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Original Article

ASSESSMENT OF NOISE POLLUTION LEVELS DURING THE NAVRATRI FESTIVAL USING ARTIFICIAL INTELLIGENCE: A GEOGRAPHICAL STUDY OF HUPARI CITY

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Abstract:

Sound is a form of energy generated by vibrating bodies and transmitted through an elastic medium, whereas noise refers to unwanted sound that disturbs human activities and the environment. Noise pollution has emerged as a significant environmental problem due to rapid urbanization and increasing socio-cultural activities. Festive celebrations, particularly Navratri, contribute substantially to short-term but intense noise pollution in urban areas of Maharashtra. Despite existing regulatory standards, effective monitoring and control of festival-related noise remain inadequate.

The present study assesses noise pollution levels at selected locations in Hupari City, Kolhapur District, during the Navratri festival. Noise measurements were carried out at five different sites using a sound level meter during various celebration periods, especially during Garba dance events that utilize high-powered sound systems. The recorded noise levels were compared with the permissible limits prescribed by the Central Pollution Control Board (CPCB).The results reveal that noise levels during the festival were excessively high and exceeded CPCB standards, even in designated silence zones. Major sources of noise pollution included loudspeakers, powerful music systems, drums, and orchestras. Elevated noise levels were found to cause adverse effects such as disturbance in communication, sleep disruption, reduced work efficiency, and increased stress among residents. The study highlights the potential role of Artificial Intelligence (AI) in enhancing noise pollution assessment through real-time monitoring, identification of peak noise periods, classification of high-risk zones, and prediction of future noise trends. Integration of AI with geographical and environmental studies offers a more efficient and sustainable approach for monitoring and managing festival-induced noise pollution, thereby supporting informed planning, regulation, and public awareness.

Keywords**: **Festival, Noise Pollution Level, Sound Level Meter, Decibel, Environment.

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Introduction:

Noise is derived from the Latin word *"nausea"*, meaning unwanted or unpleasant sound. From a physical perspective, there is no fundamental difference between sound and noise; sound is a sensory perception, and when complex

sound waves become undesirable or disturbing, they are perceived as noise. Traditionally, noise has been regarded as a nuisance rather than a form of pollution. However, increasing evidence shows that noise poses a serious threat to human health, communication, and overall quality of life. Gradually and often imperceptibly, excessive noise has become an unjustifiable interference in human comfort and social well-being. High-intensity noise disturbs the social environment, and due to its slow and subtle impact, noise pollution has been described as a "silent killer" (Singh and Davar, 2004).

Sound intensity is measured in decibels (dB), where 0 dB represents the threshold of human hearing, and around 140 dB marks the threshold of pain, at which sound becomes physically harmful. Sources of noise pollution are diverse and are generally classified into public and industrial noise. Among public sources, loudspeakers play a major role, especially during festivals and social functions. Indian festivals are traditionally celebrated with group singing, dancing, musical instruments, and drums, which inevitably generate elevated sound levels.

While moderate levels of festive sound can enhance joy and social bonding without harming health, the increasing use of high-powered sound systems, orchestras, and amplified loudspeakers has significantly raised noise levels beyond tolerable limits. Such excessive noise adversely affects both human and social health, disrupting daily activities and degrading environmental quality. Noise pollution has therefore emerged as a serious environmental problem.

In this context, Artificial Intelligence (AI) applications offer advanced solutions for noise pollution assessment and management. AI-based systems can continuously monitor sound levels, analyze decibel data in real time, identify dominant noise sources, and classify areas based on risk intensity. Machine learning models can distinguish between acceptable cultural sound and harmful noise, predict high-noise events during festivals, and support authorities in enforcing regulatory standards. The integration of AI with environmental monitoring enables more accurate, efficient, and sustainable control of noise pollution, helping to protect human health, improve social well-being, and maintain environmental quality.

Material and Methods:

Study Area: Hupari City is located in Hatkanangale Tehsil of Kolhapur District, Maharashtra State, India, and forms part of the Western Maharashtra region. Geographically, the city lies at approximately 16°61′94″ N latitude and 74°40′09″ E longitude. Hupari is situated about 22 km east of Kolhapur, the district headquarters.

The city covers an area of approximately 17 square km and has a population of around 35,000. Hupari is widely recognized for its traditional silver ornament manufacturing industry. A large proportion of the population possesses ancestral skills in crafting artistic silver ornaments, making this activity a significant economic and cultural characteristic of the city.

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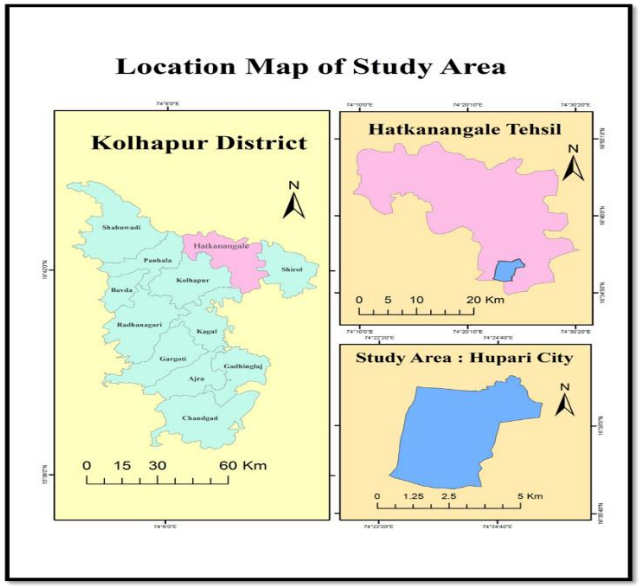

Methods:

The present study was carried out during the Navratri festival from 23 September to 2 October 2025. Ambient noise levels were monitored and recorded at five selected locations within Hupari City using a Sound Level Meter (SLM–4005). Noise measurements were conducted during two time intervals, morning hours (8:00 AM to 10:00 AM) and evening hours (5:00 PM to 6:00 PM), to capture variations in noise levels associated with festival activities.

The sound level meter operated within a measurement range of 30–180 dB(A) and was positioned at a distance of approximately 100 meters from the identified study locations during data collection. The recorded ambient noise levels were compared with the permissible limits prescribed under the Environmental Protection Act, 1986, and the standards established by the Central Pollution Control Board (CPCB) to assess the extent of noise pollution during the festival period.

Results and Discussion:

The noise levels recorded at various locations in Hupari City during the study period are presented in Tables 2 to 4, while Table 5 and Figure 2 illustrate the site-wise average noise levels. The analysis clearly indicates that noise levels across all five selected localities during the Navratri festival were significantly higher than the permissible limits prescribed by the Central Pollution Control Board (CPCB), particularly the night-time residential standard of 45 dB(A). When integrated with Artificial Intelligence (AI)-based analytical applications, the collected noise data can be automatically processed to detect exceedances, identify high-noise zones, and analyse spatial and temporal patterns more accurately. The AI-assisted assessment confirms widespread noise limit violations during the festival period, highlighting the need for intelligent noise monitoring and management systems to support effective regulation and environmental planning.

Table 1: Noise Standards for Ambient Noise level

Area code	Category of area	Limits in dB (A) Leg	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Sensitive area	50	40

Sources: Environmental noise standards as prescribed by the Central Pollution Control Board (CPCB), New Delhi, India

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Table 2: Showing the noise level status at different locations in Hupari city between 8.00 and 9.00 am

Date	L-1	L-2	L-3	L-4	L-5
23/09/2025	104	95	85	78	82
24/09/2025	102	100	84	79	76
25/09/2025	107	98	80	87	73
26/09/2025	109	102	88	86	80
27/09/2025	110	99	89	87	77
28/09/2025	108	101	85	84	79
29/09/2025	112	100	92	89	80
30/09/2025	114	103	90	88	75
01/10/2025	116	99	81	85	73
02/10/2025	115	97	87	91	76
Mean Value	109.7	99.4	86.1	85.4	77.1

Parameter values are in dB (A) Leg.Source: Based on Fieldwork- (2025)

Table 3: Showing the noise level status at different locations in Hupari city between 9.00 and 10.00 am

Date	L-1	L-2	L-3	L-4	L-5
23/09/2025	112	110	96	91	88
24/09/2025	111	108	92	88	79
25/09/2025	115	109	89	93	82
26/09/2025	118	101	91	92	81
27/09/2025	113	109	95	94	80
28/09/2025	117	105	93	85	83
29/09/2025	110	106	97	87	83
30/09/2025	118	112	98	89	78
01/10/2025	119	113	94	92	84
02/10/2025	122	115	99	94	89
Mean Value	115.5	108.8	94.4	90.5	82.7

Parameter values are in dB (A) Leg. Source: Based on Fieldwork- (2025)

Table 4: Showing the noise level status at different locations in Hupari city between 5.00 and 6.00 pm

Date	L-1	L-2	L-3	L-4	L-5
23/09/2025	116	112	101	100	98
24/09/2025	118	115	103	101	97
25/09/2025	117	113	104	105	95
26/09/2025	121	118	106	102	99
27/09/2025	124	119	109	102	96
28/09/2025	126	122	111	104	99
29/09/2025	128	121	113	108	100
30/09/2025	124	120	110	113	101
01/10/2025	127	122	115	111	103
02/10/2025	130	123	116	113	104
Mean Value	123.1	118.5	108.8	105.9	99.2

Parameter values are in dB (A) Leg. Source: Based on Fieldwork- (2025)

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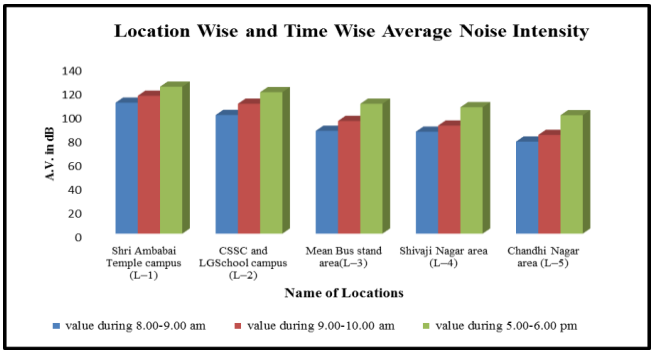
Table 5: Showing location wise and time wise average noise intensity values

S. No.	Locations under study area	Category of area	Average Noise intensity dB (A) value during 8.00-9.00 am	Average Noise intensity dB (A) value during 9.00-10.00 am	Average Noise intensity dB (A) value during 5.00-6.00 pm
1	Shri AmbabaiTemple campus (L–1)	Commercial	109.7	115.5	123.1
2	CSSC and LGSchool campus (L–2)	Sensitive	99.4	108.8	118.5
3	Mean Busstand area(L–3)	Commercial	86.1	94.4	108.8
4	Shivaji Nagar area (L–4)	Residential	85.4	90.5	105.9
5	Chandhi Nagar area (L–5)	Commercial	77.1	82.7	99.2

Source: Based on Fieldwork2025

Fig.1 Location Wise and Time Wise Average Noise Intensity



Source: Based on fieldwork 2025

Table 5 and Figure 1 illustrate the location-wise and time-wise average noise intensity levels recorded at five selected sites in Hupari City during the Navratri festival. The results indicate a consistent increase in noise levels from morning to evening hours across all locations. The highest average noise intensity was observed at the Shri Ambabai Temple campus (L–1), a commercial area, where values increased from 109.7 dB(A) in the morning (8:00–9:00 AM) to 123.1 dB(A) during peak evening hours (5:00–6:00 PM). This extreme noise level corresponds with intense Garba dance activities and the organization of an annual fair by the local Municipal Corporation. In contrast, the lowest average noise level of 77.1 dB(A) was recorded at ChandhiNagar (L–5) during the morning hours, as this location experienced minimal festival activity at the beginning of the celebrations.

Notably, the CSS College and L.G. School campus area (L–2), classified as a sensitive or silence zone under CPCB guidelines, recorded alarmingly high average noise levels ranging from 99.4 dB(A) in the morning to 118.5 dB(A) in the evening. These values substantially exceed the prescribed noise limits, highlighting serious violations even in protected zones. When analyzed using Artificial Intelligence (AI)-based applications, such noise data can be efficiently processed to detect threshold exceedances, identify high-risk locations, and recognize temporal noise patterns associated with crowd density and event intensity. AI-driven analytics enable automated classification of noise hotspots and provide predictive insights into future noise trends during festival periods.

Both the minimum and maximum recorded noise levels across all locations were significantly higher than the permissible standards set by the

Central Pollution Control Board (CPCB). The AI-assisted interpretation underscores that festival-related noise pollution has emerged as a major environmental issue in Hupari City and other parts of India during religious celebrations. Excessive noise exposure poses serious risks to public health and social well-being, as it interferes with complex task performance, alters social behavior, causes annoyance, and increases stress levels. The findings emphasize the urgent need for AI-enabled noise monitoring and management systems to ensure regulatory compliance, protect sensitive zones, and promote environmentally responsible celebration practices.

Conclusion:

The present study clearly demonstrates that noise pollution levels during the Navratri festival in Hupari City far exceed the permissible limits prescribed by the Central Pollution Control Board (CPCB) across all categories of land use, including commercial, residential, and sensitive zones. The analysis of location-wise and time-wise data reveals a consistent rise in noise intensity from morning to evening hours, with peak values recorded during active Garba performances and associated festive events. Particularly alarming is the observation that even sensitive areas such as educational institutions experienced noise levels well above prescribed standards, indicating serious regulatory violations. The integration of Artificial Intelligence (AI)–based analytical applications enhances the effectiveness of this assessment by enabling automated detection of threshold exceedances, identification of noise hotspots, and analysis of spatial and temporal patterns linked to crowd density and festival activities. The findings highlight that festival-induced noise pollution has become a significant environmental and public health concern, adversely affecting social behavior, task performance, mental well-being, and overall quality of life. Therefore, the study emphasizes the urgent need for AI-enabled noise monitoring, predictive modelling, and intelligent management systems to support effective regulation, protect sensitive zones, and promote environmentally responsible and sustainable celebration practices in urban areas.

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