



Assessing the level of noise pollution in the town of Pabna, Bangladesh

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Abstract

The purpose of this research was to assess the extent of noise pollution in different areas of Pabna District Town. The land usage of Pabna District Town dictated the selection of 6 zones and 32 sites. Beginning on January 1, 2021, and ending on April 30, 2021, the town of Pabna had its noise levels measured using a REED SD-4023 sound level meter. Multiple samples were taken from each sampling site. The noise level was checked three times daily in all locations. According to the study, Pabna District Town had a mean noise level of 75.14 dBA and a Leq of 97.83 dBA. The highest mean noise level was found in Bus Stand Goli (86.18 dBA), whereas the lowest mean noise level was found in Square Pharmaceuticals (57.01 dBA). In addition, the hierarchy in various land uses based on mean noise level was Residential Area (84.11 dBA) > Mixed Areas (77.83 dBA) > Commercial Area (75.16 dBA) > Silent Area (73.90 dBA) > Road Intersection (72.88 dBA) > Industrial Area (66.95 dBA). Nevertheless, the study discovered that the noise level at every sample location was higher than the national standard.

Keywords: Noise pollution, land use, pabna district town, dispersion, cluster, Bangladesh

Introduction

Noise pollution refers to the increase of undesired or harmful noises in the environment. These sounds can disrupt everyday activities, cause psychological stress, and lead to chronic health problems for both people and animals. Noise pollution in Pabna City is escalating, attributable to the city's elevated population density and rapid urbanization. Key causes encompass loudspeakers utilized at public events, construction noise, industrial noise, and severe traffic congestion. The incessant honking of vehicles, construction operations, and noise from markets and industries all add to a more disturbing environment. Persistent noise adversely affects individuals' quality of life and contributes to health issues like headaches, weariness, stress, hearing impairment, reduced work capacity, and sleep disturbances [1, 2, 3]. Furthermore, the neurological and auditory systems of urban dwellers, particularly youngsters, may be significantly compromised by extended exposure to elevated noise levels. Stressed-out students appear to be more likely to engage in unhealthy habits, including procrastination, drug addiction, alcoholism, and smoking [4]. Motor vehicles constitute the principal source of noise pollution in metropolitan environments [5].

The risk of illness due to noise and air pollution is significantly elevated for traffic police officers, particularly at crossroads with heavy vehicular traffic [6, 7, 8, 9, 10, 11, 12]. They frequently have auditory impairment and psychological issues [13, 14, 15, 16]. Noise pollution is a significant problem in the bustling metropolis, despite several governmental efforts to mitigate it. Coughing constitutes a significant disturbance of the upper respiratory tract; hence, most traffic police officers use masks to shield themselves from the detrimental effects of air pollution. The majority of individuals remain oblivious to the effects of noise on their hearing, making this a slow process that

requires time to manifest. The World Health Organization (WHO) systematically identified 25 risk factors contributing to the worldwide health burden associated with workplace noise [17].

Occupational hearing loss, either total or partial, may affect one or both ears due to employment-related factors [18]. It pertains to both traumatic auditory injury and noise-induced hearing loss (NIHL). Excessive workplace noise is a global issue. For instance, almost 30 million workers in the United States are exposed to dangerous noise levels [19]. Approximately 12–15% of the German workforce, or to 4-5 million persons, were subjected to noise levels deemed detrimental by the WHO [20]. Although nearly all professional activities entail noise, certain tasks—most notably piloting commercial airplanes, managing specialized materials, and conducting impact operations—are linked to extraordinarily high noise levels. The occupations most susceptible to noise-induced hearing loss (NIHL) include manufacturing, transportation, mining, construction, agriculture, and the military. The situation is improving in industrialized nations due to the implementation of preventative measures stemming from heightened public awareness of the risks. Research indicates that mean noise levels considerably exceed the occupational threshold advised in several industrialized nations, notwithstanding the limited data available for developing countries [21, 22, 23, 24].

Noise has both auditory and non-auditory health consequences. Various species inhabiting areas characterized by loud, high-frequency noise have been extensively studied on these impacts [25, 26, 27, 28, 29]. The auditory impact of vehicular noise on traffic police personnel has not been investigated in India [12]. The traffic police in Pabna District Town are fundamentally in a same predicament. Withholding hearing protection devices from

this set of workers may be one possible cause. Traffic officers should only then be concerned with understanding the health dangers. There has been minimal worry over the influence of noise and its potential harm, as most individuals do not perceive it as a significant environmental problem. Medical authorities assert that exposure to a noise level of 80 dBA for over 15 minutes may result in temporary or permanent hearing damage.

Noise pollution in our nation may currently appear to be a minor issue. Nevertheless, it is wise to consider the possibilities. If the government neglects the public interest, noise issues may quickly escalate ^[30]. This study assessed noise pollution levels throughout several locations in Pabna District Town to evaluate the overall severity of the issue, the correlation between noise levels and diverse land uses, and the geographical distribution of noise levels throughout the city.

Methodology

1. Study Area

The inquiry was carried out at Pabna District Town (Figure 1). Criteria for choosing Pabna District Town include its considerable tourist influx, rapid urbanization, and notable increase in industrial activity and automobile ownership. Recently, the ambient noise level in Pabna District Town generally exceeds international standards by two to three times. Such noise negatively impacts the environment and public health. This study concentrated on regions with exceptionally high traffic in the Pabna District Town. A REED SD-4023, a device for measuring ambient sound pressure levels, was utilized to evaluate the noise levels in the designated area. The survey was done during the week. The city's most significant intersections served as the sites for the measurements. The highway's noise level was evaluated with A-weighting. 6 separate zones and 32 sites were identified in Pabna District Town according to land usage.

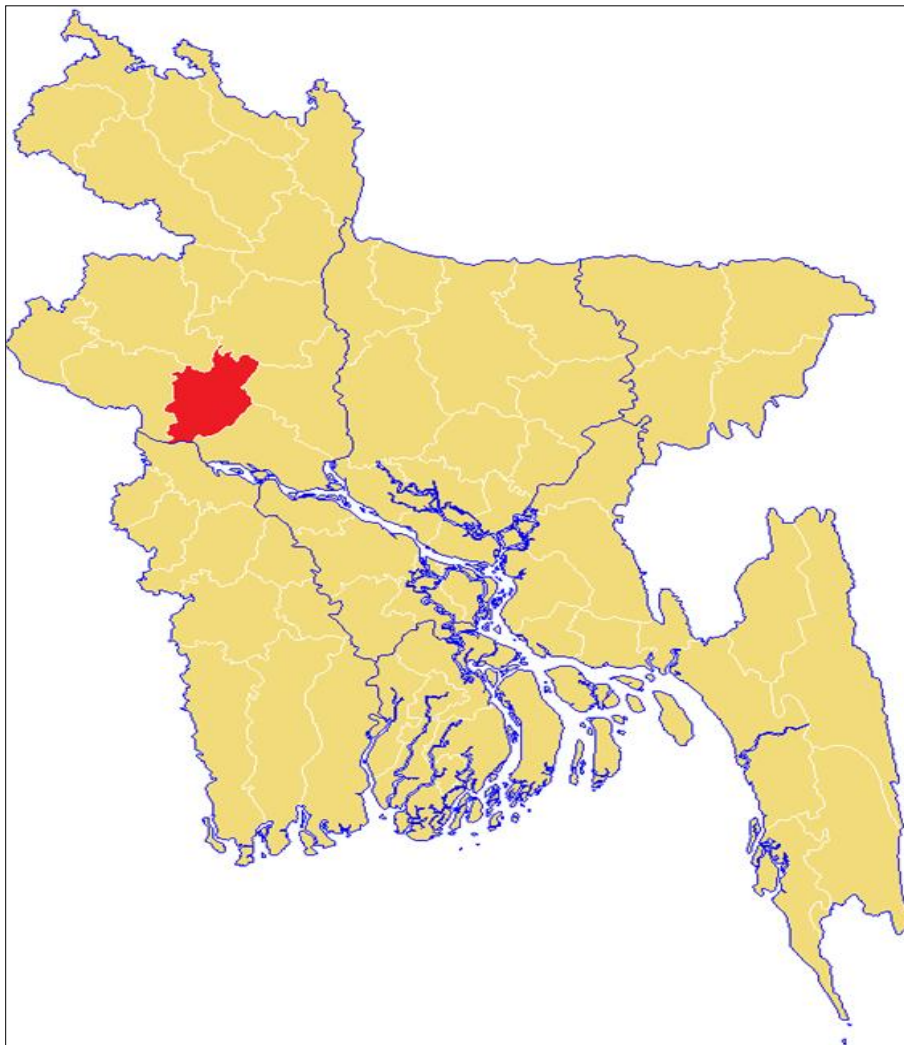


Fig 1: Study Area Map of Pabna District Town, Bangladesh

2. Data Collection

Noise levels in Pabna District Town were recorded using a sound level meter (REED SD-4023) from January 1, 2021, to April 30, 2021. Users can choose a sample rate ranging from 1 to 3,600 seconds to get triple range data using the SD series of sound level meters. Moreover, users may quickly and easily create an Excel file with raw data from an SD card (up to 16 GB) by choosing a desired sampling rate,

without requiring software installation. An optional AC converter and tripod provide continuous long-term monitoring, while users may obtain live measurement data using PC software.

3. Measuring Procedure and Analysis

The function for data recording catches the most extreme values. Click once on the REC button to start the Data

Record feature; a "REC" indication will show on the screen. The "REC" sign will be displayed on the screen. One single press of the REC button will display a "REC. MAX." indicator together with the maximum value. Once a user wants to reset the maximum value, hold the Hold button once. The memory operation will continue unabatedly and the display will show a "REC." indicator. Once more, pressing the REC button will show the minimal number together with the "REC. MIN." signal. Press once to remove the minimum value and hold the Hold Button. The display will show a "REC." indicator and the memory will run continuously. Two seconds of pressing and holding the REC button will stop the feature of memory recording. The display will then return to showing the current reading. The

data came from a roadside point elevated over 1.5 meters above ground level. We made sure all noise filters were eliminated throughout the real sound level measurement. For each site, data was gathered every second for a total of five minutes. A micro SD card housed the data. Both Microsoft Excel version 2010 and IBM SPSS version 20 were used for analysis of the obtained data. The information is shown in numerous tables and graphs compatible with many ArcGIS 2.0 versions. With version 2.1, we created a map showing the region of the study area.

Results and Discussion

The mean noise level and Leq in Pabna District Town were 75.14 dBA and 97.83 dBA, respectively.

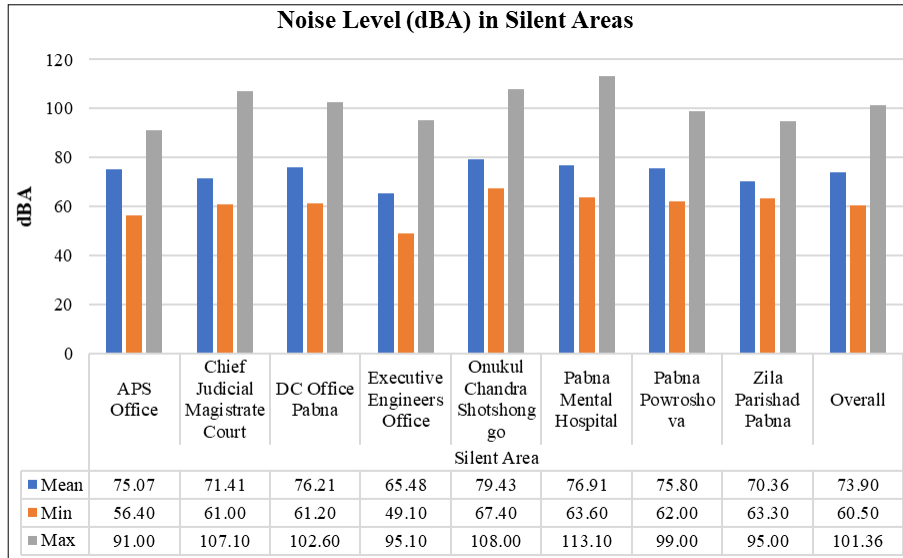


Fig 2: Noise Level (dBA) in Silent Areas

Analysis of data from 8 points in the silent area of Pabna District Town shows that, as illustrated in Figure 2, the maximum noise recorded was 113.10 dBA at Pabna Mental Hospital, whereas the minimum noise level was recorded in the Executive Engineers Office, which was 49.10 dBA.

Additionally, the mean noise level in the silent zone was found to be 73.90 dBA. The analysis also found that the highest mean noise level was 79.43 dBA in the Onukul Chandra Shotshonggo, whereas the lowest mean noise level was 65.48 dBA in the Executive Engineers Office.

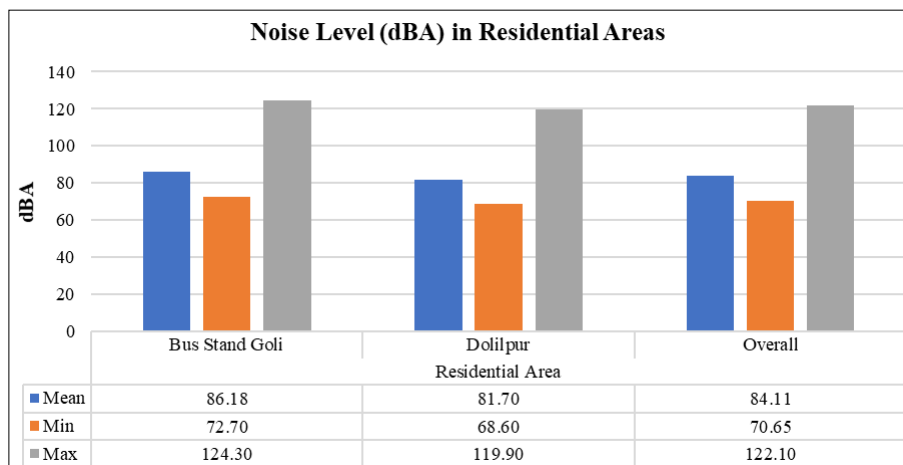


Fig 3: Noise Level (dBA) in Residential Areas

Figure 3 displays the noise levels at 2 locations in the residential area of Pabna District Town. The mean noise level in the residential area was found to be 84.11 dBA. Furthermore, the maximum noise level was recorded at Bus Stand Goli, which was 124.30 dBA, and the minimum noise

level was recorded at Dolilpur, which was 68.60 dBA. Moreover, the highest mean noise level was found to be 86.18 dBA in the Bus Stand Goli and the lowest mean noise level was 81.70 dBA in Dolilpur.

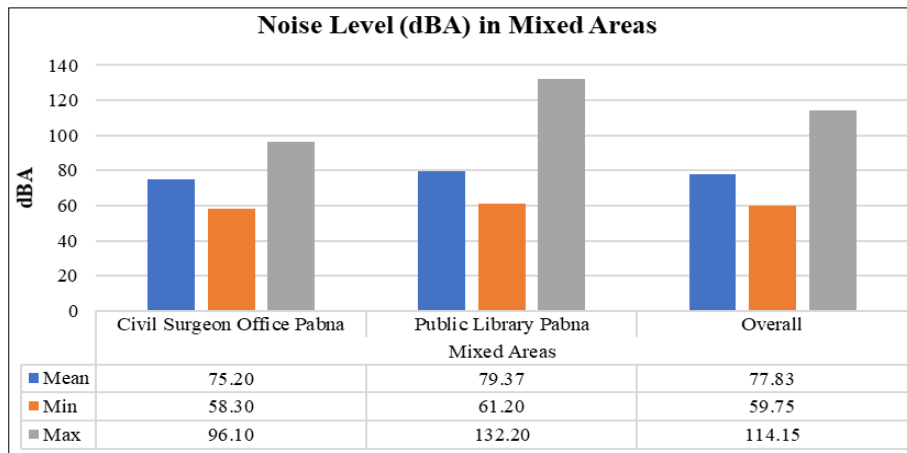


Fig 4: Noise Level (dBA) in Mixed Areas

Figure 4 illustrates the noise levels at 2 locations in the mixed areas of Pabna District Town. The mean noise level in the mixed areas was recorded at 77.83 dBA. Furthermore, the maximum noise level was discovered to be 132.20 dBA at the Public Library Pabna, and the minimum noise level

was 58.30 dBA at the Civil Surgeon Office Pabna. Moreover, the highest mean noise level was reported at 79.37 dBA at Public Library Pabna, whereas the lowest mean noise level was found to be 75.20 dBA at the Civil Surgeon Office Pabna.

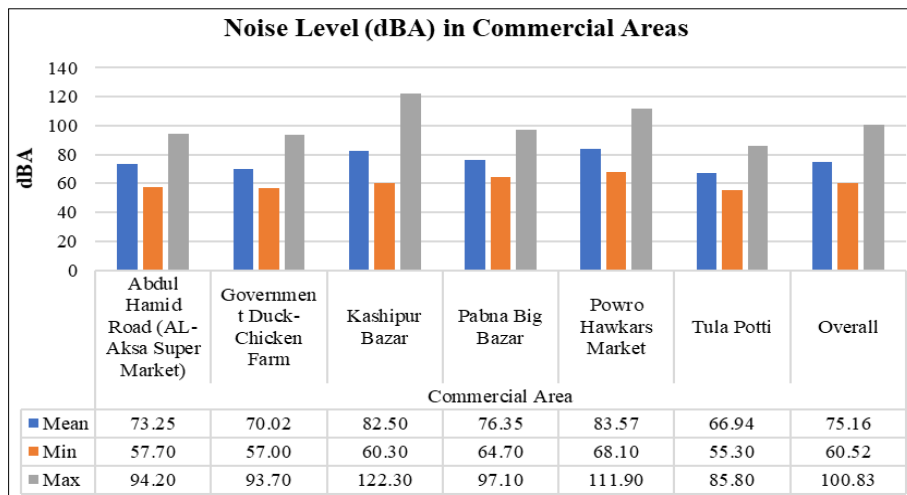


Fig 5: Noise Level (dBA) in Commercial Areas

Figure 5 explores the noise levels of 6 locations in the commercial area of Pabna District Town. The mean noise level in the commercial area was found to be 75.16 dBA. The maximum noise level was found in Kashipur Bazar (122.30 dBA), while the minimum noise level was found in

Tula Potti (55.30 dBA). Moreover, the highest mean noise level was recorded in Powro Hawkars Market (83.57 dBA), whereas the lowest mean noise level was discovered in Tula Potti (66.94 dBA).

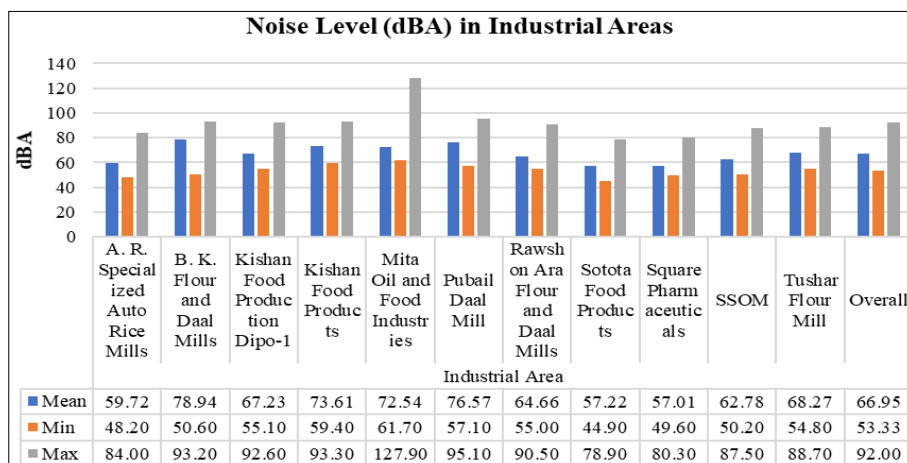


Fig 6: Noise Level (dBA) in Industrial Areas

Figure 6 depicts noise levels at 11 locations in the industrial area of Pabna District Town. The mean noise level in the industrial area was found to be 66.95 dBA. Furthermore, the maximum noise level was found in Mita Oil and Food Industries (127.90 dBA) and the minimum noise level was

identified in Sotota Food Products (44.90 dBA). Moreover, the highest mean noise level was observed in B. K. Flour and Daal Mills (78.94 dBA) and the lowest mean noise level was observed in Square Pharmaceuticals (57.01 dBA).

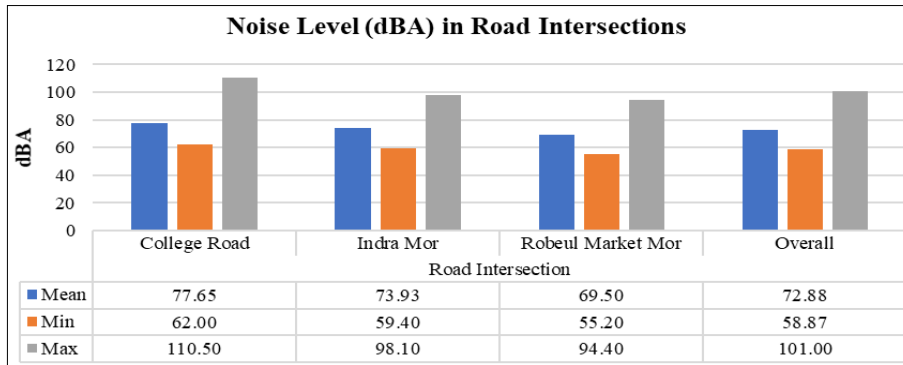


Fig 7: Noise Level (dBA) in Road Intersections

Figure 7 portrays the noise levels at 3 locations in the road intersection of Pabna District Town. The mean noise level in the road intersection was found to be 72.88 dBA. Additionally, the maximum noise level was found in College Road (110.50 dBA) and the minimum noise level

was identified in Robeul Market Mor (55.20 dBA). Moreover, the highest mean noise level was found in College Road (77.65 dBA), whereas the lowest mean noise level was found in Robeul Market Mor (69.50 dBA).

Table 1: Dispersion of Noise Quality in Different Land Use in Pabna District Town

Land Use (N)	Mean	Minimum	Maximum	Standard Deviation	Range	Median	Rank
Silent Area (8)	73.90	49.10	113.10	8.30	64.00	72.80	4
Residential Area (2)	84.11	68.60	124.30	7.40	55.70	83.80	1
Mixed Areas (2)	77.83	58.30	132.20	8.40	73.90	76.90	2
Commercial Area (6)	75.16	55.30	122.30	10.11	67.00	74.30	3
Industrial Area (11)	66.95	44.90	127.90	10.54	83.00	65.90	6
Road Intersection (3)	72.88	55.20	110.50	9.44	55.30	71.20	5
Overall (32)	75.14	44.90	132.20	10.46	87.30	72.00	-

The subsequent Table 1 represents the descriptive statistics for the noise quality of the study area, which consisted of 6 different land uses. The highest mean noise level was found in the residential area (84.11 dBA) and the lowest mean noise level was identified in the industrial area (66.95 dBA). The higher ranges of noise were found in the industrial area (83 dBA), which is almost close to the mixed area (73.50

dBA), and the lower ranges of noise were found in the road intersection (55.30 dBA). From the comparison of mean, standard deviation, and coefficient of variation, it is observed that the highest variation is in the industrial zone, which means that due to the various activities in this zone, the noise level varies a lot.

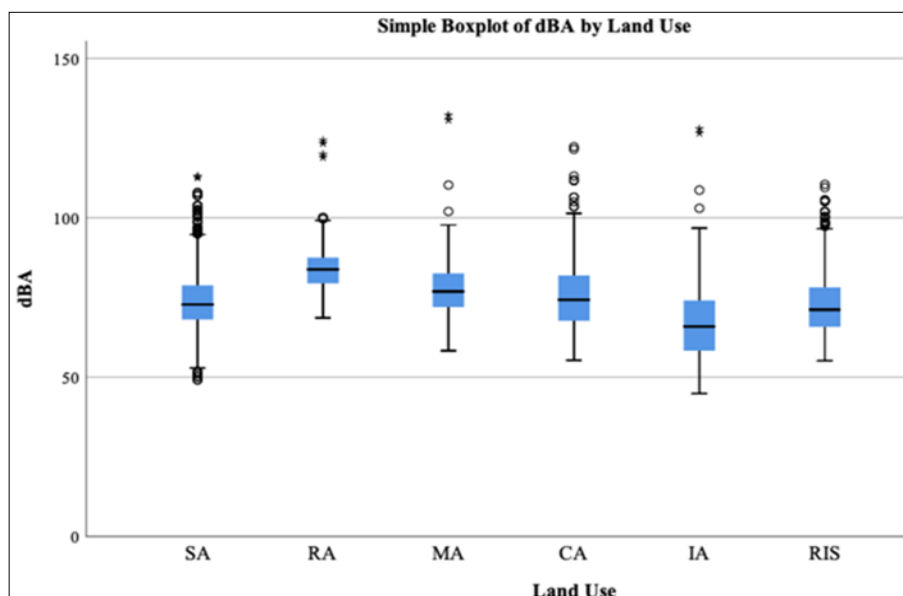


Fig 8: Mean Noise Pollution in Pabna District Town.

The whisker box plot (Figure 8) reveals mean noise pollution in Pabna District Town. 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.

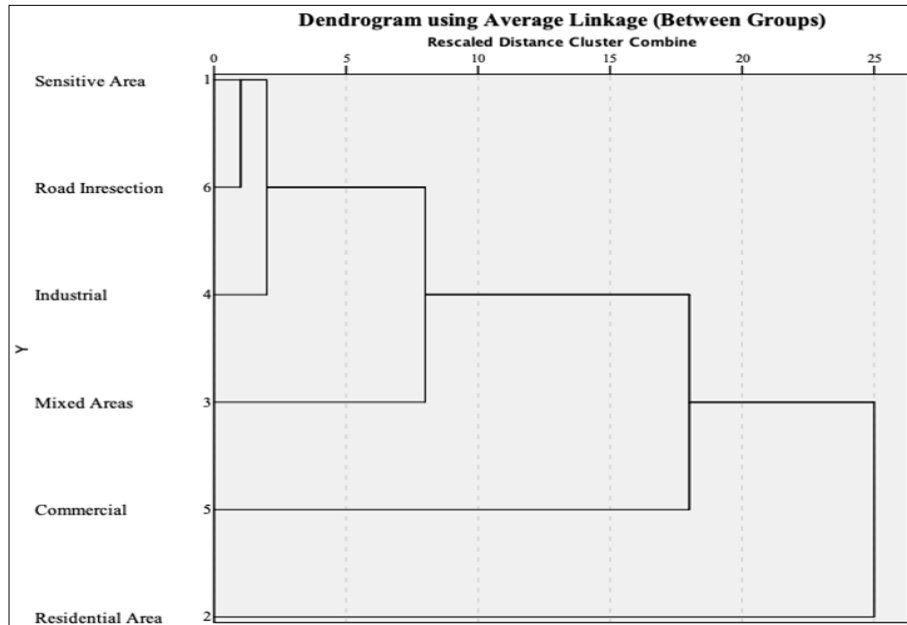


Fig 9: Land Use Based Cluster, in Terms of dBA.

Figure 9 portrays the land-use-based cluster in terms of dBA; there are two clusters. The first cluster includes the silent area, residential area, mixed areas, commercial area,

and road intersection. Conversely, the final cluster is represented by the industrial area.

Table 2: Post-hoc Analysis

(I) Land Use	(J) Land Use	Mean Difference (I-J)	Standard Error	Sig.
Silent Area	Residential Area	-10.2043*	0.55644	0
	Mixed Areas	-3.9289*	0.47702	0
	Commercial Area	-1.2589*	0.32944	0
	Industrial Area	6.9540*	0.26633	0
	Road Intersection	1.0213*	0.39464	0.01
Residential Area	Silent Area	10.2043*	0.55644	0
	Mixed Areas	6.2754*	0.67973	0
	Commercial Area	8.9454*	0.58567	0
	Industrial Area	17.1583*	0.55264	0
	Road Intersection	11.2256*	0.62468	0
Mixed Areas	Silent Area	3.9289*	0.47702	0
	Residential Area	-6.2754*	0.67973	0
	Commercial Area	2.6700*	0.51082	0
	Industrial Area	10.8829*	0.47259	0
	Road Intersection	4.9502*	0.55511	0
Commercial Area	Silent Area	1.2589*	0.32944	0
	Residential Area	-8.9454*	0.58567	0
	Mixed Areas	-2.6700*	0.51082	0
	Industrial Area	8.2129*	0.32299	0
	Road Intersection	2.2802*	0.4349	0
Industrial Area	Silent Area	-6.9540*	0.26633	0
	Residential Area	-17.1583*	0.55264	0
	Mixed Areas	-10.8829*	0.47259	0
	Commercial Area	-8.2129*	0.32299	0
	Road Intersection	-5.9327*	0.38928	0
Road Intersection	Silent Area	-1.0213*	0.39464	0.01
	Residential Area	-11.2256*	0.62468	0
	Mixed Areas	-4.9502*	0.55511	0
	Commercial Area	-2.2802*	0.4349	0
	Industrial Area	5.9327*	0.38928	0

The error term is Mean Square (Error) = 90.049

* The mean difference is significant at the 0

Table 2 depicts the significant differences among 6 distributed land uses. The mean differences at specific land

uses are significantly lower, with significance determined at the 0.05 level.

Table 3: Comply with Noise Standard ^[31]

Land Use (N)	Location	Standard Value	Within Standard (%)
Silent Area (8)	APS Office	50	0.00%
	Chief Judicial Magistrate Court		0.00%
	DC Office Pabna		0.00%
	Executive Engineers Office		1.06%
	Onukul Chandra Shotshonggo		0.00%
	Pabna Mental Hospital		0.00%
	Pabna Powroshova		0.00%
	Zila Parishad Pabna		0.00%
Mean			0.13%
Residential Area (2)	Bus Stand Goli	55	0.00%
	Dolilpur		0.00%
Mean			0%
Mixed Areas (2)	Civil Surgeon Office Pabna	60	0.57%
	Public Library Pabna		0.00%
Mean			0.29%
Commercial Area (6)	Abdul Hamid Road (AL-Aksa Super Market)	70	35.71%
	Government Duck-Chicken Farm		46.53%
	Kashipur Bazar		11.06%
	Pabna Big Bazar		12.87%
	Powro Hawkars Market		1.70%
	Tula Potti		70.59%
Mean			29.74%
Industrial Area (11)	A. R. Specialized Auto Rice Mills	75	99.01%
	B. K. Flour and Daal Mills		24.47%
	Kishan Food Production Dipo-1		80.83%
	Kishan Food Products		56.80%
	Mita Oil and Food Industries		66.86%
	Pubail Daal Mill		44.25%
	Rawshon Ara Flour and Daal Mills		94.70%
	Sotota Food Products		97.13%
	Square Pharmaceuticals		97.54%
	SSOM		90.78%
	Tushar Flour Mill		94.19%
Mean			76.96%
All Mean			21.42%

Table 3 demonstrates that 21.42% of areas in Pabna District Town belonged to the noise standard among 5 land uses. 0.13% of the areas in the silent zone met the noise standard across 8 locations, none of the areas in the residential zone met the noise standard in 2 locations, 0.29% of the areas in the mixed zone met the noise standard between 2 locations, 29.74% of the areas in the commercial zone met the noise standard across 6 locations, and 76.96% of the areas in the industrial zone met the noise standard across 11 locations. The Executive Engineers Office in the silent area had the highest at 1.06% within the standard; however, no within-standard levels were found in the residential area. The mixed area’s data represents the highest (0.57%) at Civil Surgeon Office Pabna, and in the commercial area, a 70.59% high intensity was found at Tula Potti. Moreover, in the industrial area, A. R. Specialized Auto Rice Mills had the highest, at 99.01% within the standard. The present study examined 6 land uses, while only 5 were incorporated in the Sound Pollution (Control) Rules—2006. Hence, in the comparison of all land uses with noise standards, the road intersection was omitted.

Conclusions

It has been discovered that the noise level was higher than the national standard in every single place where our

research was conducted. Pabna District Town, other large towns, and the quickly expanding semi-urban regions of Bangladesh are among the ten million people who are negatively impacted by noise pollution, which has emerged as one of the most pressing environmental issues in the country. The study found that the mean noise level in Pabna District Town was 75.14 dBA, with a Leq of 97.83 dBA. Bus Stand Goli had the highest mean noise level at 86.18 dBA, while Square Pharmaceuticals had the lowest mean noise level at 57.01 dBA. The ranking of land uses according to mean noise level was as follows: residential area (84.11 dBA), mixed area (77.83 dBA), commercial area (75.16 dBA), silent area (73.90 dBA), road intersection (72.88 dBA), and industrial area (66.95 dBA). Research conducted by the World Bank indicated that the monetary cost of the illnesses and early deaths caused by noise pollution amounts to several hundred million dollars annually. Beyond the general implications for future studies, this paper contains several details that are directly related to the concerns raised above. Additional monitoring of noise quality is necessary, as our work has shown. Over the past several years, the noise level in Pabna District Town has been steadily climbing due to the increasing number of cars and visitors. Unfortunately, the harmful impacts of noise pollution on human health are often overlooked; hence, it is

not considered a significant kind of pollution. Pabna, like the rest of Bangladesh, suffers from a major and often-overlooked problem of noise pollution. The government, media outlets, and non-governmental organizations (NGOs) of Bangladesh must now collaborate to alleviate the situation and improve living conditions across the nation. There is no longer any justification for further postponing action, as several noise pollution sources are superfluous and might be diminished quickly and cheaply. We cannot continue to ignore the problem of noise pollution any longer, considering its size and the human misery it causes. To protect everyone's well-being and ensure a better future for the next generations, it is important that we address this issue promptly. Everyone has the power to make a difference in the fight against noise pollution, whether they are a person, an employee of an NGO, or a member of the media.

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

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