Assessment of Noise Pollution in Central Nagpur

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Abstract

Urban noise pollution has become a pressing environmental concern, particularly due to its adverse effects on human well-being and quality of life. This study evaluates ambient noise levels in four key land-use zones—silence, residential, commercial, and transportation hubs within Central Nagpur. A total of 15 locations were systematically monitored across various times of the day (morning, afternoon, and evening) over a span of one week. The study involved computing essential acoustic indices such as Leq, Lmax, Lmin, L_{10}, L_{50}, L_{90}, TNI, LNP, and Noise Climate (NC) to capture the noise characteristics comprehensively.

The recorded values were assessed against the permissible limits set by the Central Pollution Control Board (CPCB). Results showed considerable exceedance in all zones, with the transportation and commercial areas reporting the highest average sound level, often exceeding 75 dB(A). Even designated silence zones, including hospital and educational areas, experienced noise levels beyond the CPCB threshold of 50 dB(A), indicating a serious breach of environmental standards. Time-based analysis revealed that noise levels peaked during typical traffic congestion hours in the morning and evening.

This research highlights the widespread nature of noise pollution in urban Nagpur and emphasizes the need for tailored control strategies. These may include better traffic regulation, the use of sound barriers, stricter enforcement of noise norms, and enhanced public awareness. The outcomes offer crucial insights into sustainable urban management and future noise mitigation planning.

INTRODUCTION

With rapid urbanization and increasing vehicular density, noise pollution has emerged as a serious environmental and public health issue in Indian cities. Among the various forms of pollution, noise is often overlooked despite its documented impacts on human well-being, ranging from hearing impairment and sleep disturbances to cardiovascular and psychological stress. In urban settings, the coexistence of diverse land uses including residential, commercial, institutional, and transport related areas results in spatial and temporal variations in ambient noise levels.

Nagpur, a major urban center in the Vidarbha region of Maharashtra, is witnessing significant infrastructural and population growth. The central part of the city, known for its administrative, commercial, and transit hubs, experiences high noise levels throughout the day. Recognizing this, the present study aims to assess and analyze

ambient noise pollution across four key functional zones: silence, residential, commercial, and transportation in Central Nagpur.

Using sound level meters and standard acoustic calculations, the study computes critical noise indices including Leq, Lmax, Lmin, L_{10}, L_{50}, L_{90}, TNI, LNP, and NC across 15 representative locations. The findings are compared with CPCB standards to evaluate compliance and guide future mitigation strategies for sustainable urban noise management.

STUDY AREA

Nagpur, situated in the Vidarbha region of Maharashtra, is a prominent metropolitan city often referred to as the "Zero Mile City" due to its central location in India. With a population of over 2.5 million and rapid urban growth, Nagpur plays a vital role as a center for administration, commerce, and transportation. The central part of the city—covering localities like Civil Lines, Sitabuldi, Dhantoli, and Ganesh Peth—exhibits a diverse mix of land uses, including institutional, residential, commercial, and transit-related functions.

The focus of this research is Central Nagpur, where a structured noise monitoring study was conducted to evaluate ambient noise levels across zones with different urban functions. Locations were selected based on land use classification, population density, traffic volume, and the presence of sensitive establishments like schools, hospitals, and transit points.

A total of 15 sites were carefully chosen and categorized into four functional zones:

Silence Zones	SFS College, Civil Lines, SFS Church, Mayo Hospital
Residential Zones	Ramdas Peth, Indira-Gandhi Nagar, Dhantoli, Dharampeth
Commercial Zones	Sitabuldi, Cotton Market, Gandhibagh, Ram Jhoola
Transport Hubs	Ganesh Peth Bus Stand, Nagpur Railway Station, Ajni Railway Station

These locations were selected to represent a comprehensive cross-section of the city's noisy environment. At each site, noise levels were recorded during three daily periods, morning, afternoon, and evening—over the course of one week. This approach enabled the analysis of both spatial and temporal variations in noise exposure, supporting a comparative assessment across different urban settings.

METHODS AND MATERIALS

This study was conducted to assess ambient noise pollution across four functional zones of Central Nagpur are silence, residential, commercial, and transportation, using a total of 15 strategically selected locations. Sites were chosen based on land use type, population density, traffic conditions, and proximity to noise-sensitive areas such as hospitals and schools, in line with CPCB zoning criteria. Noise levels were measured using a

precision-grade digital sound level meter (IEC 61672 Class 1), with the instrument positioned at a height of 1.2 meters and 1 meter from the edge of the road. Measurements were recorded at 15-second intervals for a duration of 10 minutes during three distinct time periods: morning (8:30–8:40 AM), afternoon (1:00–1:10 PM), and evening (6:00–6:10 PM), over seven consecutive days. From the recorded data, key acoustic indices such as Leq, Lmax, Lmin, L_{10}, L_{50}, L_{90}, Noise Climate (NC), Traffic Noise Index (TNI), and Noise Pollution Level (LNP) were calculated using standard formulas in Microsoft Excel. These parameters were analysed zone-wise and timewise, and the results were compared with the permissible limits prescribed by the Central Pollution Control Board (CPCB) to determine the severity of noise pollution and its variation across different urban settings.

Figure 1: Digital Sound Level Meter used for noise monitoring during field data collection.

To evaluate noise conditions at each location, noise indices were calculated using formulas prescribed by R.G. White (1986). These included:

i) Equivalent Continuous Sound Level (Leq):

$$Leq = L_{50} + [(L_{10} - L_{90})^2 / 56] \text{ dB(A)}$$

ii) Noise Pollution Level (LNP):

$$LNP = Leq + (L_{10} - L_{90}) \text{ dB(A)}$$

iii) Traffic Noise Index (TNI):

$$TNI = 4 \times (L_{10} - L_{90}) + L_{90} - 30 \text{ dB(A)}$$

iv) Noise Climate (NC):

$$NC = L_{10} - L_{90}\ dB(A)$$

Here, L_{10} is the level exceeded for 10% of the monitoring duration (peak levels), L_{50} is the median sound level, and L_{90} represents the background noise level. These calculations were performed using Microsoft Excel based on 40 readings taken every 15 seconds during a 10-minute monitoring session.

Results and Discussion

The noise monitoring survey conducted across 15 selected locations in Central Nagpur revealed significant variations in ambient noise levels across different urban functional zones—Silence, Residential, Commercial, and Transport Hubs. Noise indices such as Leq, Lmax, Lmin, L10, L50, L90, TNI, LNP, and Noise Climate (NC) were computed using standardized formulas for each time slot (morning, afternoon, and evening), and results were evaluated against the CPCB ambient noise standards.

Silence Zones such as Civil Lines, SFS College, SFS Church, and Mayo Hospital recorded average Leq values ranging from 63 to 69 dB(A), significantly exceeding the CPCB limit of 50 dB(A). In Residential Zones, including Dharampeth, Ramdas Peth, Dhantoli, and Indira Gandhi Nagar, Leq values consistently remained above 70 dB(A), with some even crossing 80 dB(A). Commercial Zones like Sitabuldi, Cotton Market, Gandhibagh, and Ram Jhoola had Leq values between 75 to 79 dB(A), while Transport Hubs such as Ganesh Peth Bus Stop and Nagpur Railway Station often exceeded 80 dB(A). Analysis of diurnal patterns showed peak noise levels during morning (8:00–10:00 AM) and evening (4:00–7:00 PM) hours due to traffic and public movement. Traffic Noise Index (TNI) and Noise Pollution Level (LNP) values further emphasized elevated annoyance and discomfort, particularly in Commercial and Transport zones. TNI exceeded 80 dB(A), while LNP values were highest in Residential and Transport zones. When compared with CPCB standards, all zones showed non-compliance, especially

Silence zones which should ideally maintain sound levels below 50 dB(A). These findings highlight the need for integrated urban noise management policies, including zoning reforms, traffic control, acoustic barriers, and public awareness programs to mitigate health risks associated with long-term noise exposure in Central Nagpur.

Table 1: Average Noise Indices by Zone

Zone Type	Leq (dB)	LNP (dB)	TNI (dB)
Silence	67.1	77.8	80.6
Residential	83.4	105.8	100.3
Commercial	77.3	86.1	90.9
Transport Hub	79.8	91.3	88.3

Zone-wise Noise Indices Graphs

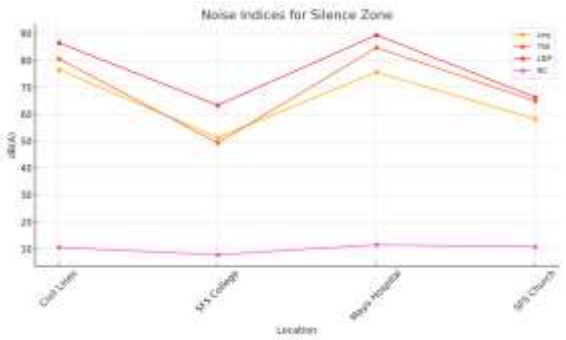

Fig.2. Noise Indices for Silence Zone

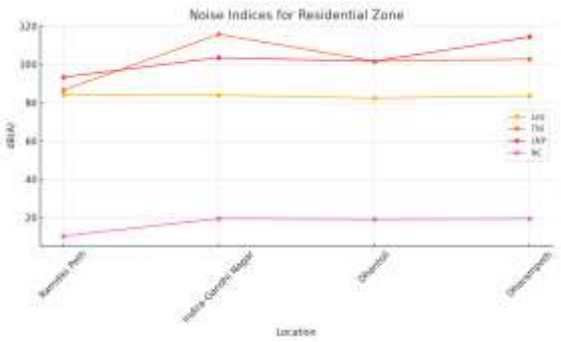

Fig. 3. Noise Indices for Residential Zone

Noise Indices for Commercial Zone

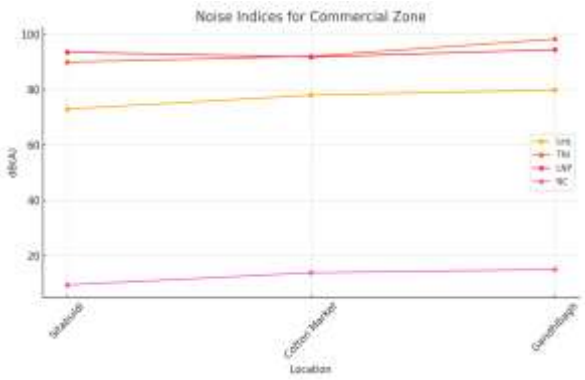

Fig. 4. Noise Indices for Commercial Zone

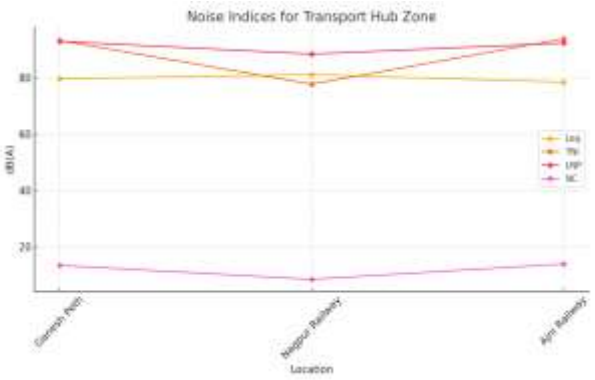

Fig.5. Noise Indices for Transport Hub

Conclusion

The present study assessed noise pollution levels across four major functional zones: Silence, Residential, Commercial, and Transport hubs in Central Nagpur. A systematic approach was adopted to monitor ambient noise levels during different times of the day across seven consecutive days. Noise indices such as Leq, L_{10}, L_{50}, L_{90}, Lmax, Lmin, TNI, LNP, and Noise Climate were computed using standard percentile-based formulas. The analysis revealed that all zones exceeded the CPCB-recommended limits, with transport and commercial zones exhibiting the highest Leq values, often surpassing 75 to 80 dB(A). Even silence zones, which should ideally maintain levels below 50 dB(A), recorded Leq values above 65 dB(A), highlighting widespread non-compliance. Residential areas also reported excessive noise levels, especially during peak hours, indicating the impact of mixed land use and traffic proximity. The calculated TNI and LNP values further confirmed high annoyance levels and acoustic discomfort, particularly in areas with significant vehicular movement and commercial activity. Temporal analysis showed a clear diurnal pattern, with noise levels peaking during morning and evening due to commuter traffic and business operations. These findings underline the urgent need

for zone-specific noise management strategies such as implementation of acoustic barriers, strict regulation of traffic near sensitive areas, urban green buffers, and awareness campaigns for noise mitigation. Effective urban planning that incorporates environmental noise control can significantly improve the livability and public health standards in Central Nagpur.

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