Noise-Induced Hearing Loss (NIHL). Elevated levels of workplace noise persist as an issue globally. In the United States, about 30 million workers are subjected to harmful noise [20]. Four to five million people in Germany, or 12 to 15 percent of the workforce, are exposed to noise levels that the WHO considers dangerous [21]. While noise is prevalent in nearly all job activities, certain tasks are linked to particularly elevated noise levels, notably those involving impact operations, the manipulation of specific materials, and the operation of commercial aircraft. Professions with the greatest susceptibility to Noise-Induced Hearing Loss (NIHL) include manufacturing, transportation, mining, construction, agriculture, and military service. The circumstances are improving in industrialized nations, as the broader recognition of the threat has resulted in protective initiatives. Although there is not a lot of information about developing countries, what is known is that noise levels are much higher on mean than what is recommended for work in many developed countries [22-25].

There are auditory and non-auditory impacts of noise on human health. Some studies [26-30] have examined these impacts in various groups of individuals who operate in environments with loud and high-frequency noise. However, no one has ever looked at how traffic cops' ears react to car exhaust, especially in India [13]. After learning about the dangers to their health, traffic cops should feel compelled to do what is necessary. Few have voiced worry over the effects of noise or the harm it can inflict since most people do not see it as a serious environmental problem. Medical professionals warn that prolonged exposure to noise levels above 80 dB can cause either short-term or long-term hearing damage in humans.

The issue of noise in our country currently may not seem particularly grave. Nonetheless, contemplating it is not imprudent. Noise disturbances may escalate uncontrollably unless the government intervenes on behalf of the public interest [31, 32]. This study has been conducted to evaluate the level of noise pollution in several zones in Barisal City.

2. Methodology

2.1. Study Area

The study area for this research is Barisal City (Figure 1). Barisal is a major city in Bangladesh. It is located on the northern side of the Bay of Bengal in southern Bangladesh, 142 kilometers (373 kilometers by car) from the capital city of Dhaka and an ancient port on the Kirtankhola River. There are 50 mahallas and 30 wards in the city. The town occupies 45 km ². It is located at longitude 90 °21' 59.99" E and latitude 22 ° 41' 59.99" N. The selection of Barisal City was based on its recent rapid and haphazard urbanization, which has led to a significant increase in the number of vehicles and industries. The ambient noise levels in Barisal City usually exceed international guidelines by 2/3 folds. Such noise has potential adverse impacts on the environment and the health of people. The different Barisal City sites where the vehicular flows are high compared to other sites were of particular interest in this research. In Barisal City, 7 distinct zones and 56 sites were delineated according to land utilization.

2.2. Data Collection

A noise level meter (REED SD-4023) was used for ambient sound pressure level monitoring in the affected areas of Barisal City from January 1, 2024, to April 30, 2024. This SD series sound level meter has triple-range measurement and features user-selectable sampling rates from 1 to 3600 seconds. Using an SD card (up to 16 GB), a user can select a desired sampling rate and quickly generate an Excel file with raw data, all without the use of software. Optional accessories include a tripod and AC adapter for continuous long-term monitoring and PC software that allows a user to track live measurements.

2.3. Measuring Procedure and Analysis

The data record function records the maximum and minimum readings. Press the REC button once to start the Data Record function, and a “REC” symbol will appear on the display. The display will display the "REC" symbol. Firstly, press the REC button once, and a “REC. MAX.” symbol along with the maximum value will appear on the display. To delete the maximum value, press the Hold Button once and the display will show a “REC.” symbol only and execute the memory function continuously. Secondly, press the REC button again, and a “REC. MIN.” symbol along with the minimum value will appear on the display. To delete the

minimum value, press the Hold Button once, and the display will show a "REC." symbol only and execute the memory function continuously. Thirdly, to exit the memory record function, press the REC button for 2 seconds. The display will revert to the current reading. The data was collected above 1.5 meters from the ground, and it was taken while standing on the roadside. Any kind of noise barrier was avoided when measuring the actual sound level. Every second, data was taken for sampling, and the total sampling time for each station was 5 minutes. Recorded data was stored on a microSD card (memory card). Using IBM SPSS v.20 and Microsoft Excel v.2010, the collected data was examined. All data are visualized in different graphs and tables using ArcGIS v.10. 2.1 was used to make a study area map and a noise buffering map.

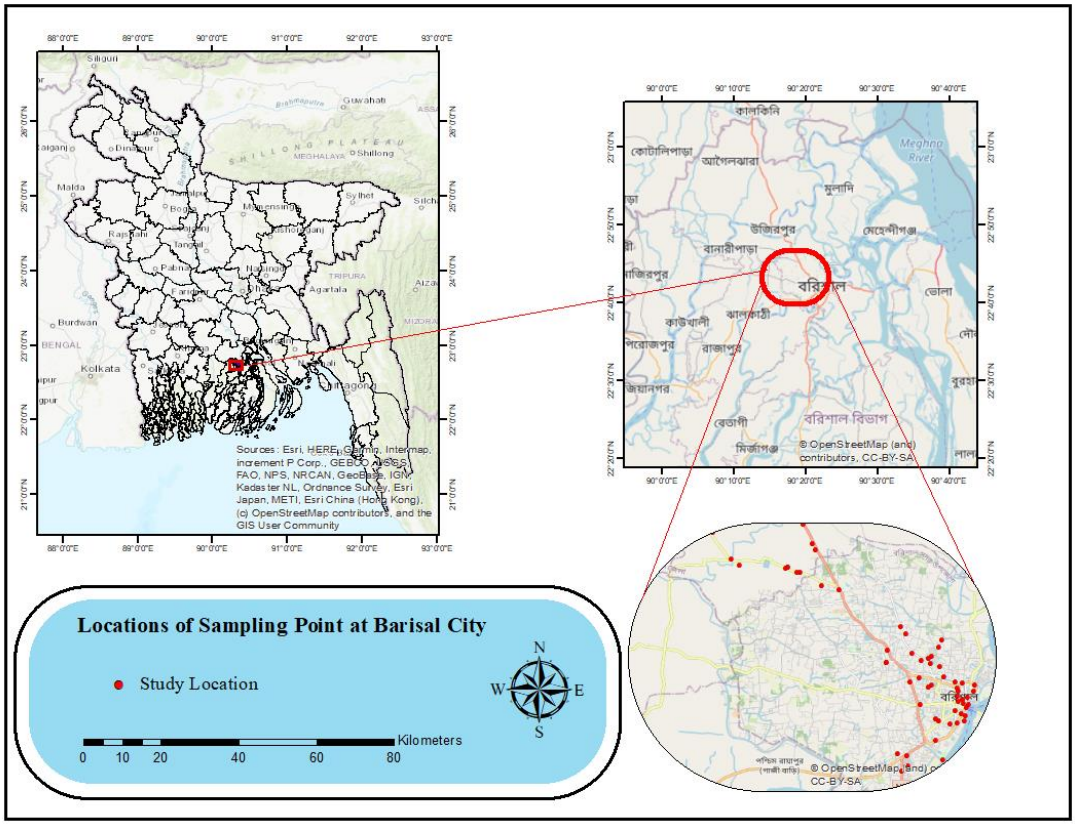


Figure 1. *Sampling Points of Barisal City.*

The survey was performed on working days. The measurement was carried out for the major traffic intersection of the city. The sound pressure level of the traffic zone was measured by A-weighting.

3. Results and Discussion

In Barisal City, the Leq was found to be 95.18 dBA, while the mean noise level was found to be 73.86 dBA.

The maximum noise level was recorded at 95.40 dBA in the Barisal Cadet College, which is about two and a half times the standard noise level during the day and almost twice as loud at night (Figure 2). The minimum noise level recorded in the Jahanara Israil School and College area was 48 dBA, higher than the tolerable daytime level. The analysis also found that the highest mean noise was explored in the BM College Barisal area, which was 77.54 dBA, and the lowest mean noise was found to be 59.24 dBA in the Guthia Mosjid. Nevertheless, the Leq and mean noise levels in Silent Areas were observed to be 76.57 dBA and 65.48 dBA. Moreover, the highest Leq was recorded at BM College Barisal (81.55 dBA), whereas the lowest Leq was found in Guthia Mosjid (67.35 dBA).

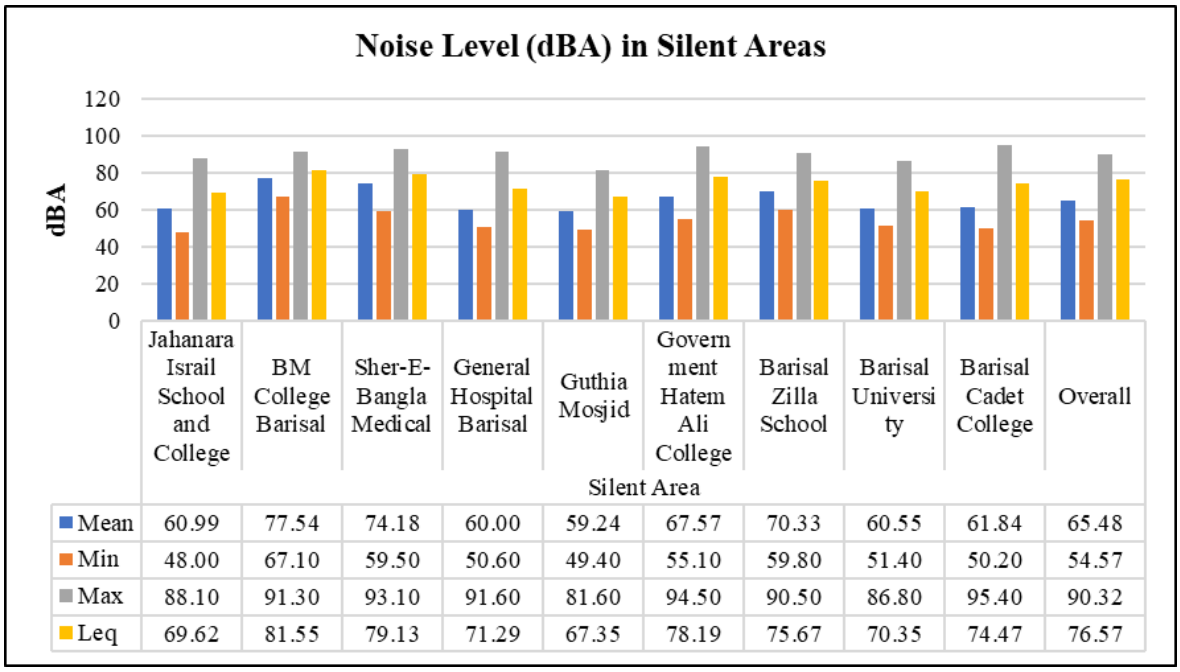


Figure 2. *Noise Level (dBA) in Silent Area.*

The DoE mentioned that noise levels in mixed areas should be 60 dBA during the day and 40 dBA at night. Figure 3 shows that noise levels in Barisal City are a maximum of 117.80 dBA at Puran Para Tower and a minimum of 50.50 dBA at Kownia Bisic Road. The maximum noise level is significantly higher than the standard noise level for the mixed area. The highest mean noise level was reported at 80.87 dBA at Puranpara Tower, and the lowest mean noise level was found to be 69.72 dBA at Port Road Bazar. Both levels exceed the standard noise levels. The Leq and mean noise levels in mixed areas were observed to be 82.17 dBA and 75.36 dBA. Furthermore, the Puranpara Tower recorded the highest Leq (96.44 dBA), while the lowest Leq was found in Kownia Bisic Road (76.30 dBA).

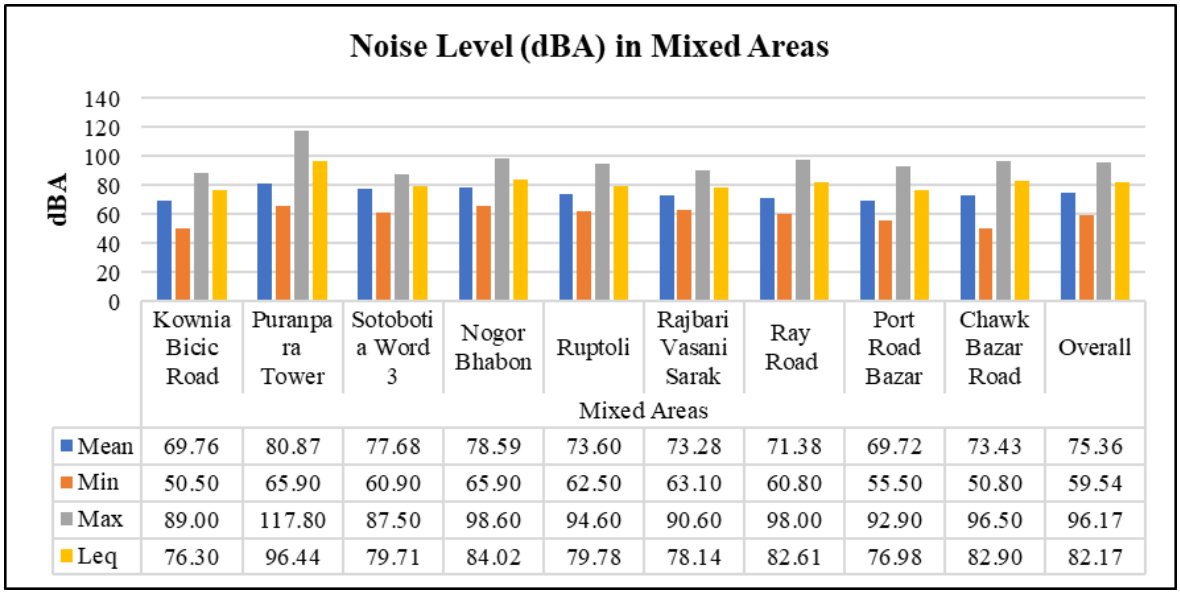


Figure 3. *Noise Level (dBA) in Mixed Area.*

In Figure 4, the maximum noise level was found at the area Kownia, which was 128.70 dBA, and the minimum noise was listed at 50.70 at Mokbul Engineer Lane in a residential area. Furthermore, the highest mean noise level was found to be 83.78 dBA in Kownia and the lowest mean noise level was determined to be 63.36 dBA in the Ruptoli Housing State.

Nevertheless, the Leq and mean noise levels in residential areas were observed to be 88.10 dBA and 72.35 dBA. Moreover, the highest Leq was recorded in Kownia (95.62 dBA) and the lowest Leq was found in Ruptoli Housing State (74.14 dBA).

The standard value for a commercial area is 75 dBA. In contrast, the commercial area of Barisal District showed the maximum at 129.00 at the Barisal Bus Terminal and the minimum at 39.60 at Kalibari Road (Figure 5). The mean noise level recorded was a maximum of 81.80 at the 30 Godaun Point and a minimum of 51.97 at Sadar Road. Furthermore, the Leq and mean noise levels in commercial areas were observed to be 97.28 dBA and 69.39 dBA. Nevertheless, the highest Leq was found in Barisal Bus Terminal (106.82 dBA) and the lowest Leq was observed in Sadar Road (59.24 dBA).

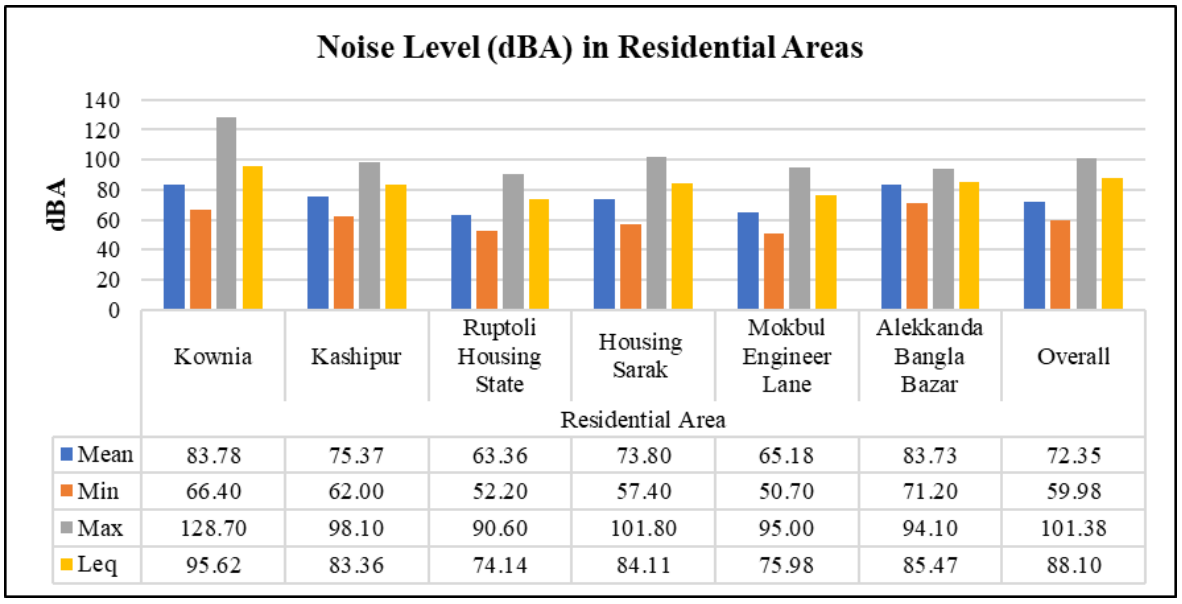


Figure 4. *Noise Level (dBA) in Residential Area.*

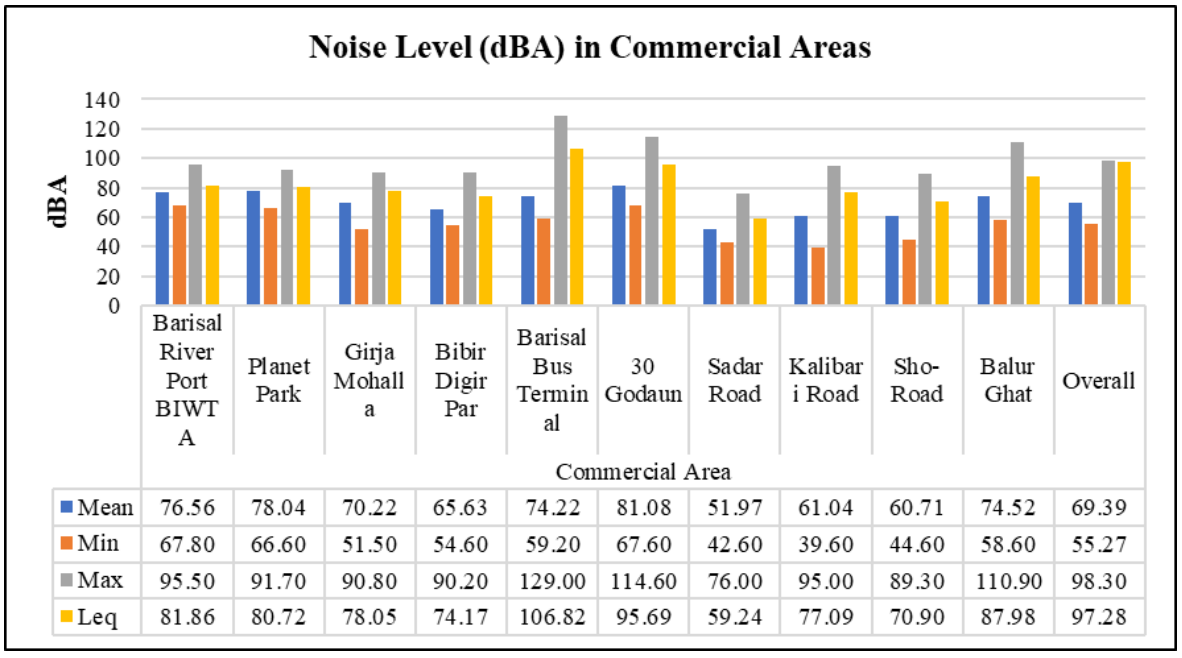
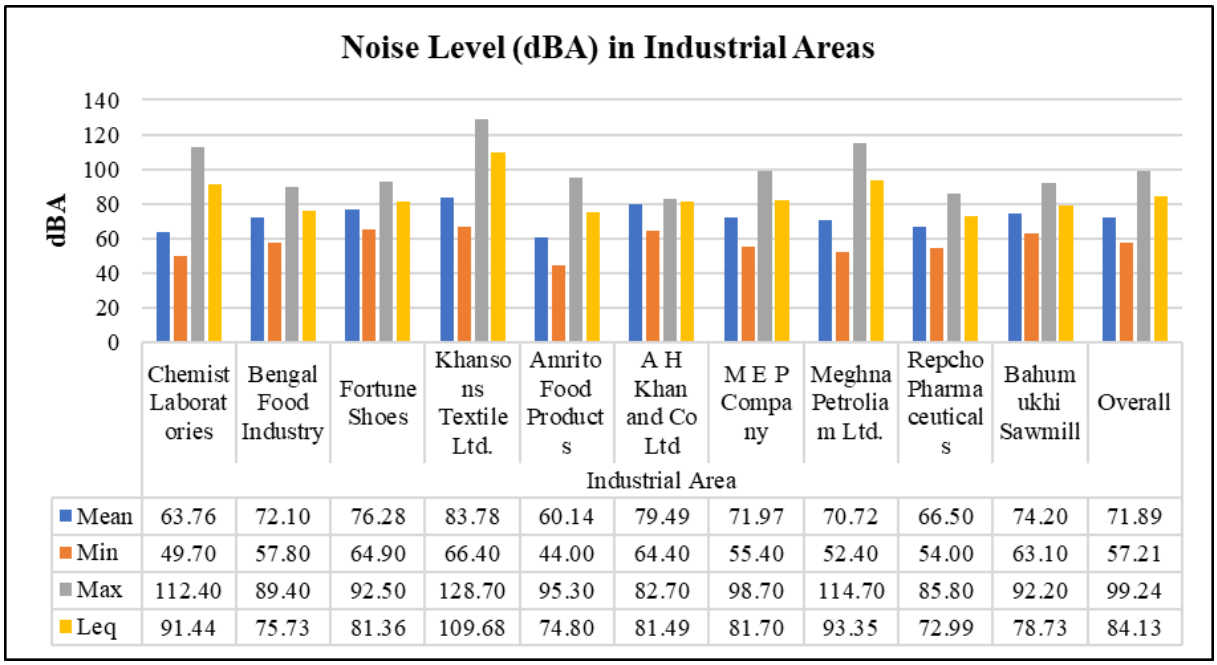


Figure 5. *Noise level (dBA) in Commercial Area.*

Figure 6 shows the maximum noise found at the Industrial Area being 128.70 dBA at the Khansons Textile Ltd. and the minimum noise level was reported at the Amrito Food Products area, which is 44 dBA. Furthermore, the highest mean

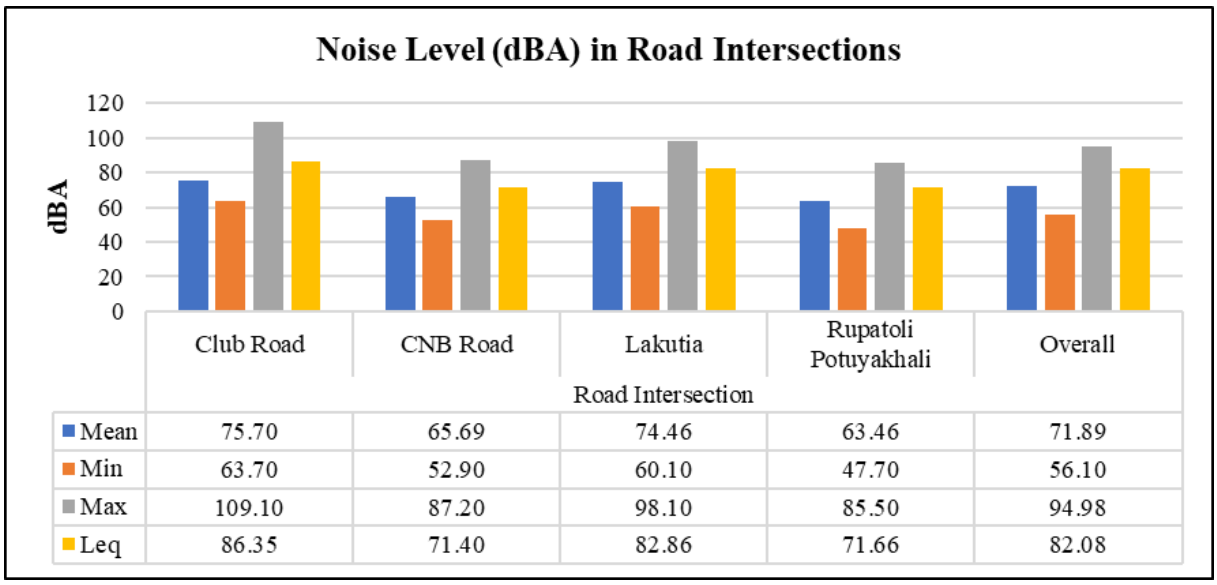
noise level was found to be 83.78 dBA at Khansons Textile Ltd., whereas the lowest mean noise level was discovered to be 60.14 dBA at the Amrito Food Products area. Nevertheless, the Leq and mean noise levels in industrial areas were observed to be 84.13 dBA and 71.89 dBA. Moreover, the highest Leq was found in Khansons Textile Ltd. (109.68 dBA), while the lowest Leq was recorded in Repcho Pharmaceuticals (72.99 dBA).



	Chemist Laboratories	Bengal Food Industry	Fortune Shoes	Khansons Textile Ltd.	Amrito Food Products	A H Khan and Co Ltd	M E P Company	Meghna Petrolium Ltd.	Repcho Pharmaceuticals	Bahumukhi Sawmill	Overall
Mean	63.76	72.10	76.28	83.78	60.14	79.49	71.97	70.72	66.50	74.20	71.89
Min	49.70	57.80	64.90	66.40	44.00	64.40	55.40	52.40	54.00	63.10	57.21
Max	112.40	89.40	92.50	128.70	95.30	82.70	98.70	114.70	85.80	92.20	99.24
Leq	91.44	75.73	81.36	109.68	74.80	81.49	81.70	93.35	72.99	78.73	84.13

Figure 6. *Noise Level (dBA) in Industrial Area.*

The maximum noise level in the road intersection was found at Club Road (109.10 dBA), whereas the minimum noise level was observed in Rupatoli Patuakhali (47.7 dBA), as seen in Figure 7. The highest mean noise level was recorded at Club Road (75.70 dBA), whereas the lowest mean noise level was found at Rupatoli Patuakhali (63.46 dBA). All the specified noise level levels are approximately equivalent within their category. Furthermore, the Leq and mean noise levels in road intersections were observed to be 82.08 dBA and 71.89 dBA. Moreover, the highest Leq was recorded on Club Road (86.35 dBA), while the lowest Leq was noted on CNB Road (71.40 dBA).



	Club Road	CNB Road	Lakutia	Rupatoli Potuyakhali	Overall
Mean	75.70	65.69	74.46	63.46	71.89
Min	63.70	52.90	60.10	47.70	56.10
Max	109.10	87.20	98.10	85.50	94.98
Leq	86.35	71.40	82.86	71.66	82.08

Figure 7. *Noise Level (dBA) in Road Intersection.*

The village area (Figure 8) showed significantly high levels of noise at Madhobpasa (102.30 dBA) and low noise levels at Shib Barir Pol (52.30 dBA). Furthermore, the highest mean noise level was reported in the Madhobpasa (99.90 dBA) and Kaladema area (99.90 dBA), whereas the lowest mean noise level was found at Shib Barir Pol (63.95 dBA). Nevertheless, the Leq and mean noise levels in the village area were observed to be 82.08 dBA and 71.89 dBA. Moreover, the highest Leq was recorded in Kaladema (101.24 dBA), whereas the lowest Leq was found in Shib Barir Pol (71.57 dBA).

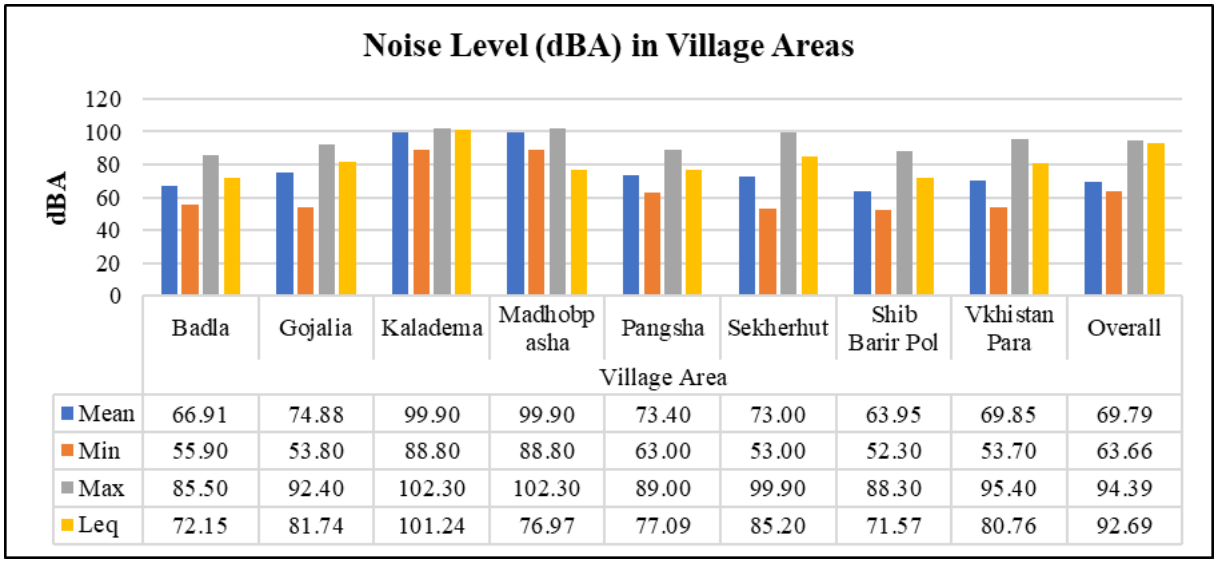


Figure 8. *Noise Level (dBA) in Village Area.*

Table 1. *Dispersion of Noise Level (dBA) in Different Land Use in Barisal City.*

Land Use (N)	Mean	Minimum	Maximum	Standard Deviation	Range	Median
Silent Area (9)	65.48	48.00	98.30	9.35	50.30	64.50
Mixed Area (9)	75.36	50.50	117.80	8.44	67.30	75.20
Residential Area (6)	72.35	50.70	101.80	9.72	51.10	72.50
Commercial Area (10)	69.39	39.60	129.00	12.12	89.40	71.40
Industrial Area (10)	71.89	63.66	94.39	11.02	30.73	71.95
Road Intersection (4)	71.89	44.00	128.70	11.08	84.70	72.10
Village Area (8)	69.79	47.70	109.10	9.12	61.40	69.70
Overall (56)	73.86	52.30	102.30	13.31	50.00	71.40

The subsequent Table 1 and Figure 9 present the descriptive statistics for the noise quality of the study. The study encompasses 7 distinct land uses. The higher ranges are found in the commercial area (89.40 dBA), and the road intersection area is almost the equivalent (84.70 dBA), and lower ranges are observed in the Industrial Area (30.73 dBA). From the comparison of the mean, standard deviation, and coefficient of variation, it is 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.

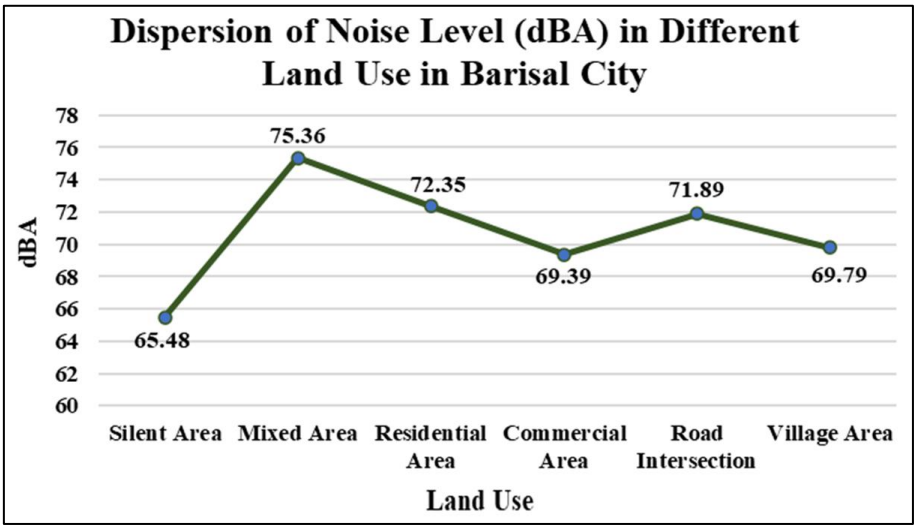


Figure 9. *Dispersion of Noise Level (dBA) in Different Land Use in Barisal City.*

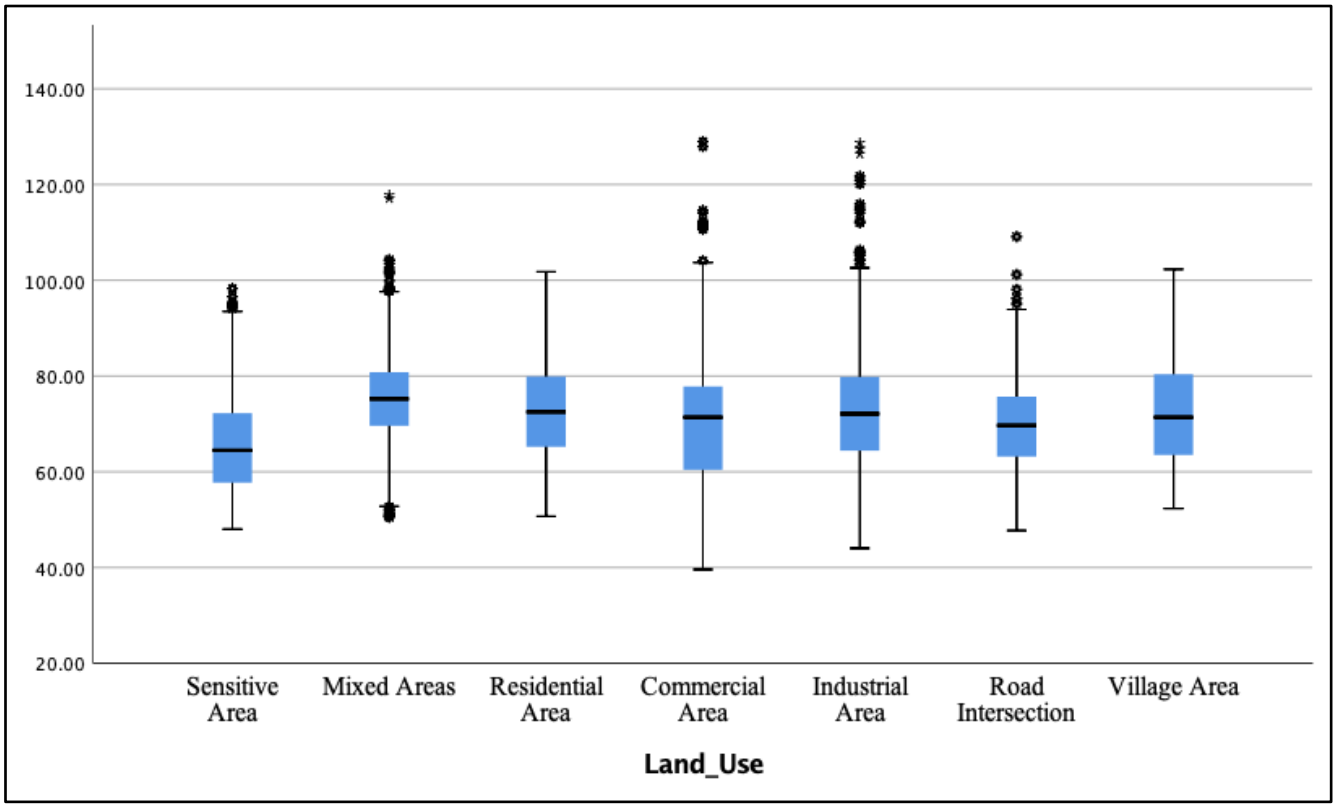


Figure 10. *Mean Noise Pollution (dBA) in Barisal City.*

The whiskerbox plot (Figure 10) shows mean noise pollution in Barisal City. A horizontal black line marks the median. The lower boundary of the box indicates the 25th percentile. The 75th percentile is shown by the upper edge of the box. The whisker represents the maximum (upper whisker) and minimum value (lower whisker). Points above the whiskers indicate outliers.

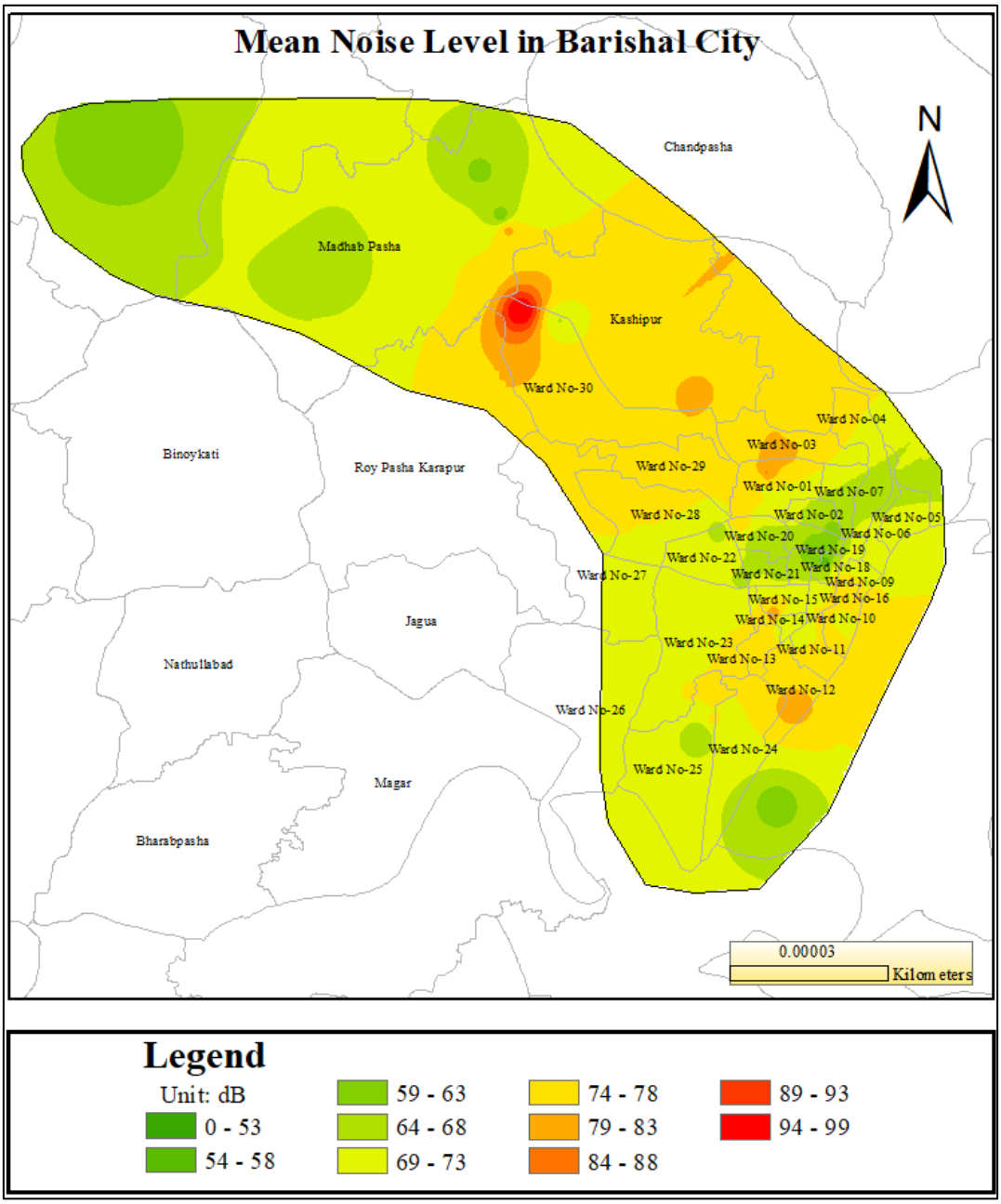


Figure 11. *Spatial Map of Mean Noise Pollution.*

Figure 11 shows the noise level at different places in Barisal City. The yellow areas indicate lower noise levels, while the orange and red areas indicate higher levels. The noise was found to be higher (78-81 dBA).

Table 2. *Post-hoc Analysis.*

(I) Land Use	(J) Land Use	Mean Difference (I-J)	Standard Error	Sig.
Silent Area	Mixed Areas	-9.8755*	0.28415	.000
	Residential Area	-6.8636*	0.29511	.000
	Commercial Area	-3.9032*	0.2787	.000
	Industrial Area	-6.4097*	0.27861	.000

(I) Land Use	(J) Land Use	Mean Difference (I-J)	Standard Error	Sig.
	Road Intersection	-4.3099*	0.3672	.000
	Village Area	-8.3763*	0.30034	.000
Mixed Areas	Silent Area	9.8755*	0.28415	.000
	Residential Area	3.0119*	0.29659	.000
	Commercial Area	5.9723*	0.28026	.000
	Industrial Area	3.4657*	0.28018	.000
	Road Intersection	5.5656*	0.36839	.000
	Village Area	1.4992*	0.30179	.000
Residential Area	Silent Area	6.8636*	0.29511	.000
	Mixed Areas	-3.0119*	0.29659	.000
	Commercial Area	2.9604*	0.29137	.000
	Industrial Area	0.4538	0.29128	0.119
	Road Intersection	2.5537*	0.3769	.000
	Village Area	-1.5127*	0.31213	.000
Commercial Area	Silent Area	3.9032*	0.2787	.000
	Mixed Areas	-5.9723*	0.28026	.000
	Residential Area	-2.9604*	0.29137	.000
	Industrial Area	-2.5065*	0.27464	.000
	Road Intersection	-0.4067	0.3642	0.264
	Village Area	-4.4731*	0.29666	.000
Industrial Area	Silent Area	6.4097*	0.27861	.000
	Mixed Areas	-3.4657*	0.28018	.000
	Residential Area	-0.4538	0.29128	0.119
	Commercial Area	2.5065*	0.27464	.000
	Road Intersection	2.0998*	0.36413	.000
	Village Area	-1.9666*	0.29658	.000
Road Intersection	Silent Area	4.3099*	0.3672	.000
	Mixed Areas	-5.5656*	0.36839	.000
	Residential Area	-2.5537*	0.3769	.000
	Commercial Area	0.4067	0.3642	0.264
	Industrial Area	-2.0998*	0.36413	.000
	Village Area	-4.0664*	0.38101	0
Village Area	Silent Area	8.3763*	0.30034	0
	Mixed Areas	-1.4992*	0.30179	0
	Residential Area	1.5127*	0.31213	0
	Commercial Area	4.4731*	0.29666	0
	Industrial Area	1.9666*	0.29658	0
	Road Intersection	4.0664*	0.38101	0

Table 2 displays significant differences between the 7 distributed land uses in Barisal City. It shows significant differences in the 7 distributed land uses in Barisal City. The mean differences are significantly lower (the mean difference is significant at the 0.05 level) at particular land uses.

Table 3. *Comply with Noise Standard [33].*

Land Use (N)	Location	Standard (day time)	Within Standard (%)
Silent Area (9)	Jahanara Israil School and College	50	80%
	BM College Barisal		0%
	Sher-E-Bangla Medical		0%
	General Hospital Barisal		0%
	Guthia Mosjid		20%
	Government Hatem Ali College		0%
	Barisal Zilla School		0%
	Barisal University		0%
	Barisal Cadet College		0%
Mean			11.11%
Mixed Areas (9)	Kownia Bilic Road	60	27.38%
	Puranpara Tower		0%
	Sotobotia Word 3		0%
	Nogor Bovon		0%
	Ruptoli		0%
	Rajbari Vasani Sarak		0%
	Ray Road		0%
	Port Road Bazar		19.05%
	Chawk Bazar Road		53.57%
Mean			11.11%
Residential Area (6)	Kownia	55	0%
	Kashipur		0%
	Ruptoli Housing State		47.56%
	Housing Sarak		0%
	Mokbul Engineer Len		52.44%
	Alekkanda Bangla Bazar		0%
Mean			17%
Commercial Area (10)	Barisal River Port BIWTA	70	1.44%
	Planet Park		0.5%
	Girjamohalla		10.63%
	Bibir Digir Par		15.01%
	Barisal Bus Tarminal		6.75%
	30 Godaun		0.43%

Land Use (N)	Location	Standard (day time)	Within Standard (%)
	Sadar Road		21.41%
	Kalibari Road		17.17%
	Sho-Road		18.68%
	Balur Ghat		7.97%
Mean			10%
	Chemist Laboratories		14.29%
	Bengal Food Industry		10.51%
	Fortune Shoes		8.25%
	Khansons Textile Ltd		2.31%
	Amrito Food Products		15.2%
Industrial Area (10)	A H Khan and Company Ltd	75	2.6%
	M E P Company		11.19%
	Meghna Petroliam Ltd.		12.3%
	Repcho Pharmaceuticals		14.35%
	Bahumukhi Sawmill		9.27%
Mean			10.03%
All Mean			11.85%

Table 3 demonstrates that 11.85% of areas in Barisal City belonged to the noise standard among 5 land uses. It has been observed that 11.11% of the areas in the silent zone met the noise standard across 9 locations, 17% of the areas in the residential zone met the noise standard across 6 locations, 11.11% of the areas in the mixed zone met the noise standard across 9 locations, 10% of the areas in the commercial zone met the noise standard across 10 locations, and 10.03% of the areas in the industrial zone met the noise standard across 10 locations.

Comply with the noise standard (2006); Table 3 shows that the highest 80% were within the noise standard in Jahanara Israil School and College, which stands in the Silent Area; on the other hand, a maximum of 53.57% within the noise standard was found on Chawk Bazar Road in the Mixed Area. Additionally, the highest 52.44% within the noise standard was observed at Mokbul Engineer Lane in the residential area. Furthermore, 21.41% high intensity within the noise standard was discovered at Sadar Road in the commercial area. Moreover, highest 15.2% within the noise standard was found at Amrito Food Products in the industrial area.

The present study was carried out on 7 land uses, but only 5 were included in the Sound Pollution (Control) Rules—2006. Therefore, while comparing all land uses with noise standards, village areas and road intersections were not taken into account.

4. Conclusions

Noise pollution has become one of the most critical environmental challenges, affecting almost 10 million residents in diverse towns, major cities, and swiftly developing semi-urban metropolitan regions throughout Bangladesh. The Leq of Barisal City was 95.18 dBA and the mean noise level was measured at 73.86 dBA. The Leq and mean noise levels in Silent, Mixed, Residential, Commercial, Industrial, Road Intersection, and Village Area were 76.57 dBA and 65.48 dBA; 82.17 dBA and 75.36 dBA; 88.10 dBA and 72.35 dBA; 97.28 dBA and 69.39 dBA; 84.13 dBA and 71.89 dBA; 82.08 dBA and 71.89 dBA; and 92.69 dBA and 69.79 dBA, respectively. The hierarchy of land uses according to mean noise levels was Mixed Area > Residential Area > Industrial Area and Road Intersection > Village Area > Commercial Area > Silent Area. The three areas with the highest noise pollution levels were Khansons Textile Ltd. (109.68 dBA), Barisal Bus Terminal (106.82 dBA), and Kaladema (101.24 dBA). Conversely, the three areas with the lowest noise pollution levels were Sadar Road (59.24 dBA), Guthia Mosjid (67.35 dBA), and Jahanara Israil School and College (69.62 dBA), as measured by Leq. The maximum and minimum noise levels were found in commercial areas, which were 129.0 dBA and 39.60 dBA. In our study, we found that in all the locations, the noise level exceeded the national standard. The research has indicated the

necessity for enhanced surveillance of noise quality. It is imperative for NGOs, the media, and the Bangladeshi government to collaborate to mitigate the issue and enhance the quality of life in the nation. Given that several sources of noise pollution are superfluous and can be mitigated with relative ease and minimal expense, there is no justification for postponing action any longer. In light of the severity of the situation and the resultant human suffering, we can no longer disregard the issue of noise pollution. This issue must be addressed with gravity for the health, mental stability, and welfare of the populace, as well as for the future of our children, through the enforcement of legislation and the adoption of environmentally sustainable solutions.

Abbreviations

AC	Alternating Current
BIWTA	Bangladesh Inland Water Transport Authority
CA	Commercial Area
CAPS	Center for Atmospheric Pollution Studies
CNG	Compressed Natural Gas
dBA	A-weighted Decibel
DoE	Department of Environment
GB	Gigabyte
GIS	Geographic Information System
Govt.	Government
IA	Industrial Area
Leq	Equivalent Continuous Sound Pressure Level
Ltd	Limited
MA	Mixed Areas
MAX	Maximum
MBM	Madina Bricks Manufacturing
MIN	Minimum
N	Number (in Terms of Quantity)
NIHL	Noise-Induced Hearing Loss
PC	Personal Computer
RA	Residential Area
REC	Record
RIS	Road Intersections
SA	Silent Area
SD	Secure Digital
Sig	Significant
SPSS	Statistical Package for the Social Sciences
VA	Village Area
WHO	World Health Organization

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Author Contributions

Ahmad Kamruzzaman Majumder: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing

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Informed Consent

Informed consent was obtained from each individual participant involved in this study.

Statement of Human Rights

This study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments.

Statement of Animal Welfare

All animals involved in this study were treated in accordance with the ethical standards set forth by the institution at which the study was conducted.

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Conflicts of Interest

The authors declare no conflicts of interest.

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