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Study of Noise Levels at Commercial and Industrial Areas in an Urban Environment

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Abstract
Noise is undesirable sound caused by industrial and human activities that are detrimental to quality of an individual. Long term exposure to noise may induce physiological, psychological and behavioral changes. In the present study, different environmental backdrops of Secunderabad is selected as a case study to assess ambient noise levels generated by industrial and traffic activities. The average equivalent noise levels L_{eq} at different locations of Trimulgherry (Commercial and Residential) area and the other Jeedimetla, an industrial corridor were measured for a period of one month. The noise level indices (L_{10}, $L_{50,}$ L_{90}) and Traffic Noise Index (TNI), Noise Climate (NC), Noise pollution Level (Lnp) were calculated. L_{eq}. at two study locations have reported higher values during day and night average noise levels along with all the other Indices (TNI and L_{np}). The higher value is due to increase of vehicles, industrial and human activities. The calculated L_{eq} was predicted by using Calixto model and the regression between Observed and Calculated L_{eq} has shown good value of correlation coefficient (R^2) for both the study locations.

I. Introduction

The term noise refers any unwanted or undesirable sound. Noise can also defined as when sound level is beyond the acceptable level and creates annoyance [1]. The unit for measurement of sound is in decibel (dB). Noise pollution is recognized as one of the major environmental issue in cities and affecting the quality of life. The increase in traffic and industrialization, noise pollution is also increased. Noise pollution in urban environment is also considered as environmental noise, which defined as collection of offending sounds to which humans are involuntarily exposed [2].

The present environmental problems are universal in almost all the countries. Road traffic, garbage trucks, constructions, manufacturing process, road congestion are major sources of this unwanted sound that are routinely transmitted in to the air [3]. All these problems are due to consequence of rapid population growth, which resulted in increase of usage of large number of vehicles, excessive exploitation of natural resources. The Increase of traffic noise levels in urban environment depends on various factors such as with heavy density of vehicle flow related with the traffic composition, road slope, width and surface structure distance to crossroad etc [4].

In addition, Noise pollution also depends upon on different factors such as kind of activities involved, the population density, and even the local habitants and culture. Noise pollution is now a day's considered world wide as one of the major problems for the quality of life in urban areas. There have been several studies which were carried out in many urban cities to characterize the acoustical conditions of different cities, as noise pollution is one of the major sources for the effect of physiological and psychological effects of noise exposure. Some of the major health hazards are raise in blood pressure, anxiety, headache, irritability, hearing problems and insomnia etc. [5-7].

In the present study urban and industrial areas of Trimulgherry and Jeedimetla of Secunderabad areas were selected to assess the noise levels. This baseline data will helps to understand the noise level and to develop better environmental management practices.

II. Study areas and Methodology

2.1 Study area

The city of Hyderabad is one of most populated cities in India along with its twin city Secunderabad, and it is a capital city of Telangana state. A survey has been conducted at two different locations of Secunderabad for one month i.e. at Trimulgherry (Commercial and Residential) location and the other Jeedimetla an industrial corridor to assess ambient noise levels.

2.2 Noise Indices

Noise levels were measured at both the locations and diurnal (6:00am-5:00am) averages for both study locations were measured for over a period of one month in June 2011. An Environmental sound level meter, CYGNET 2001 is used to measure ambient noise by following the standard procedure [8].

The noise measured noise levels exceeded for 10% of the time of measurement duration (L_{10}), the noise measured noise levels exceeded for 50% of the time of measurement duration (L_{50}) and the noise measured noise levels exceeded for 90% of the time of measurement duration (L_{90}) were also determined.

2.3 Indexing of traffic noise:

Three noise indices were measured viz., Traffic Noise Index (TNI) [9], Noise Climate (NC)[10], Noise pollution Level(Lnp)[11] were calculated to determine the extent of noise pollution for all hours.

2.4 Statistical analysis:

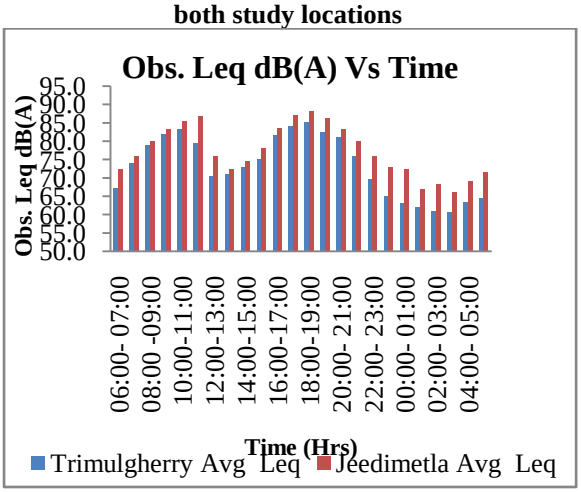
A regression equation were developed between Observed L_{eq} and Calculated L_{eq} to determine R^2 value using Calixto model[12] which is best suited for Indian road conditions.

III. Results and Discussion:

3.1 Noise levels Leq dB(A) at both study locations

The study location of Trimulgherry which is a mixed area is growing in commercial activity along with residential where the average equivalent noise levels Leq shows a value of 73.1 dB (A) for 24hrs and the minimum and maximum are varying between 60.6-85.0 dB (A). While the other location of Jeedimetla an industrial area showed an average Leq value of 77.3 dB (A) for 24 hrs with a minimum value of 66.0 dB(A) and a maximum value of 88.1 dB (A). From the analysis it was observed that the noise levels were exceeding the prescribed levels as given by CPCB (Central Pollution Control Board), India 2000 [13] as shown in Fig:1

Fig:1 Average Equivalent noise levels Vs Time at both study locations



3.2 Noise Indices analysis

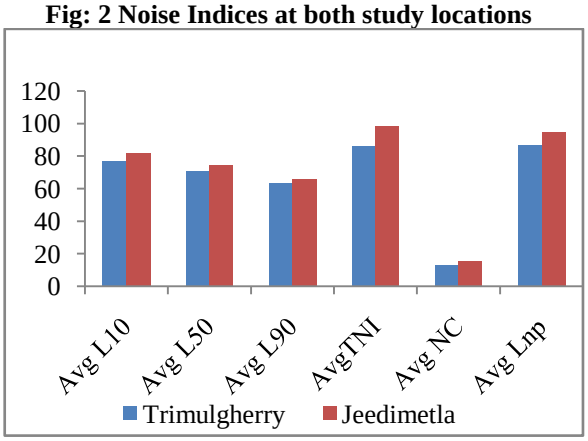
The average noise indices such as L_{10}, L_{50} and L_{90} were studied for 24 hrs at both study locations is shown in Fig: 2. The average L_{10} values for 24 hrs for the study location of mixed area of Trimulgherry showed an average value of 76.8 dB (A) and an industrial area of Jeedimetla 81.5 dB (A) L_{50} and L_{90} followed the same trend.

The different noise parameters Traffic Noise Index (TNI) values were computed to estimate the annoyance response due to traffic noise and the value of TNI over 74dB (A) is defined as the threshold of over criterion and also depends upon the different noise indices. The average TNI value of 24 hrs at the study location of mixed area of Trimulgherry has a value of 86.3 dB (A) and industrial area of Jeedimetla has a value of 98.2 dB (A). Both these areas show higher values of TNI due to annoyance caused by noise.

The Noise Climate (NC) provides the range over which the sound levels fluctuate in an interval of time and expressed in dB (A) which also depends upon noise indices. The values are 13.2 dB (A) and 15.6 dB (A) for mixed and industrial areas respectively.

The average noise pollution level L_{np} which gives varying levels of noise the mixed area of Trimulgherry showed a value of 86.6 dB (A) and industrial area of Jeedimetla has a value of 94.3 dB (A).

Fig: 2 Noise Indices at both study locations



3.3 Day and Night average noise levels at both study locations

The day and night average noise levels were measured in both the study locations and the average noise levels (Leq) values were given in Table-1. From the table it is observed that noise levels Leq during day and night time are above the prescribed levels of standard.

Table: 1 Day and Night average noise levels

Sampling area	Day	Night
	Avg Leq	Avg Leq
Trimulgherry	77.8	63.7
Jeedimetla	80.8	70.4

3.3 Mathematical model:

The vehicle flow is the sum of Light and Heavy vehicles flow that passes at a road during certain time duration. As the heavy vehicle generates a stronger noise compared to lighter vehicles. A factor 'n', has been considered for such vehicles ,so that an equivalent value can been achieved for the traffic flow Q_{eq} , by considering Q as the real hourly vehicle flow, VP as the percentage of heavy vehicles and 'n' as the weighting factor , we get

$$Q_{eq} = Q(1+n*VP/100) \quad (1)$$

So the term, 10log (Q_{eq}) will be transformed into 10log [Q(1+n*VP/100)].

The values of 'n' vary from 4 to 10 that can used to find the largest correlation coefficient between the observed and calculated L_{eq}.

Once the vehicle flow Q, the percentage of heavy vehicles, VP, the value of 'n' is determined we can calculate the noise equivalent level L_{eq}. In our study the value of n=9.5 gives the highest correlation between the values of Observed L_{eq} and 10log [Q (1+n*VP/100)] have been plotted on a graph, a curve has been adjusted to the measured points.

Mathematically, the curve can be represented by

$$Y=a*x+k \quad (2)$$

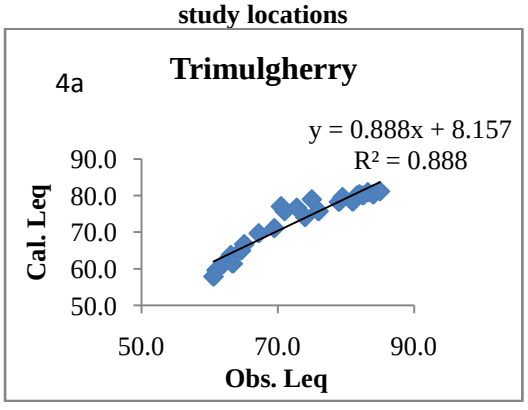
By applying the variables on the straight line equation, we get

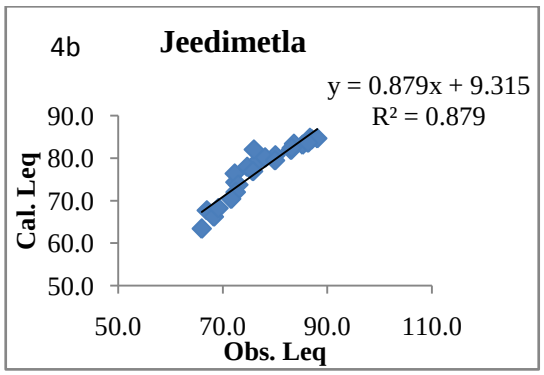
$$L_{eq} = a*10\log [Q (1+9.5*VP/100)] +k \quad (3)$$

The values of constants 'a' and 'k' can be found after the statistical methods of linear regression have been applied.

The Mathematical modeling for predicting the equivalent noise levels L_{eq} generated by road traffic was done by earlier researchers by using statistical methods of linear regression.

3.4 Model: Observed Vs Calculated Leq at both study locations





The correlation coefficient R^2 showed a value of 0.8883 and 0.8796 respectively for mixed and industrial area. From the above Fig 4(a-b) it is clear that there exists a strong correlation between the observed and calculated Leq for both study locations.

IV. Conclusions

A survey has been conducted at two different locations of Secunderabad for one month i.e. at Trimulgherry (Commercial and Residential) location and the other Jeedimetla an industrial corridor to assess ambient noise levels. The average equivalent noise levels L_{eq} at both study locations showed high values along with all the other indices (L_{10},TNI and L_{np}). Increases of vehicle flow of all types apart from the industrial and human activities. The usage of more number of personal vehicles and inadequate public transport leading to frequent traffic jams is one of the major sources noise. The variations of observed and calculated L_{eq} showed a good value of R^2 at all study location. Traffic noise can be reduced by increasing mass transport, plantation of trees, awareness programs.

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