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*Full Length Research Paper*

# An Analysis of Noise levels in Selected areas of Lucknow City, Uttar Pradesh, India

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***Abstract***
*Noise has instantaneous effect on nearby space, unlike other pollutants; it cannot be carried far away and spread from its source area. Its intensity and threat differ from time to time and place to place. This paper analyzes the pattern of noise level intensity in different functional areas and examines the correlation between traffic density and noise level in Lucknow city. Noise level was measured in day hours (6 am to 9 pm) and night hours (9 pm to 6 am) at 31 different functional (residential, commercial and industrial) areas. Furthermore, traffic survey and noise monitoring was conducted at 16 road crossings of the city. The measurement of noise level was carried out with sound level meter placed at height of 1.2 meter above the ground and 15 meter from the centre of the road. Coefficient Variation (CV) was used to analyze the noise pattern in different functional areas and Pearson's correlation (r) and Coefficient of determination ($r^2$) was used to examine the association between traffic density and noise level. The study result reveals that the pattern of noise level intensity in different functional areas of the city is more or less uniform and, also, there is slight variation in the pattern of noise level intensity between day and night hours (Day hours CV=6.12% and Night hours CV=10.22%). Association between traffic density and noise level is moderate (r=0.69267) and ($r^2$=47.97%).*

***Key words:*** *Lucknow city, noise level, functional areas, traffic density*

## Introduction

High intensity noise is an *"unpleasant, unacceptable and unhealthy sound level to human being"* (Trivedi and Gurdip, 1992, Swaminathan, 1997). Noise is generally made up of different components and of different pitches mixed in various proportions, each component with its own potential for nuisance. The perception of noise may vary from one individual to another which makes it a very subjective pollutant. It also differs in intensity from time to time and place to place (Singh, 2002). The sound generated in a closed space may be much louder than that in the open space, and sound waves get transmitted all around in a spherical fashion with the intensity rapidly decreasing as distance increases (Kopkar, 1993). Urban centers in India have noise levels much higher than the prescribed standards (Kumar and Srinivas, 2014); and due to growing urbanization, modernization and industrialization noise has become a significant feature of urban environmental pollution. With a developing technology and a modern mode of living, noise has penetrated almost every aspect of life and caused injury to human health and comfort in Lucknow. The city, covering an area of about 310.10 $km^2$ and with a population of 2,815,033 projected by the current Master plan to reach 4,500,000 by the year 2021 (ITRC, 2015), is witnessing a high population growth, increasing commerce and services sector, an expanding industrial sector along with other infrastructural facilities. Lack of adequate mass transport system has resulted in vigorous escalation in vehicular population raising concern for high noise level and related health effects. The paper analyzes the pattern of noise intensity level in different functional areas and examines the correlation between traffic density and noise level in the city.

## Materials and Methods

The noise level was measured at 31 monitoring stations of different functional characteristics; of which, 15 were residential (Aliganj, Indiranagar, Vikasnagar, Gomtinagar, Sharadanagar, Geetapally, Rajajipuram, Alambagh, Rajendranagar, Haidarganj, Triveninagar, Jankipuram, Chitranagar, Lohiyanagar, Niralanagar), 13 commercial (Chowk, Aminabad, Kaserbagh, Nishatganj, Charbagh, Hussainganj, Hazaratganj, Daulatganj, Hussainabad, Saadatganj, Kashmiri Mohalla, Alambagh, Badshahnagar) and 3 have industrial function (Chinhat, Talkatora, Amausi). Furthermore, traffic survey and noise monitoring was also conducted at 16 different road crossings of the city namely; Hazaratganj, K. G. M. College, Parivartam Chowk, Charbagh,

Hussainganj, Naka Hindola, Royal Hotel, Kaserbagh, I. T. College, I. T. R. C. Gate, Alambagh, Nishatganj, Chowk, Aminabad, University Road, S. G. P. G. I. Road

The measurement of noise level was carried out for 30 minutes at each location during the day time (6 am to 9 pm) and night time (9 pm to 6 am). Noise levels in 'A' weighting network were measured using Sound Level Meter. The measurement of noise level was carried out with sound level meter was placed at height of 1.2 meters above the ground surface, 15 meters from the centre of the road and 3.0 meters away from reflecting surface, if any present at the location.

Statistics method like; Coefficient Variation (CV), Pearson's correlation (r) and Coefficient of determination ($r^2$) with the help of SPPSS software was used to analyze the data. Coefficient Variation (CV) was used to analyze the noise pattern in different functional areas. Noise levels of monitoring stations in different functional areas were also compared with Noise Pollution Standards references of the Central Pollution Control Board of India, 2000 to assess the noise pollution level in the city. Pearson's correlation (r) and Coefficient of determination ($r^2$) was used to examine the association between traffic density and noise level.

**Results and Discussion**

*Sources of noise pollution in the city*

In Lucknow city automobiles contribute significantly to high level of noise particularly in congested localities. A major share of total noise pollution is contributed by moving vehicles like car, trucks, buses, tempos, motorcycles, taxis and trains. The rapid increase in vehicle numbers along with poorly maintained vehicles and poor driving habits (unnecessary and frequent tooting of horns) affect the intensity of noise; and so is the vibration of automobile bodies. Variation in intensity depends on the degree of load and age of vehicle. Motorcycles are also becoming very noisy in the congested parts of the city. During peak hours a large number of vehicles congregate in traffic signal points causing traffic jams creating noise pollution. Noise is also generated from trains in the city particularly near where the railway station is located in the inner city, and along the rail line as it passes through residential localities of the city. Aircraft noise is not a serious problem in Lucknow city because there are limited flights in the city. Noise produced by factories in the city varies from 63 dB(A) to 69 dB(A) (ITRC, 2015). There is also found variation in intensity of noise from inside to outside the factory. The noise level from loudspeakers was recorded at the range of 77 dB(A) to 99 dB(A) (Singh, 2002). Though there is a restriction on using loudspeakers for advertisement purposes, there are still a number of loudspeakers used in the city for different purposes. Presently the metro rail section from Airport to Charbagh railway station on Kanpur road is under construction and the noise level in the area has increased as an addition to that associated with the traffic congestion.

*Pattern of noise pollution level in different functional areas of the city*

Noise levels vary considerably by location and by time as well as density of population and also according to the functional characteristics of the each area. Particularly, areas characterized with overcrowding in the city are highly prone to noise pollution. Table 1 shows that average noise level in different functional areas of Lucknow city. In the city, the noise level during day time varies from 68 dB(A) in Amausi industrial area to 82dB(A) in Nishatganj commercial area and during night hours its varies between 69 dB(A) at Charbagh to 48dB(A) at Gomtinagar. To analyze diurnal variation pattern of noise level in the city Coefficient Variation (CV) of both day and night hours was calculated and it was found that, overall in the city, night hours CV was 10.22 % slightly higher than day hours CV i.e. 6.12%, which indicates that both day and night hours noise creating activities are more or less uniform and consistent. Marginally high variation in noise levels during night hours may be, some areas location are near to the transport centers, but others areas functional activities seize down significantly during night.

*Noise level pattern during day hours*

During day hours, in the case of residential areas, average noise level varies between 69 dB(A) at Triveninagar and Jankipuram to 79 dB(A) at Niralanagar. Low intensity of noise in Triveninagar and Jankipuram is due to low density of traffic and availability of sufficient open space. The main sources of high noise level in residential areas are automobiles and other domestic appliances. In commercial areas average noise level of day time is recorded between 73 dB(A) at Badshahnagar to 82 dB(A) at Nishatganj. High level of noise at Chowk, Aminabad and Kaserbagh is found due to high traffic density, traffic congestion and busy commercial activities. The reason for high noise in Alambagh area is quite different. It is situated along with National Highway No. 24, which connects Lucknow and Kanpur. Besides, the flow of heavy traffic is very high which causes high noise level. Hazaratganj, Hussainganj, Nishatganj and Charbagh are main traffic convergence points of the city and therefore, recorded high level of noise. Day time industrial area noise level varies between 68 dB(A) at Amausi to 70 dB(A) at Chinhat.

In industrial locations noise is mainly caused by machines operating as well as by automobiles. It is interesting to note that noise levels during day hours in all the residential and commercial areas are higher than the tolerance limit as prescribed by the CPCB, though lower than the prescribed level in all industrial areas. The low levels of noise recorded in industrial areas are due to the fact that noise was only captured outside the industrial buildings. The study results also reveal that in the day

time there is no significant variation of noise levels among the different functional areas of the city (CV of residential- 4.28%, commercial- 4.97% and industrial areas- 1.18%). In the case of industrial areas where variation coefficient recorded was slightly lower the reason might be due to the fact that industrial activities in all three industrial areas were more or less of the same type.

**Table 1:** Noise Levels in Lucknow City (*Day & Night Hours*)

| Monitoring Stations | Functional Characteristics | Noise Level (dB(A), Day | Noise Level (dB(A), Night |
|---|---|---|---|
| **Aliganj** | Residential | 77 | **58** |
| **Indiranagar** | Residential | 74 | **60** |
| **Vikasnagar** | Residential | 72 | **54** |
| **Gomtinagar** | Residential | 71 | **48** |
| **Sharadanagar** | Residential | 70 | **51** |
| **Geetapally** | Residential | 72 | **52** |
| **Rajajipuram** | Residential | 70 | **51** |
| **Alambagh** | Residential | 69 | **49** |
| **Rajendranagar** | Residential | 76 | **58** |
| **Haidarganj** | Residential | 70 | **50** |
| **Triveninagar** | Residential | 69 | **50** |
| **Jankipuram** | Residential | 69 | **49** |
| **Chitranagar** | Residential | 70 | **53** |
| **Lohiyanagar** | Residential | 70 | **52** |
| **Niralanagar** | Residential | 79 | **59** |
| **Residential area noise level standards (permissible limits)* | | ***55*** | 45 |
| **Chowk** | Commercial | 81 | **64** |
| **Aminabad** | Commercial | 78 | **63** |
| **Kaserbagh** | Commercial | 77 | **63** |
| **Nishatganj** | Commercial | 82 | **60** |
| **Charbagh** | Commercial | 81 | **69** |
| **Hussainganj** | Commercial | 80 | **66** |
| **Hazaratganj** | Commercial | 78 | **64** |
| **Daulatganj** | Commercial | 70 | **54** |
| **Hussainabad** | Commercial | 70 | **52** |
| **Saadatganj** | Commercial | 79 | **58** |
| **Kashmiri Mohalla** | Commercial | 80 | **57** |
| **Alambagh** | Commercial | 78 | **65** |
| **Badshahnagar** | Commercial | 73 | **51** |
| **Commercial area noise level standards (permissible limits)* | | **65** | 55 |
| **Chinhat** | Industrial | 70 | **58** |
| **Talkatora** | Industrial | 69 | **54** |
| **Amausi** | Industrial | 68 | **62** |
| **Industrial area noise level standards (permissible limits)* | | 75 | 65 |

*Source: Field Survey, 2014-2015 and * CPCB, 2000*

*Noise level pattern during night hours*

Noise levels during night hours are lower than the day hours. If noise level during sleeping hours is more than 30 dB(A), people usually cannot sleep. It is evident from Table 1 that noise level varies between 69 dB(A) at Charbagh to 48 dB(A) at Gomtinagar during night hours. Charbagh is a commercial-cum-traffic junction area where the main railway station and bus station are located resulting in a heavy flow of traffic and passengers during night hours. Therefore, it is obvious that intensity of noise will be quite high during night hours as trains and buses arrive and depart throughout the night hours. In the residential areas during night hours the noise level ranges between 48 dB(A) at Gomtinagar to 60 dB(A) in Indiranagar area. In the commercial areas during night hours the noise level fluctuates between 51 dB(A) in Badshahnagar to 69 dB(A) at Charbagh and in the industrial areas the lowest noise level of 54 dB(A) in the night hours is found in Talkatora area and highest of 62 dB(A) in Amausi area. It is further observed that at all the monitoring areas excepting Amausi, and Talkatora industrial areas and Badshahnagar, Daulatganj and Hussainabad commercial areas have high noise levels during night hours than the prescribed standards set by CPCB for night hours. None of the residential noise levels during night hours were equal to or below the prescribed limit. Noise level variation in all the functional area of the city during night time was also found to be similar, (CV of residential- 7.25%, commercial- 8.98% and industrial areas- 5.63%).

Study was carried out by Kisku et. al., (2006) also indicates that, in residential areas, noise ranged between 67.7 to 78.9 and 52.9 to 56.4; in commercial cum traffic areas 74.8 to 84.2 and 68.2 to 74.9 and in industrial areas 76.9-77.2 and 72.2-73.1 dB(A) during day and night time respectively and values were higher than their prescribed standards which may pose a significant impact on quality of life.

*Traffic density and noise level correlation*

Generally, it is assumed that traffic density at any crossing governs the level of noise at that place. Table 2 shows traffic density and noise level in Lucknow city and it is evident from the table that maximum traffic density (4572 vehicles/hour) is found at Hazaratganj crossing, and the minimum (980 vehicles/hour) at SGPGI road crossing. Low traffic at SGPGI road crossing is due to its location the outer part of the city along Lucknow-Raebareily road. Noise levels at these two crossings were recorded as 100 dB(A) and 71 dB(A), respectively. At Charbagh crossing the noise level was recorded to be highest 103 dB(A) with a traffic density of 4098 vehicles/hour, less than that of Hazaratganj crossing, as Charbagh is the main crossing at the traffic convergence point of the city and nearer to the railway station. Besides, due to limited space most of the buses and other passenger traffic park along roadsides causing a continuous traffic jam which, in turn, slows vehicular movement of the traffic high level of noise is recorded at this crossing. At Kaserbagh, Chowk and Aminabad crossing low traffic density is recorded (2015 to 2286 vehicles/hour) with a high level of noise- 92 to 102 dB(A) – these crossings are located in the older parts of the city. Besides, they are heavily congested with crossings surrounded by buildings and narrow roads resulting to slow traffic movement and high noise levels.

**Table 2:** Traffic Density and Noise Level in Lucknow City

| Name of Crossing | Traffic Density (*per hour*) | Noise Level dB(A) |
|---|---|---|
| **Hazaratganj** | 4572 | **100** |
| **K. G. M. College** | 2809 | **92** |
| **Parivartam Chowk** | 2000 | **87** |
| **Charbagh** | 4098 | **103** |
| **Hussainganj** | 4286 | **94** |
| **Naka Hindola** | 2086 | **90** |
| **Royal Hotel** | 4398 | **96** |
| **Kaserbagh** | 2281 | **92** |
| **I. T. College** | 1987 | **89** |
| **I. T. R. C. Gate** | 1007 | **74** |
| **Alambagh** | 3815 | **96** |
| **Nishatganj** | 2680 | **91** |
| **Chowk** | 2286 | **102** |
| **Aminabad** | 2015 | **101** |
| **University Road** | 2815 | **90** |
| **S. G. P. G. I. Road** | **980** | **71** |

*Source: Field Survey, 2014-2015*

To examine the association between traffic density and noise level Pearson's coefficient of correlation (r = 0.69267) and Coefficient of determination ($r^2$ = 47.97%) were calculated. The result indicated that there was a moderate degree of interdependence/correlation between traffic density and noise level. Furthermore, quantitatively, it can be expressed that as much as 47.97 percent of the noise level is attributable to the traffic density in Lucknow city. Other determinants, which could be significant for causing high level of noise at various road crossings in the city, were functional area location, road width, building height, density and nature of road crossings.

**Conclusions and Recommendations**

The major sources of high noise level in the city are high traffic density and congestion due to inadequacy of road width. By reference to the CPCB standards, high noise levels were recorded in all the residential areas during both day and night hours. The study found that some commercial activities operating in the residential areas may be responsible for high noise level. In commercial areas during day time noise level was recorded above the permissible limit and in night hours also all areas it was high above the limits, except two areas (Daulatganj and Hussainabad) are slightly below the CPCB standards. In the case of industrial areas in both day and night hour's noise level are below the permissible limits. Both day and night hour's noise creating activities were more or less uniform and marginally high variation in noise levels during night hours was observed. There is moderate degree of interdependence/correlation between traffic density and noise level in Lucknow city. Due to the uniform pattern of noise level in all functional areas and also in both day and night hours; somewhat similar type of remedial measures to reduce the noise level can be adopted by the city authorities. The study also recommends that, extensive traffic survey should be conducted to know the daily spatio-temporal pattern of vehicle flow and direction. Based on this detail traffic management plan (re-routing, one way road movement etc.) of the city should be formulated and implemented. Encroachment of the road side by vehicles in the city is a common phenomenon which creates traffic jams

and the city authorities should use legal/economic (high parking fees, penalties etc.) sanctions. This will helpful in controlling road side encroachment and bring smooth traffic flow. Traffic noise can also be reduced by increasing mass public transport (BRT with separate bus lane), plantation of trees, awareness programs. Although, a metro rail system is under construction, its coverage might not be adequate for the city. Therefore enlargement of the metro rail route network promptly is required to reduce vehicular population on the roads, as a direct means of controlling noise pollution.

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