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(RESEARCH ARTICLE)

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Evaluation of noise pollution of industrial cities in Ghaziabad by noise map using ARC GIS

Ayushi Jain *, AK Shukla and Asit Singh

Department of Civil Engineering, Institute of Engineering and Technology Lucknow, India.

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Abstract

Industrial Noise pollution means noise pollution that is clashing and intolerable that occurs in most of the factories. Sound occurs in intolerable form only when it becomes offensive and when it becomes more than a limit that it is known as “noise pollution”. A Geographic Information System (GIS) is a system that generate, be head of, investigate, and maps all forms of information given. GIS joins information to a map, combine location information (where data are to be) with all forms of illustrative information (what data is like present there). This leads to starting point for mapping and investigation that is used in technology and almost every in every industrial factories. Noise maps are implementes to evaluate the effects of noise pollution. In this paper, evaluation of noise pollution of two industries are done which are located in different areas of ghaziabad city. Both industries are machine manufacturing industries. With the aid of a sound level meter (SL-4010), the noise data is gathered. In April, May, and June 2023, measurements are made for both industries in three time periods: 8 a. m. to 10 a. m., 12 p. m. to 2 p. m., and 4 p. m. to 6 p. m. Sound meters were used to measure the noise levels in terms of L10, L50, L90, LAeq, and LNP. As the data observed of both industries from april to june the value of LEQ in morning time (8am-10am) is 73. 96 dB to 79. 26 dB, in afternoon time (12pm-2pm) is 70. 15 dB to 78. 20 and in evening time (4pm-6pm) is 75. 87 dB to 80. 89 dB. As it is observed that industries are producing higher noise pollution beyound a limit set by CPCB.

Keywords: Noise pollution; Noise maps; GIS; Equivalent noise level; Noise levels

1. Introduction

Industrial noise pollution occur’s by mills and production plants – it can have an influence on the workers working there within as well as thosewho are present around these industrial sities areas. Determined by the amplitude, frequency, and scope of the industrial noise, it may merely irritating those within hearing problem, and it may also interfere with speech and hearing, causing irreversible listening problem in many form of cases. People working in the shipping and steelwork industries are revealed to the highest levels of proffesional noise pollution because they work close to large industrial blowers that emits sounds of up to 112 dB or of much higher level. There are many most harming varients noise pollution in an industrial surroundings that equipments, and automobiles. Wearing protective gear is a must for everybody who uses various types of equipment in order to reduce the impacts of noise pollution. Additionally, the noise produced by saws, spinning belts, mechanical fluttering drills, etc., can be intolerably loud and offend the general public as well as negatively impact workers in steelworking, textile, and other sectors. The likelihood of noise pollution from construction workers, bulldozing, and other related activities is considerable. Workers included in these industrial activities should wear earplugs for safety as to help them avoiding damage exposure to these causes of noise pollution. Accordingly, this data of information to develop a noise map and graph of industries situated in ghaziabad city on the parameters of noise as LAeq, L 10, L 50, L 90 and LNP. [1] As due to the fast city development and enormous population exp losion, today many cities are facing the problem of noise pollution. A noise map is a depiction of the level of sound,where diffusion occuring in a given region, for a limited period which is saw on map of that area which may be

* Corresponding author: Ayushi Jain

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coloured, claiming to the levels of in the area. [2] Noise moves in each and every direction, is important to advance noise maps that can reveal the influence of noise in each and every directions. noise map is ssen to investigate noise levels in cities that can be used in traffic control, urban planning & management. The spatial dissemination of the sound levels during each time interval were analysed and envisaged by GIS. [3] Grasping the nuances of noise level mapping is pivotal, particularly for India expansive urban hubs. This study examines the merits, requisite input factors, techniques of interpolation, sampling approache, proactive measures for noise moderatio and the forthcoming hurdles in formulating key noise maps. Additionally, it sheds light on the intricacies associated with noise mapping and the credibility of major traffic noise models adapted for the Indian scenario. Furthermore, the paper elucidates varied technical approaches to noise mapping within the Indian milieu drawing insights from conventional practices adopted worldwide.**[4]** To create different noise maps, utilize the Krigging approach. Many sound broadcasting models, such as ISO 9613:1996, are used to compute noise emission levels. [5] As we know the creation which is developed is the only one available for noise calculation executed as an Arc noiseMap in non-commercial regions. Several things were executed to investigate noise levels, ranging from entire different regions like to several streets in detail. Tools may be used to anticipate noise and calculate noise levels before and after the installation of noise barriers. The noise barrier technology is also used for noise prediction.

2. Material and methods

2.1. Study area

This study is based on the results of measurements and analyses of noise levels made between April and June 2023 at two separate industrial sites: RAJENDRA GEARS INDUSTRY in Yadav Nagar, Ghaziabad, and NAVBHARAT ENGG WORKS LIMITED in Udyog Kunj, Ghaziabad. This investigation took place in the city of Ghaziabad which is positioned at a longitude of 77° 26' 59. 2476'' E and a latitude of 28° 40' 4. 2816'' N . FIGURE 1 provides an overview of Ghaziabad city, highlighting the industrial areas under examination.

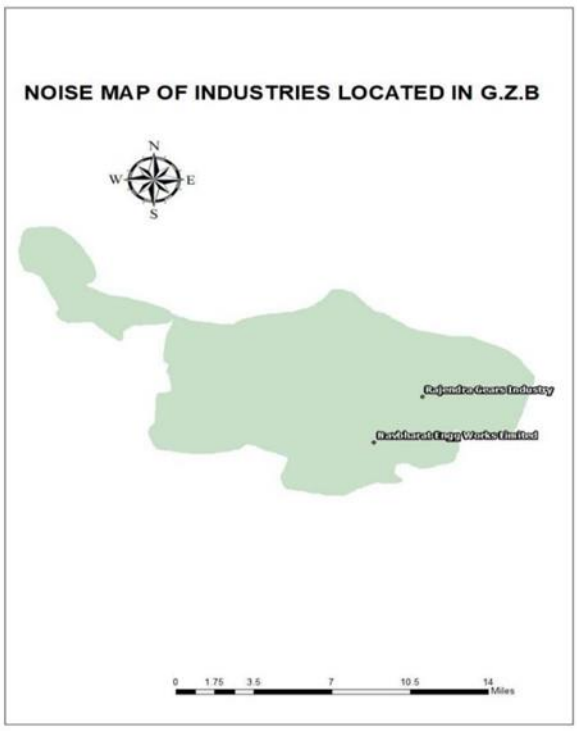

Figure 1 shows a general perspective of the city of Ghaziabad and the locations of its industrial cities

2.2. Experimental procedure

A very accurate sound level meter, more precisely the SL 4010 type, was the apparatus utilized to conduct field measurements. The individual's chest was one meter away from the monitor, which was mounted at a height of 1. 5 meters. In the morning (from 8:00 AM to 10:00 AM), the afternoon (from 12:00 PM to 2:00 PM), and the evening (from 4:00 PM to 6:00 PM), measurements were obtained for an hour at various times throughout the day. These observations

were performed over the course of 5 days per month from April to June 2023. For our field measurements, the very accurate SL 4010 sound level meter was employed. The accuracy of our data gathering is ensured by the apparatus's ability to give accurate and trustworthy readings of sound levels. One meter away from the observer's chest and 1. 5 meters above the ground, the sound level meter was positioned as part of our monitoring setup. We took considerable effort in selecting this location to guarantee accuracy and consistency in our measurements. We took measurements at specified times of day to provide a precise picture of the noise levels throughout the day. These times ranged from 8:00 AM to 10:00 AM in the morning, from 12:00 PM to 2:00 PM in the afternoon, and from 4:00 PM to 6:00 PM at night. Through the use of this adaptable calendar, we were able to evaluate noise levels throughout varied everyday activities and traffic patterns. From April through June 2023, a total of 5 days were allotted for the collecting of our data. We were able to record changes in noise levels over time as a result of elements including weather, industrial activity, and traffic patterns because to this prolonged period of monitoring. With the use of this equipment and technique, we sought to compile an extensive dataset of the noise levels throughout the city of Ghaziabad. Understanding the types and origins of noise pollution is essential for developing solutions for both noise management and urban planning. In conclusion, to guarantee the quality and dependability of our noise level data, our field measurements were methodically carried out using accurate tools and a well-planned timetable. This information will be crucial in tackling the issue of noise pollution and trying to create a more peaceful and healthy urban environment in Ghaziabad.

2.3. Measurement characteristics

Sound level indicators like L10, L50, L90, LNP, and LAeq were established based on measurements made in a given location. L10 stands for the peak noise level, often known as the sound level that is surpassed 10% of the time that is monitored. The average sound level, or L50, is the level that is higher than 50% of the observation period. L90, or ambient or residual noise level, is the level that is consistently surpassed 90% of the time. Excel from the Microsoft Office suite was used to calculate L10 and L90. These numbers were then used to compute the Noise Pollution Level (LNP) and the Equivalent Continuous Noise Level (Leq). For locating and assessing the highest and possibly disruptive noise episodes, L10, also known as the Peak Noise Level, is essential. It aids in identifying irregular noise spikes that could be upsetting or even detrimental to people's health. For identifying certain noise pollution sources that contribute to these peak levels, understanding L10 is important. The Average Sound Level, or L50, provides a measurement of the usual noise exposure throughout the course of the monitoring period. By taking into account both calm and loud times, this indicator offers insight into the everyday acoustic environment. It frequently serves as a benchmark for evaluating noise pollution and contrasting noise levels at various times and locations. The background noise that never goes away is referred to as the ambient or residual noise level, or L90. The noise floor, which pervades the majority of the observation, may then be found with its help. L90 is necessary for distinguishing between periodic noise disturbances and constant background noise. Leq, calculated as $Leq = L50 + [(L10 - L90)^2 / 60]$, provides a single value that summarizes the overall noise exposure. It quantifies the continuous equivalent noise level experienced over the monitoring period, offering a more complete picture of noise conditions. Leq is particularly useful for comparing noise levels across different time frames or locations and for assessing compliance with noise regulation. LNP, derived from $LNP = Leq + (L10 - L90)$, quantifies the extent of noise pollution in the area. It directly reflects the additional noise impact beyond the ambient or background noise. LNP is a vital metric for evaluating the overall noise pollution situation, especially in urban areas with diverse sources of noise. In practical terms, these sound level indicators and calculations enable policymakers, urban planners, and environmental scientists to:Identify noisy hotspots within a city or region. Assess the effectiveness of noise control measures and policies. Make informed decisions regarding urban planning and zoning regulations. Understand the impact of noise pollution on public health and well-being. Overall, these indicators provide essential data for managing and mitigating the adverse effects of noise pollution, contributing to quieter and more livable environments for communities. The respective formulas to determine these indices are:$Leq = L50 + [(L10-L90)^2/60]$…. . . (1) $LNP = LEQ + (L10 - L90)$…. . . (2)

In which: Leq stands for the Continuous equivalent noise level, LNP represents the Level of noise pollution.

3. Results and discussion

3.1. Assessment of noise parameters

Various average noise characteristics were measured as part of the investigation at various sites. The research area's average values for various noise parameters are shown in Table 1. It's important to note that at two specific locations in the month of April 2023, the values of LEQ and LNP surpassed the specified limitations from 8 AM to 10 AM, 12 PM to 2 PM, and 4 PM to 6 PM. Figures 2 and 5 depict the same noise level parameter for distinct sites from 8 to 10 a. m., including L10, L50, L90, LNP, and LEQ. The L10 values of noise level changes from 78. 10 to 82. 93 dB, L 50 changes from 70. 78 to 73. 56,L90 values varied between 64. 19 to 60. 13 dB, LAeq values varied between 76. 41 to 79. 26dB and

LNPwas in the range of 90. 45 to 101. 99 dB . Then, between 12 and 2 in the afternoon, various noise parameter levels were displayed at various places. LNP values range from 84. 99 to 85. 32 dB, L10 values range from 77. 27 to 78. 90 dB, L50 values range from 68. 32 to 69. 45 dB, L90 values range from 62. 00 to 66. 12 dB, LAeq values range from 72. 82 to 73. 20 dB, and LNP values vary between 84. 99 and 78. 90 dB. At dissimilar sites between the hours of 4 and 6, similar noise level values were also displayed. L10 values ranged from 72. 83 to 85. 00 decibels, L50 values were between 66. 71 and 74. 92, L90 values were between 60. 00 and 64. 20 decibels, LAeq values were between 71. 45 and 79. 66 decibels, and LNP values were between 80. 67 and 107. 45 decibels. The average values for the research area's noise parameters are shown in Table 2. In the MAY 2023 time periods (8AM to 10AM), (12PM to 2PM), and (4PM to 6PM), respectively, levels of LEQ and LNP were found at two locations to be higher than the permitted limits. Figures 3 and 6 depict the dissimilar noise level parameter for dissimilar sites from 8am to 10am. These parameters include L10, L50, L90, LNP, and LEQ. L10 measurements of changes in noise level from 79. 93 - 81. 78 dB, L 50 values varied between 70. 61 to 74. 78 dB,L90 values varied between 60. 13 to 70. 92 dB, LAeq values varied between 75. 26 to 73. 96 dB and LNPwas in the range of 90. 12 to 101. 89 dB . Then, between 12 and 2 in the afternoon, similar parameter levels were displayed at similar places. LNP values range from 82. 08 to 84. 46 dB, LAeq values from 70. 82 to 74. 80, L10 values from 76. 70 to 77. 92 dB, L50 values from 68. 46 to 72. 56 dB, L90 values from 61. 00 to 67. 72 dB, and LNP values from 82. 08 to 84. 46 dB. At several places between the hours of 4 and 6, similar noise level parameters were also displayed. The LAeq values range from 71. 97 to 77. 66 dB, the LNP values range from 80. 67 to 82. 56 dB, the L10 values range from 72. 93 to 75. 00 dB, the L 50 values range from 68. 32 to 70. 34, the L90 values range from 64. 00 to 64. 40 dB. The average values for the research area's noise parameters are shown in Table 3. During the time periods (8AM to 10AM), (12PM to 2PM), and (4PM to 6PM), respectively, at two sites, the values of LEQ and LNP were higher than the permitted limits. Figures 4 and 7 depict the dissimilar noise level parameter for dissimilar sites from 8am to 10am. These parameters include L10, L50, L90, LNP, and LEQ. The noise level L10 ranges from 79. 50 to 80. 32 dB, the noise level L50 ranges from 68. 72 to 73. 97 dB, the noise level L90 ranges from 62. 36 to 71. 45 dB, the noise level LAeq ranges from 75. 75 to 78. 98 dB, and the noise level LNP ranges from 92. 97 to 98. 82 dB. The values of the L10 range from 74. 89 to 78. 42 dB, the L50 from 67. 51 to 70. 76 dB, the L90 from 63. 34 to 64. 97 dB, the LAeq from 71. 98 to 74. 90 dB, and the LNP from 80. 53 to 85. 43 dB. Also, between the hours of 4 and 6, similar noise level numbers were displayed at similar places. LNP values ranged from 82. 98 to 86. 87 dB, LAeq values varied from 73. 98 to 79. 67 dB, L50 values varied from 67. 82 to 68. 43 dB, L90 values varied from 66. 20 to 65. 30 dB, and L10 values changed from 71. 14 to 73. 56 dB.

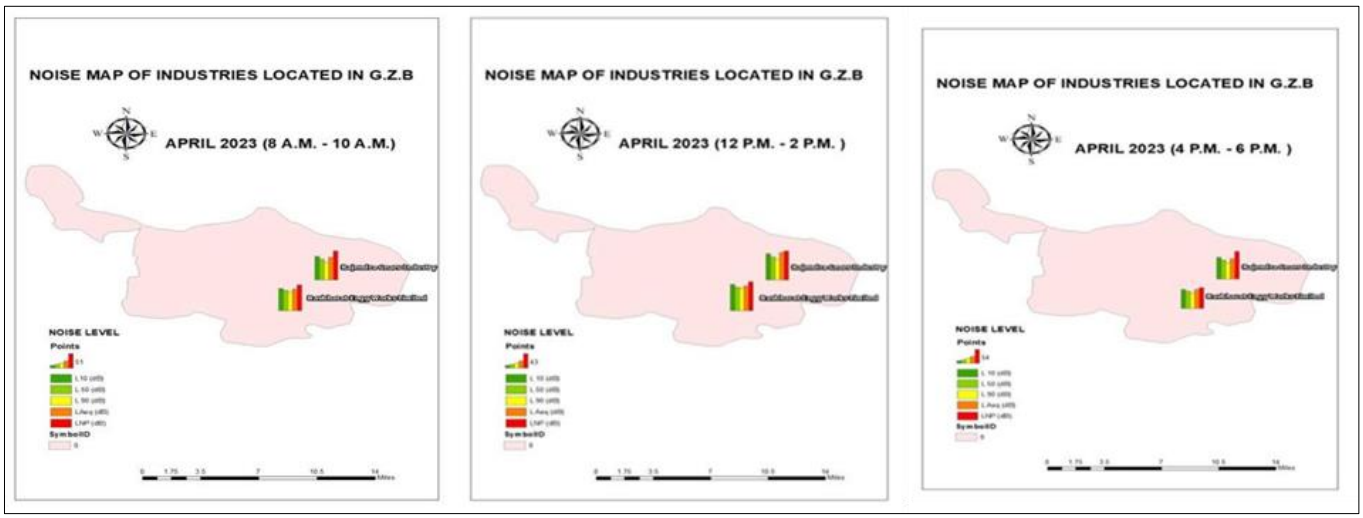

Figure 2 Noise map for Ghaziabad city for the month of APRIL 2023

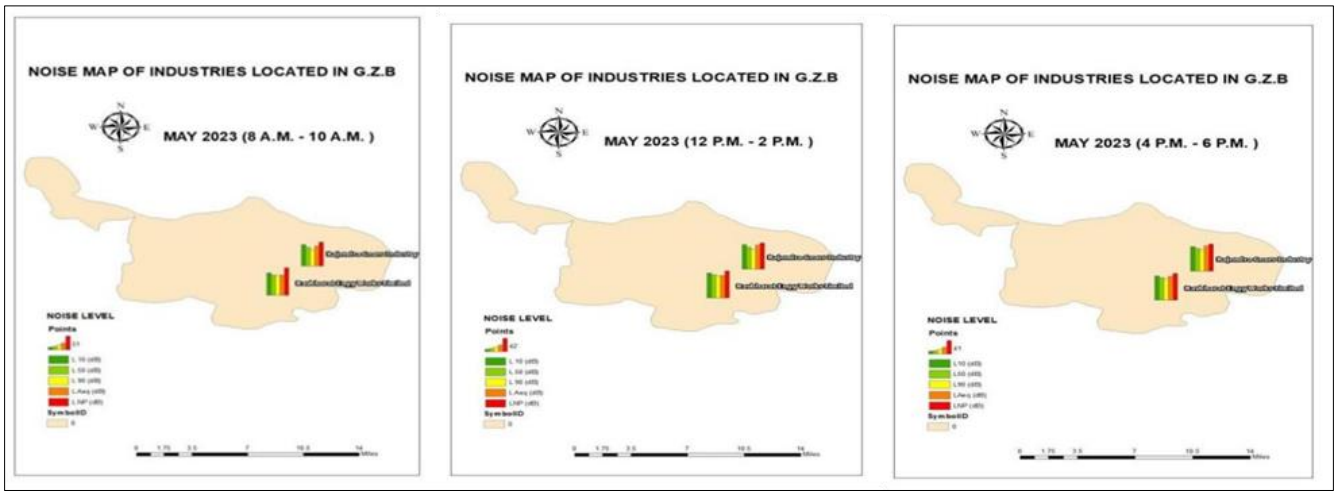

Figure 3 Noise map for Ghaziabad city for the month of MAY 2023

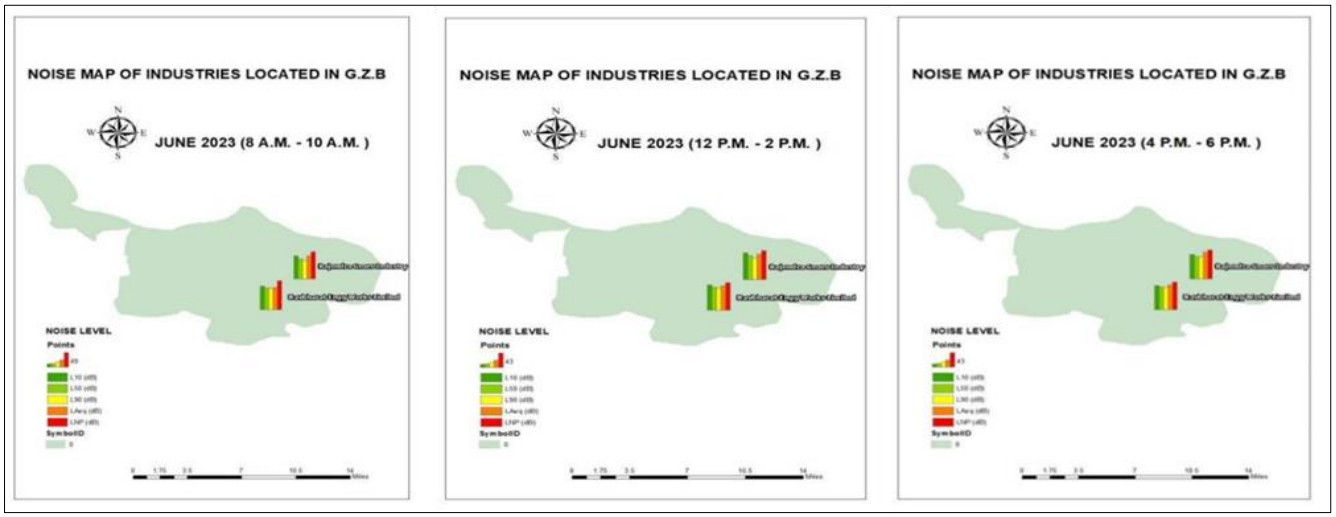

Figure 4 Noise map for Ghaziabad city for the month of JUNE 2023Figure 4. Noise map for Ghaziabad city for the month of JUNE 2023

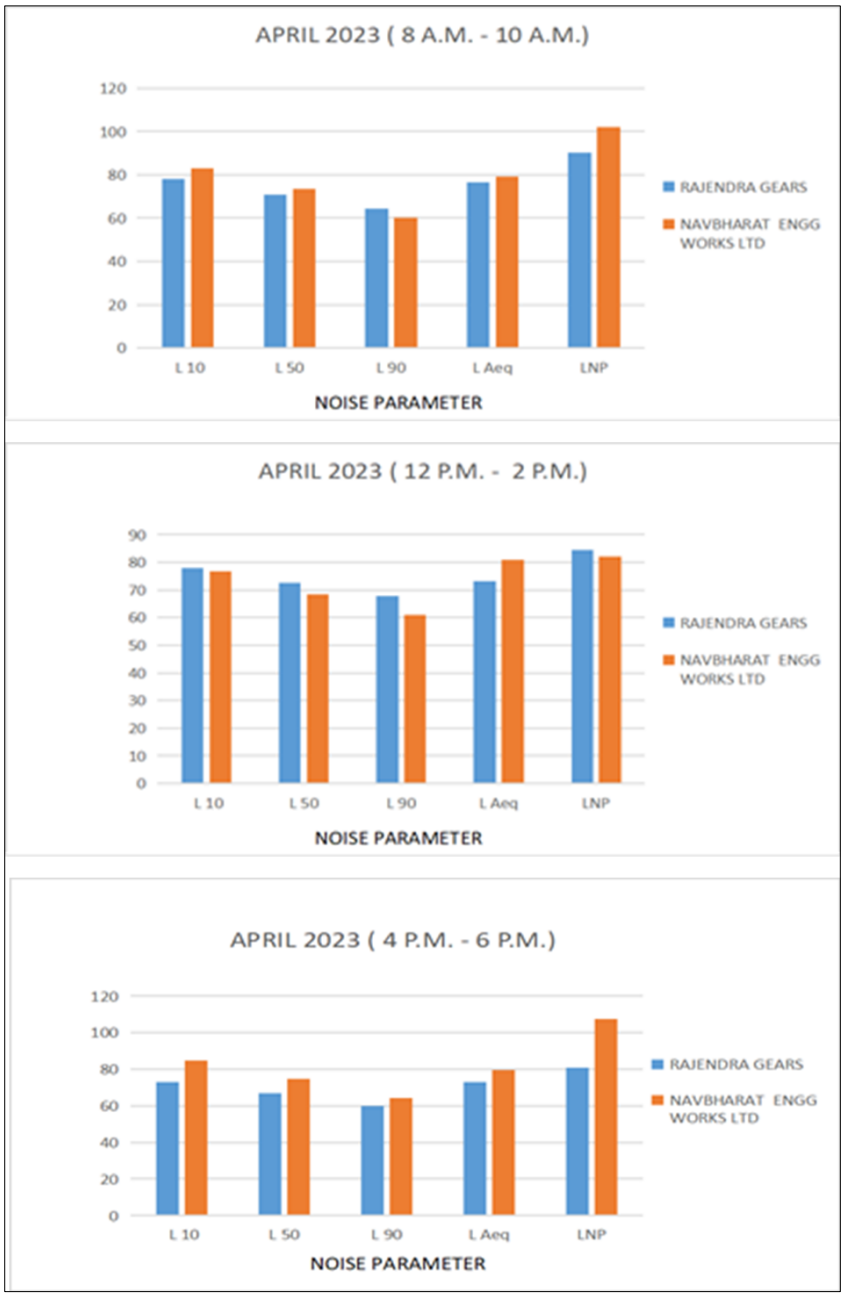

Figure 5 GRAPH for Ghaziabad city for the month of APRIL 2023

Figure 6 GRAPH for Ghaziabad city for the month of MAY 2023

Figure 7 GRAPH for Ghaziabad city for the month of JUNE 2023

Table 1 Data of noise pollution measurement at study arears in gzb in april month 2023

TIME	**LOCATION**		**UDYOG KUNG**	**YADAV**	**NAGAR**
8 A.M. – 10 A.M.	L10	(dB)	78.1	82.9	
	L50	(dB)	70.7	73.5	
	L90	(dB)	64.1	60.1	
	LAeq	(dB)	76.4	79.2	
	LNP	(dB)	90.4	102	
	L10	(dB)	77.3	77	

12 P.M. – 2 P.M.	L50	(dB)	69.4	68.3
	L90	(dB)	66.1	62
	LAeq	(dB)	73.2	66.1
	LNP	(dB)	85	84.3
4 P.M. – 6 P.M.	L10	(dB)	72.8	85
	L50	(dB)	66.7	74.9
	L90	(dB)	60	64.2
	LAeq	(dB)	68.7	79.6
	LNP	(dB)	81	108

Table 2 Data of noise pollution measurement at study arears in gzb in may month 2023

TIME	**LOCATION**		**UDYOG KUNG**	**YADAV**	**NAGAR**
8 A.M. – 10 A.M.	L10	(dB)	81.7	79.9	
	L50	(dB)	74.8	70.6	
	L90	(dB)	70.9	60.1	
	LAeq	(dB)	73.9	75.3	
	LNP	(dB)	102	90.1	
12 P.M. – 2 P.M.	L10	(dB)	77.9	76.7	
	L50	(dB)	72.5	68.4	
	L90	(dB)	67.7	61	
	LAeq	(dB)	70.2	65.1	
	LNP	(dB)	84.5	82	
4 P.M. – 6 P.M.	L10	(dB)	72.9	75	
	L50	(dB)	68.3	70.3	
	L90	(dB)	64	64.4	
	LAeq	(dB)	68.9	77.6	
	LNP	(dB)	81	83	

Table 3 Data of noise pollution measurement at study arears in gzb in june month 2023

TIME	**LOCATION**		**UDYOG KUNG**	**YADAV**	**NAGAR**
8 A.M. – 10 A.M.	L10	(dB)	80.4	79.5	
	L50	(dB)	73.9	68.7	
	L90	(dB)	71.4	62.3	
	LAeq	(dB)	75.7	78.9	
	LNP	(dB)	74.8	78.4	

12 P.M. – 2 P.M.	L10	(dB)	75	78.4
	L50	(dB)	67.5	71
	L90	(dB)	64.9	63.3
	LAeq	(dB)	69.2	71.2
	LNP	(dB)	81	86
4 P.M. – 6 P.M.	L10	(dB)	71.1	73.5
	L50	(dB)	67.8	68.3
	L90	(dB)	66.2	65.3
	LAeq	(dB)	70	65.4
	LNP	(dB)	83	87

4. Conclusion

We used metrics like L10, L50, L90, LAeq, and LNP to conduct a noise assessment in the city of Ghaziabad for this study. The results of our investigation showed that the highest levels of noise pollution are found in locations that are close to industrial hubs, particularly those that are close to marketplaces and residential areas. According to these findings, the noise levels in Ghaziabad are far higher than the Central Pollution Control Board's (CPCB) limits, which puts the inhabitants' health at serious danger. A loss in productivity in both the private and public spheres is one of the effects of this pollution, along with increased irritation. The construction of an extensive noise map is one of the key steps taken to reduce noise pollution in Ghaziabad. City planners, engineers, and other professionals in related fields might benefit greatly from this tool when used in conjunction with the noise data that has been gathered during planning and implementation stages. It's important to note that several cities in Uttar Pradesh have not yet created noise maps for their specific regions. In industrial areas, noise pollution can be effectively reduced by installing noise barriers or using noise-damping techniques. As a result, in order to implement effective noise control strategies, it is crucial to create a noise map for each city in Uttar Pradesh. One intriguing discovery is that noise maps have not yet been developed for specific areas in a number of cities in Uttar Pradesh, including Ghaziabad. This reveals a substantial gap between urban development and environmental planning methods. Lack of noise maps can result in ineffective noise control measures and, as a result, a worsening of noise pollution issues. These actions can significantly lower noise levels while also enhancing Ghaziabad people' quality of life. Our study highlights the wider relevance of noise reduction in urban environments, not just in Ghaziabad but also in other cities throughout Uttar Pradesh and beyond. Every city should make creating noise maps a top priority since they serve as the basis for efficient noise control measures and environmentally friendly urban growth. In conclusion, reducing noise pollution is essential for the welfare of city dwellers. Our study of Ghaziabad serves as a wake-up call, highlighting the necessity of preventative actions and the construction of noise maps as crucial tools for building calmer and healthier communities.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no competing interests.

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