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Comparative Analysis Of Noise Levels In Educational Institutions: Pre-Pandemic, During COVID-19, And Post-Pandemic Trends

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Abstract:
This study investigates noise pollution variations in Janseva Shikshan Mandal's Shantarambhau Gholap Arts, Science, and Gotirambhau Pawar Commerce College, Shivle, Murbad, during three distinct phases: pre-lockdown (November 2019), lockdown (April 2020), and post-lockdown (February 2022). Noise levels were measured across 12 key locations, including residential, commercial, and silence zones, using a sound level meter at one-hour intervals. The collected data were analyzed and compared against the standards set by the Environmental Protection Act, 1986, and the Central Pollution Control Board (CPCB). Findings reveal a significant reduction in noise pollution during the lockdown due to restricted vehicular movement, market closures, and the suspension of public activities. However, pre-lockdown and post-lockdown phases exhibited considerably higher noise levels, with values exceeding prescribed limits by approximately 1.4 times in certain areas. The study highlights the adverse effects of noise pollution on human health, including stress, cardiovascular complications, and sleep disturbances. It also emphasizes the broader environmental impact, affecting communication and survival patterns in wildlife. The results underscore the need for long-term noise management strategies to mitigate excessive urban noise levels. Future urban planning should incorporate policies that promote sustainable noise reduction measures, stricter regulations on vehicular emissions, and public awareness campaigns on noise pollution control. This research provides valuable insights into the relationship between human activities and environmental noise fluctuations, offering a reference for policymakers and environmental scientists aiming to develop effective noise control strategies.

Keywords: *Environmental Impact, Lockdown Effects, Noise Pollution, Public Health, Urban Soundscape.*

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I. Introduction

Environmental noise pollution has become a significant concern worldwide, impacting both human health and ecosystems. Janseva Shikshan Mandal's Shantarambhau Gholap Arts, Science, and Gotirambhau Pawar Commerce College, established in 1989, is located in Shivle, Murbad Taluka, Thane District, Maharashtra. The institution, affiliated with the University of Mumbai, provides undergraduate and postgraduate education in arts, science, and commerce. With a campus spanning 11 acres and accommodating approximately 1,933 students, the college experiences varying noise levels due to academic activities and external environmental factors.

Noise pollution is defined as continuous exposure to high-intensity sound, which can negatively impact both humans and other living organisms [1]. According to the World Health Organization (WHO), noise levels below 70 dB are generally not harmful, regardless of exposure duration. However, exposure to constant sound levels exceeding 85 dB for more than eight hours may pose serious health risks [2-3]. Prolonged exposure to high noise levels can lead to various health complications, including temporary deafness, headaches, elevated blood pressure, and increased cholesterol levels, which may contribute to heart diseases [4]. Additionally, excessive noise exposure during pregnancy has been linked to adverse developmental outcomes [5]. Among the various sources of noise pollution, road traffic remains a predominant factor affecting urban environments [6].

The physiological and psychological effects of noise pollution vary depending on sound intensity, exposure duration, and proximity to the noise source. The adverse effects can be classified into four primary categories: physical effects such as hearing loss and ear discomfort; physiological effects, including increased blood pressure, irregular heart rhythms, and digestive ulcers; psychological effects, such as irritability, anxiety, and sleep disturbances; and performance-related effects, including reduced concentration and decreased productivity [7,8,9]. Studies indicate that prolonged exposure to excessive noise significantly increases the risk of premature mortality [8]. The impact of noise pollution on public health has, therefore, become a growing concern globally [9].

The outbreak of the COVID-19 pandemic led to drastic changes in human activities and mobility patterns worldwide. In India, the government implemented four phases of lockdown from April to June 2020 to contain the rapid spread of the virus. The first phase of the lockdown, imposed on March 24, 2020, restricted the movement of 138 crore people across the country, suspending all non-essential services, including markets, transportation, factories, educational institutions, and other public activities. This unprecedented situation led to a significant decline in noise pollution levels in urban areas due to the reduction in vehicular traffic, commercial activities, and industrial operations.

In Indian cities, research has highlighted that average noise levels often surpass the permissible limits established by the Central Pollution Control Board (CPCB) [10,11]. This study aims to analyze the variations in noise pollution levels in college before, during, and after the lockdown period. The analysis focuses on different types of zones, including residential, commercial, industrial, and silence zones. The study further compares the recorded noise levels with standard limits set by regulatory bodies.

This research investigates fluctuations in noise pollution during different phases of the pandemic and assesses their impact on human well-being[11-13]. The findings highlight the influence of environmental noise on psychological factors such as stress, irritability, and sleep disturbances[13]. The study offers valuable insights into how significant reductions in human activity during lockdown periods influenced urban noise levels. Understanding these variations can contribute to developing noise control strategies, ensuring a healthier and more sustainable urban sound environment [14].

II. Measurement Sites And Methodology

The COVID-19 lockdown led to a dramatic decrease in public movement and a significant reduction in private, commercial, and leisure activities. As part of this study, noise pollution data was collected from 12 key locations, including practical laboratories and areas outside the college premises. These measurements were conducted at one-hour intervals during peak hours in different months across three phases—pre-lockdown (November 2019), lockdown (April 2020), and post-lockdown (February 2022). The study aimed to analyze variations in noise levels during different phases of the pandemic, considering the impact of reduced human activity and vehicular movement.

To understand the effects of noise exposure during these phases, nine major sampling locations were selected. These locations were categorized based on their noise environment into residential, commercial, and silence zones within the college. The details of the noise monitoring stations are presented in Table 2, providing a structured overview of the selected sites.

Sampling Method and Duration

The ambient noise levels were recorded using a sound level meter during the daytime from 10:00 AM to 4:00 PM. Measurements were taken at one-hour intervals to capture fluctuations in noise levels throughout the day. The **Leq sound rating system** was utilized to analyze the sound levels, as it allows for an accurate representation of noise variations, especially during the lockdown period when fluctuations were significantly high [15].

For each selected location, the sound level meter was continuously operated during each hour of measurement, and multiple readings were recorded and stored. At the conclusion of the monitoring period, the minimum, maximum, and mean noise levels were calculated to determine the overall sound environment [16]. The study considered data collected from various months during pre-lockdown, lockdown, and post-lockdown phases. Measurements were taken at distances ranging from **25 meters to 50 meters** from the key locations within the college premises to ensure a comprehensive analysis of noise pollution across different settings [17,18].

The collected data were then compared with noise level standards prescribed under the **Environmental Protection Act, 1986**, and the guidelines set by the **Central Pollution Control Board (CPCB)** (Tripathy, 1999) [17-19]. Additionally, the **Noise Pollution (Regulation & Control) Rules, 2000** were referenced to evaluate whether the observed noise levels complied with the prescribed limits for various zones [20]. These comparisons helped assess the impact of lockdown measures on urban noise levels and provided insights into long-term strategies for managing noise pollution in educational institutions [21].

Table 1: Standard value limit

Code	Area	Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Observations

This Observations data is based on sound pollution levels in college about 12 major locations in different months. i.e. Pre lockdown on November 2019, Post lockdown on February 2022 and during the phase of lockdown on April 2020 different time and date at each 1hour difference

Observations Table

Table 2: Pre-Lockdown sound analysis in college campus area.

Date			15-Jul-20			10-Oct-20			12-Dec-20			25-Mar-21			Actual Value
Sr. No	Place	Time (AM/PM)	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	
1	Canteen	10:30	84	68	76	85	72	78.5	85	70	77.5	82	72	77	50
2	Parking Area	10:45	88	71	79.5	85	74	79.5	86	72	79	84	74	79	50
3	Physics Lab	11:00	60	48	54	62	50	56	59	45	52	62	42	52	50
4	Chemistry Lab	11:10	64	50	57	65	52	58.5	66	50	58	63	49	56	50
5	Zoology Lab	11:25	61	49	55	64	50	57	60	45	52.5	63	47	55	50
6	Library	11:45	48	30	39	46	35	40.5	45	34	39.5	49	38	43.5	50
7	Office	12:05	50	40	45	52	40	46	55	42	48.5	50	40	45	50
8	College Gate	12:20	82	70	76	82	68	75	69	59	64	80	70	75	50
9	Class Room	12:35	47	30	38.5	45	38	41.5	40	32	36	45	37	41	50
10	Surrounding Coach	01:20	83	73	78	80	66	73	61	55	58	84	59	71.5	50
11	Principal Cabin	01:30	55	45	50	55	47	51	53	42	47.5	52	42	47	50
12	Science Building	01:50	62	51	56.5	59	53	56	60	50	55	65	50	57.5	50
13	Bus Stop	02:20	98	85	91.5	102	90	96	105	90	97.5	103	89	96	85

Table 3: During Lockdown sound analysis in college campus area.

Date			15-Jul-20			10-Oct-20			12-Dec-20			25-Mar-21			Actual Value
Sr. No	Place	Time (AM/PM)	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	
1	Canteen	10:30	48	32	40	50	36	43	55	46	50.5	40	32	36	50
2	Parking Area	10:45	43	34	38.5	48	42	45	56	44	50.0	40	34	37	50
3	Physics Lab	11:00	40	32	36	42	32	37	40	30	35.0	42	28	35	50

4	Chemistry Lab	11:10	42	34	38	40	32	36	38	30	34.0	46	30	38	50
5	Zoology Lab	11:25	43	30	36.5	44	38	41	39	32	35.5	43	31	37	50
6	Library	11:45	38	33	35.5	40	31	35.5	45	36	40.5	49	38	43.5	50
7	Office	12:05	65	57	61	67	57	62	70	60	65.0	61	53	57	50
8	College Gate	12:20	62	54	58	72	64	68	69	59	64.0	71	65	68	50
9	Class Room	12:35	46	40	43	45	38	41.5	40	32	36.0	45	37	41	50
10	Surrounding Coach	01:20	62	53	57.5	58	53	55.5	61	55	58.0	58	49	53.5	50
11	Principal Cabin	01:30	62	54	58	55	47	51	49	40	44.5	52	42	47	50
12	Science Building	01:50	57	46	51.5	59	53	56	60	52	56.0	55	48	51.5	50
13	Bus Stop	02:20	58	52	55	64	50	57	58	44	51.0	48	40	44	85
			Mean Value		46.81	Mean Value		48.35	Mean Value		47.69	Mean Value		45.27	

Table 4: Post-Lockdown sound analysis in college campus area.

Date			15-Jul-20			10-Oct-20			12-Dec-20			25-Mar-21			Actual Value
Sr. No	Place	Time (AM/PM)	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	Maximum Value DB	Minimum Value DB	Mean Value	
1	Canteen	10:30	88	72	80	90	80	85	87	72	79.5	90	78	84	50
2	Parking Area	10:45	90	78	84	91	80	85.5	89	81	85	90	77	83.5	50
3	Physics Lab	11:00	61	52	56.5	62	46	54	60	50	55	63	50	56.5	50
4	Chemistry Lab	11:10	65	51	58	66	52	59	64	51	57.5	66	51	58.5	50
5	Zoology Lab	11:25	63	50	56.5	64	51	57.5	61	48	54.5	60	47	53.5	50
6	Library	11:45	45	32	38.5	41	31	36	45	36	40.5	42	31	36.5	50
7	Office	12:05	52	40	46	50	40	45	49	38	43.5	48	32	40	50
8	College Gate	12:20	84	74	79	83	74	78.5	81	71	76	84	75	79.5	50
9	Class Room	12:35	46	40	43	45	38	41.5	40	32	36	45	37	41	50

10	Surrounding Coach	01:20	85	74	79.5	88	74	81	86	72	79	87	70	78.5	50
11	Principal Cabin	01:30	48	30	39		47	47	49	40	44.5	52	42	47	50
12	Science Building	01:50	57	46	51.5	55	42	48.5	60	52	56	54	44	49	50
13	Bus Stop	02:20	104	89	96.5	101	90	95.5	102	88	95	101	91	96	85

Chart-I: Pre Lockdown

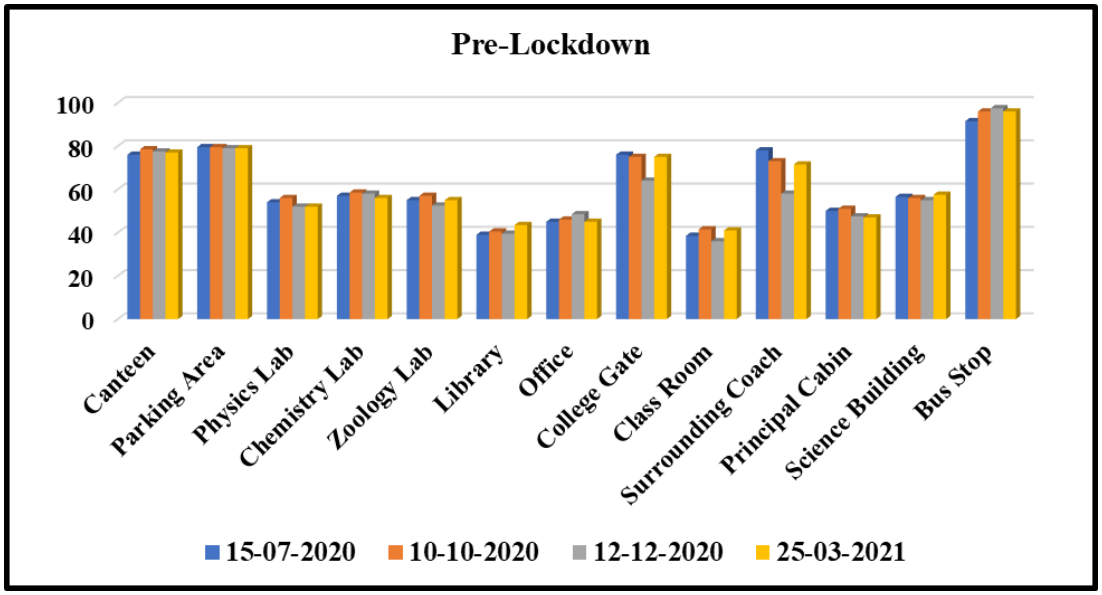

Figure 1: Pre-Lockdown sound in 12 major locations in college campus area.

Chart- II: During Lockdown

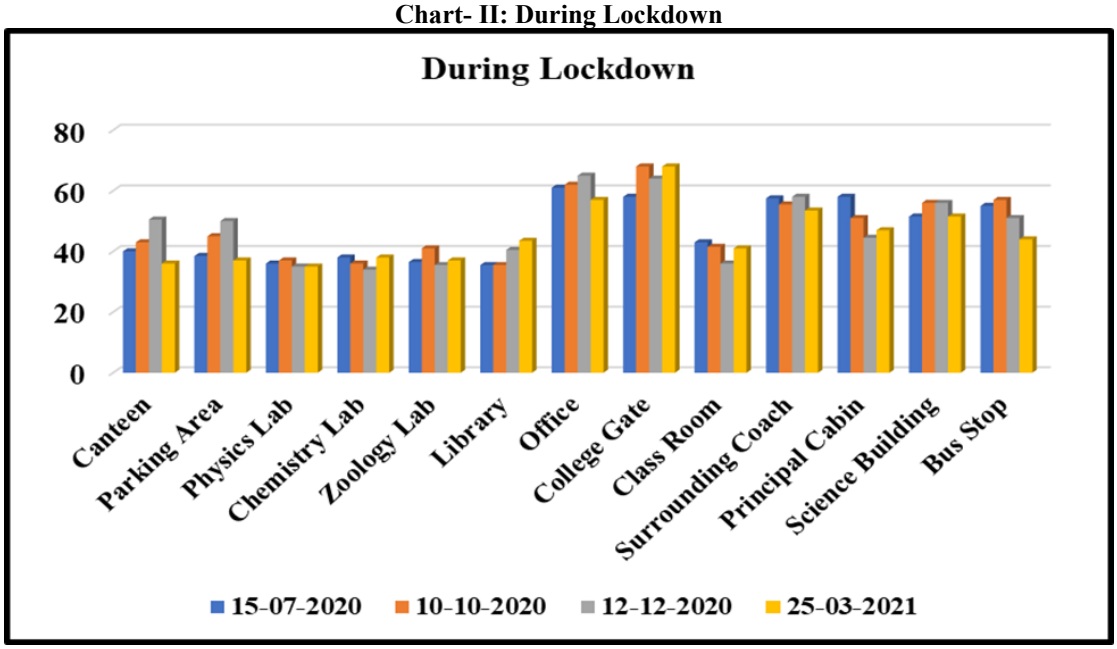

Figure 2: During Lockdown sound in 12 major locations in college campus area.

Chart – III: Post Lockdown

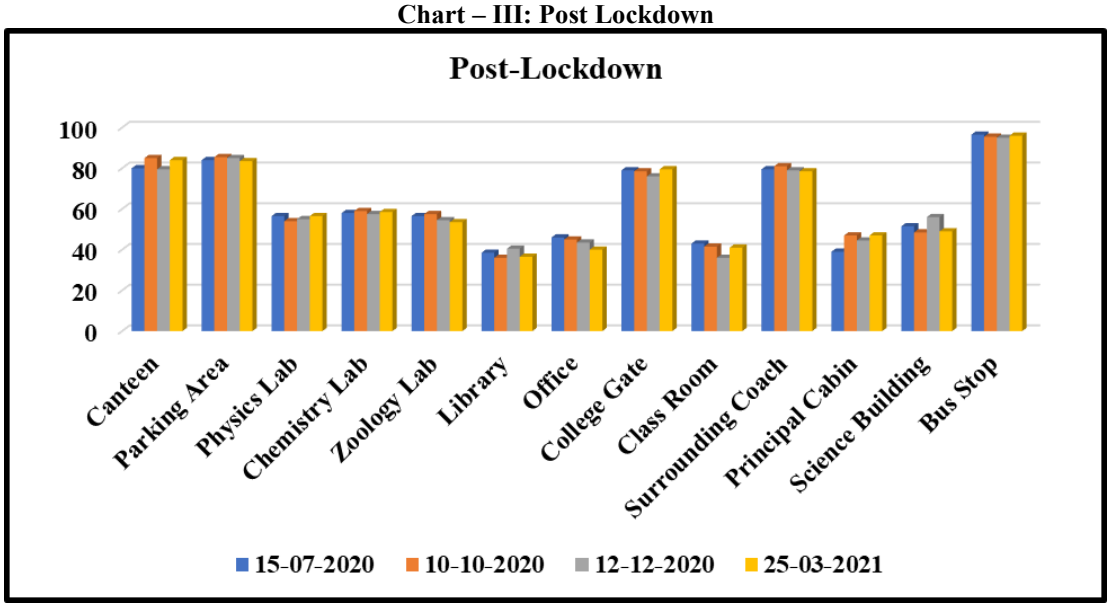

Figure 3: Post-Lockdown sound in 12 major locations in college campus area.

III. Results

The noise pollution assessment at Shivle College across 12 major locations revealed significant variations in sound levels before, during, and after the COVID-19 lockdown. The findings indicate that during the lockdown, noise levels dropped considerably in all areas due to restricted vehicular movement and the closure of markets and public spaces. The mean noise levels during this period were recorded at 45.27 dB, which is slightly below the standard limits set by CPCB for different zones. However, pre-lockdown and post-lockdown measurements exhibited elevated noise levels, averaging 46.81 dB and 48.35 dB, respectively. In commercial and high-traffic areas such as the college gate and office, noise levels frequently exceeded the permissible limits, reaching up to 72 dB. These fluctuations highlight the significant role of human activities and transportation in urban noise pollution.

IV. Conclusion

This study demonstrates how lockdown restrictions led to a temporary reduction in noise pollution, emphasizing the impact of human activities on environmental noise levels. The findings underscore the need for long-term noise management strategies, including stricter traffic regulations, awareness campaigns, and urban planning measures to mitigate excessive noise pollution in educational institutions and urban settings.

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