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A STUDY OF AMBIENT NOISE POLLUTION IN AND AROUND VIJAYAWADA CITY

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ABSTRACT
Noise Pollution is becoming one of the most challenging problems in a developing city like Vijayawada in Andhra Pradesh. Due to the proximity to the capital city of the Andhra Pradesh, Amaravati, vehicular flow in Vijayawada has increased manifold. The people commuting to and from Vijayawada to the nearby areas for their livelihood also increased considerably. With the increase of the vehicular population of transport vehicles and non-transport vehicles, the associated noise pollution is also on the rise. In this backdrop, four sampling locations pertaining to residential areas in and around Vijayawada are considered for the present study. Noise levels are measured for 8-hours at 2-minute intervals on two separate days and are analyzed using noise quality parameters such as Lavg, Leq and Noise climate. Incidentally, lockdown due to COVID-19 is in force in the sampling locations during sampling period. The results indicated that the ambient noise levels are within the permissible limits. The results are perhaps an indication of the impact of lockdown in these areas as vehicular movement is restrained during this period.

***Key words**: Noise pollution, Ambient noise level, Residential areas, Vijayawada, Noise quality parameters*

INTRODUCTION

Noise is unwanted sound. It causes many adverse impacts (Garg, 2014) such as sleeplessness, annoyance, irritation, physiological effects, deafness, disturbance leading to poor work efficiency etc. to the human beings beyond certain limits. Noise is caused due to many activities such as domestic, commercial, industrial and traffic related activities in our daily life (Muralikrishna, 2017). The permissible limits of noise levels in India are categorized based on four zones: Residential, Commercial, Industrial and Silent zones (Ramakrishna, 2017). The details are given in Table-1. The noise levels in habitat zone ie., Residential zone are important as the human beings are exposed during day as well as in the nighttime. Exposure to higher noise levels induce adverse impact to them both on short-term and on long-term basis.

Table-1: Prescribed Limits for Ambient Noise Levels in India

S.NO	Area category	Permissible limits, Leq in dB(A)	
		Day Time	Night Time
1	Industrial area	75	70
2	Commercial area	65	55
3	Residential area	55	45
4	Silent area	50	40

Note:

1. Day time: 6am to 10pm, Night time: 10p.m to 6a.m
2. Mixed categories areas should be declared as one of the four above mentioned locations by the competent authority and the corresponding standards shall apply
3. dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

Vijayawada, is the second largest city in the Andhra Pradesh after bifurcation. It is a commercially developed city housing business establishments, educational Institutions, Hospitals, Amusement parks, Hotels and restaurants, Religious places, Tourist attractions, besides State Road Transport Bus station, South Central Railway network, and airport. The Pandit Nehru Bus station in Vijayawada is regarded as one of the largest Bus stations in the coutry (Wiki, 2021). Many people daily commute to Vijayawada for their day to needs besides the local population. It is known as the agrarian and business capital of Andhra Pradesh. The population in the city has seen tremendous growth after the state bifurcation in 2014 as they got migrated from Hyderabad, which was the capital of undivided Andhra Pradesh. This has increased the residential housing activities due to urgent needs of this excess population. This has also brought an unwanted increase of ambient noise pollution in the city. The present study focuses on determining and analyzing the ambient noise levels in and around Vijayawada.

Higher noise levels due to vehicular traffic to cater the increased urban needs are reported in Akola (Anurag et al., 2013), Amaravati (Kavitha, 2014), Vijayawada (Ramakrishna et al., 2017, 2019), Turkey (Ozer et al, 2009). Pal et al (2012) and Meline et al (2013) studied extensively on the adverse impacts of noise on human beings. Poor condition of roads, poor maintenance of vehicles, overpopulated roadways are identified as some of the reasons for the increased noise levels due to transportation sector. Annoyance and poor human efficiency are identified as the outcomes from the associated noise pollution. Meline et al (2013) analyzed the data collected through specially prepared questionnaires and noticed that impact or traffic noise is more significant in residential areas as the population staying there are more prone to the adverse impacts since their movement in the residential area is often restricted. Further, the elderly population and patients with cardio and neuro related problems are the major sufferers due to the increased noise pollution. Manea et al (2012) studied impacts of noise pollution in Cernovoda city and offered useful suggestions for reducing the ambient and traffic noise pollution problems. Ramakrishna et al (2021) applied Artificial Neural Networks model to develop empirical relation between the sampling point and its distance from source.

2. STUDY AREA

The study area selected for the purpose is Vijayawada, renowned as the commercial capital of united Andhra Pradesh (AP). After the bifurcation of the Andhra Pradesh in 2014, the capital of residual AP, Amaravati is located 15 km from Vijayawada city. Many employees of the Secretariat, High Court etc and other people connected to their works at these places commute daily from Vijayawada. This has increased the traffic heavily in the Vijayawada city and the associated noise levels in the city. It is in this context, study of the ambient noise levels in and around Vijayawada city is taken up. Though the permissible guidelines stipulate four zones viz., Residential, Commercial, Industrial and Silent, for monitoring ambient noise levels, in the present study ambient noise levels

from Residential zone is only considered. Ramakrishna et al (2017, 2019), Sundarkumar (2011) have extensively studied noise levels in and around Vijayawada city in all the above zones.

Four locations in Residential zones are identified for the purpose: (i) Kondapalli, which is 25 km away from Vijayawada city (ii) Bhavanipuram, within the city limits (iii) Mylavaram, around 40 km away from Vijayawada and is located in the rural area near the Vijayawada Municipal zone (iv) Joginagar in Bhavanipuram, within the city limits.

Kondapalli, is an industrial area housing many industries in the region. People commute from Vijayawada daily for their livelihood along with the local people. Bhavanipuram is the semi urban area, which is a center of many commercial activities such as retail and whole-sale merchant trades. A local market yard is exclusively constructed for this purpose. The residential life is also quite busy in this area due to these activities. Two different areas are considered in Bhavanipuram and these locations are far away from each other but fall in residential area only. Though Mylavaram is in Rural area, this town acts as a commercial center for the nearby villages around. Further, Educational institutions, Banks, Markets, Commercial complexes, Cinema halls are also making this town a busy location for the locals as well as to the daily commuters.

The present study is taken up with the following objectives:

- To study the noise levels in the residential area in and around the Vijayawada city.
- To estimate the equivalent noise levels in the residential area.
- To compare noise levels with regulatory standards.

2.1 Sampling:

Ambient noise levels are carried out in all these four Residential areas at a single location only. Sampling is carried out from 7am-9am, 10am-12 Noon, 1pm-3pm, 4pm-6pm i.e., a total of 8-hours at an interval of every 2 minutes. Sampling is carried out for 2-days to ascertain the variation and accuracy of noise level distribution in these areas. Sampling is carried out using a digital hand-held Sound Level meter that can measure up to 130 dB values. It is also provided with flexible option of detecting slow and fast response of sound signals.

2.2: Models and tools used

The noise levels that are obtained from the field study are analyzed using the noise quality parameters given below (Ramakrishna (2017, 2019)).

$$L = 20 \log_{10}\left[\frac{1}{N}\sum_{1}^{N}(10)^{\frac{Li}{20}}\right] \text{ ---------- (1)}$$

$Leq = L50+0.018(L10-L90)^2$ ---- (2)

NC = L10-L90 ---- (3)

The average sound level Lavg is calculated using Eq (1). The equivalent sound levels obtained from field data are estimated using Eq.2. In this method, the standard noise quality parameters such as L10, L50 and L90 are used. The L10, L50 and L90 values are the parameters obtained from standard Noise climate curve. In this curve, the Sound levels are taken on the X-axis and Percent time finer than is taken on the Y-axis. The corresponding abscissa values of L10, L50 and L90 are noted from the graph. The Noise climate (NC) is obtained using Eq.3. This NC indicates the background noise levels. Smaller is the value of NC, lesser is the variation of sound levels in the region and vice-versa. The analysis is carried out using MS Excel.

3. RESULTS AND DISCUSSION

Based on the collected noise data at four different locations at four residential zones for two days at each location, the following empirical results were obtained at each location respectively. The results are given in Table-1 and Fig. 1. Based on these results, the output is compared with standard permissible limits (Ref Table-1) of different noise values.

Table-1: Results obtained at Sampling locations

S No	Location	Sampling time	L10	L50	L90	NC	Leq	Lavg	Permissible Limits
1	Kondapalli	Day 1 (8 hours)	55	44.5	41	14	48.02	50	55 dB (A)
2		Day 2 (8 hours)	60.3	54.3	51.3	9	53.4	52.4	
3	Bhaavanipuram	Day 1 (8 hours)	60.2	54.2	48.3	11.9	50.8	50.6	55 dB (A)
4		Day 2 (8 hours)	58.6	51.3	46.3	12.3	51.3	50.2	
5	Mylavaram	Day 1 (8 hours)	60.2	49.5	46.2	14	50.5	50.8	55 dB (A)
6		Day 2 (8 hours)	58.6	48.5	41	17.6	50.2	50.7	
7	Joginagar	Day 1 (8 hours)	60.2	49.5	48.2	12	50.7	51.3	55 dB (A)
8		Day 2(8 hours)	61.2	54.3	49.6	11.4	53.4	52.4	

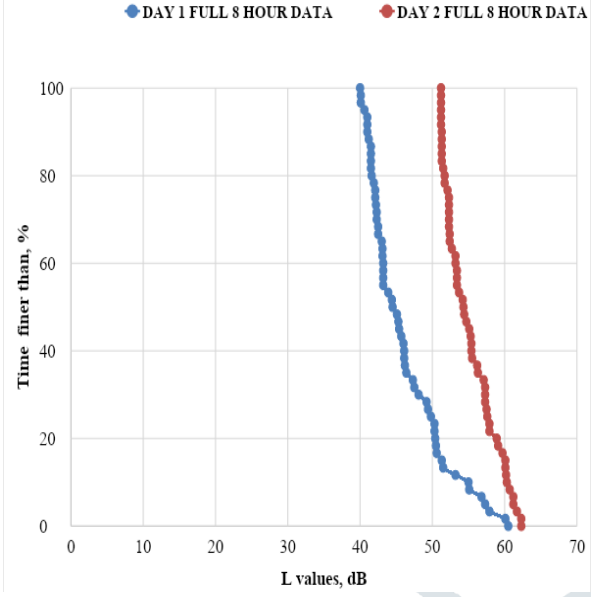

Fig. 1 (a): Day1 & Day2 8 hour graph at Kondapalli

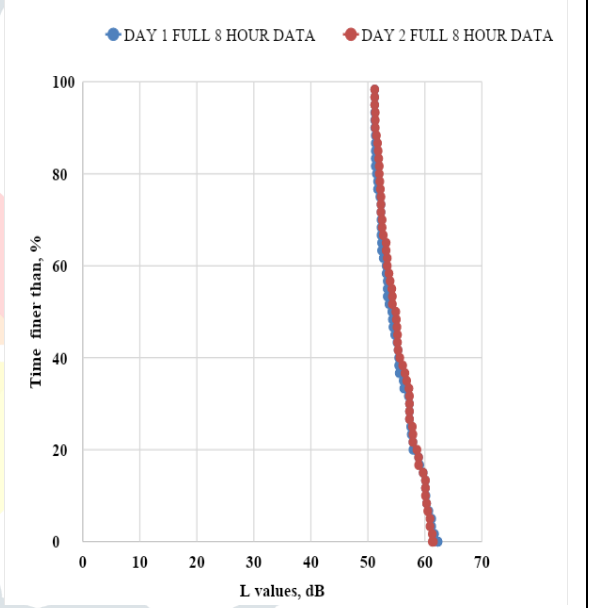

Fig.1 (b): Day1 & Day2 8 hour graph at Bhavanipuram

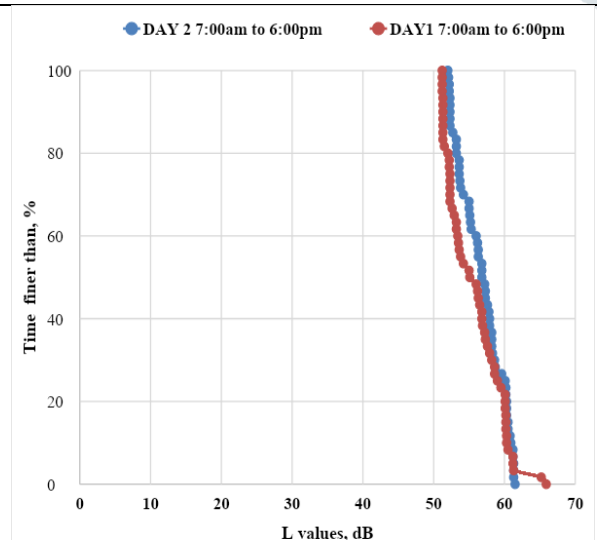

Fig.1 (c): Day1 & Day2 8 hour graph at Mylavaram

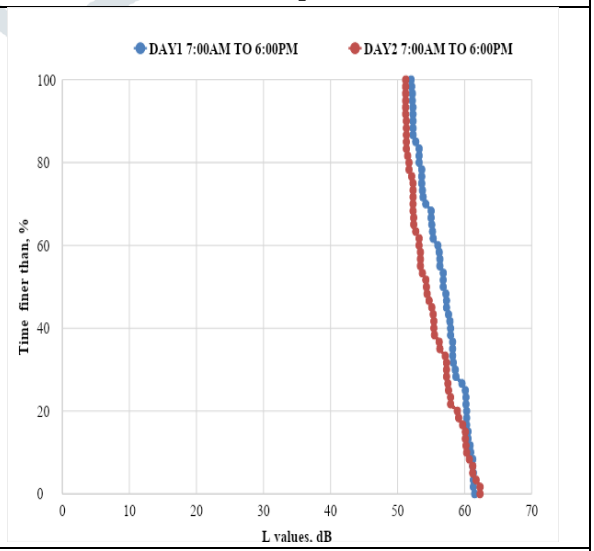

Fig.1 (d): Day1 & Day2 8 hour graph at Joginagar

Salient observations from the results obtained

The following observations are drawn by analyzing Table-1 and Fig.1:

- Except in Kondapalli, the trends of the graphs are almost similar. In Kondapalli, however, the variation is very nominal. This is evident from the computed NC values at the sampling locations. The deviation of NC values at Kondapalli between Day-1 and Day-2 is slightly higher than at the remaining locations. This indicates that, the band width of background levels is similar at these locations except at Kondapalli due to local disturbance during sampling time.
- The Leq and Lavg values are computed using two different models. The Lavg value is a logarithmic average for the values obtained during sampling period. The Leq value is the equivalent value of sound levels after considering extremely high (L10) and extremely low (L90) values during sampling duration. Such levels will often exist only for very short duration and hence their contribution is considered in the model. The Lavg and Leq values are very similar on each day at these locations indicate the consistency of generated sound levels in the sampling zone during sampling duration. It also indicates that no local disturbances in these areas are occurring except the normal sound levels that are usually generated during the day operation.
- The obtained Leq and Lavg values for each location are similar highlighting the similar background noise levels in these areas.
- The Leq and Lavg values for the daytime are less than the permissible limits of 55 dB (A) at all the four locations. It shows that, the sampling locations are not disturbed by their zonal importance, whether they are in the industrial area or commercial area etc.
- The daytime as per the Regulations is considered from 6am-10 pm indicating the active period during the 24 hours. The remaining time is considered as nighttime. The sampling duration adopted in the study is from 7 am - 6 pm only due to certain practical limitations. The sampling period considered includes most of the active period considered under daytime as per the regulations. During this period, the noise levels are obtained within the permissible limits. It is hence assumed that the noise levels from 6–10 pm will also be within the limits at these locations.

Since, the 8-hour sampling results are obtained as to be within the permissible limits, it is decided to analyze the results for the nosiest sampling time during the study at these locations. For this purpose, the data is analyzed for each day with respect to sampling time. The results are given in Table-2.

Table-2: Sampling time wise results obtained at sampling locations

S. No	Location	Sampling time, Hours, IST	Leq	Lavg	Permissible limits
1	Kondapalli	Day1 (7-9)	46.8	48.1	55dB(A)
2		Day1 (10-12)	54.9	53.1	
3		Day1 (13-15)	48.1	48.6	
4		Day1 (16-18)	49.2	49.1	
5		Day2 (7-9)	55.3	53.2	
6		Day2 (10-12)	49.8	49.1	
7		Day2 (13-15)	50.1	50.3	
8		Day2 (16-18)	48.9	48.9	
1	Bhavanipuram	Day1 (7-9)	52.2	51.6	55dB(A)
2		Day1 (10-12)	51.5	51.4	
3		Day1 (13-15)	49.5	49.7	
4		Day1 (16-18)	50.1	49.6	
5		Day2 (7-9)	49.7	49.9	
6		Day2 (10-12)	49.3	48.6	
7		Day2 (13-15)	51.6	50.2	
8		Day2 (16-18)	53.9	51.7	
1	Mylavaram	Day1 (7-9)	54.12	53.3	55dB(A)

2		Day1 (10-12)	50.9	50.5	
3		Day1 (13-15)	48.1	50.3	
4		Day1 (16-18)	46.8	48.1	
5		Day2 (7-9)	49.3	51.3	
6		Day2 (10-12)	52.0	52.6	
7		Day2 (13-15)	48.9	50.1	
8		Day2 (16-18)	46.8	48.1	
1	Jogi Nagar	Day1 (7-9)	53.4	52.7	55dB(A)
2		Day1 (10-12)	55.8	55.3	
3		Day1 (13-15)	55.2	54	
4		Day1 (16-18)	57.6	56.4	
5		Day2 (7-9)	58.3	57.6	
6		Day2 (10-12)	57.4	56.7	
7		Day2 (13-15)	57.5	55.6	
8		Day2 (16-18)	57.0	55.7	

The following observations are drawn from Table-2:

- The noise levels at these locations at different timings are similar on both days of sampling at all the four locations. Normally, the noise levels before 9 am will be relatively less, increases slightly due to vehicular activity of the people going to offices, markets etc, relatively less between 1-3 pm which is considered as lunch hours, and slightly increases from 4 pm onwards as vehicular activity increases since people will be returning from offices/workplaces. However, the sampling is carried out in May/June 2021, which is lockdown time in Vijayawada due to COVID-19. The movement of people in these areas is limited and hence, very little variation is noticed at all the four locations.
- The lockdown is relaxed till 12 noon for the people purchasing essential items. After 12 noon, it is strictly implemented. The slightly higher values of noise levels are hence observed at the sampling locations before 12 noon and reduced slightly afterwards.

Ramakrishna et al., (2017, 2019) observed that ambient and traffic noise levels in and around Vijayawada city are high due to the increased transport activity after bifurcation. The results of the present study proved that, increased ambient noise levels are mainly attributed due to increased vehicular activity as the noise levels during lockdown period are below the permissible limits.

SUMMARY AND CONCLUSIONS

Ambient noise levels are monitored at four sampling locations in and around Vijayawada. Sampling is carried out in two days for 8-hour per day from 7am – 6 pm at 2 minute intervals. The values obtained are analyzed using noise quality parameters such as Leq, Lavg and Noise climate. The following conclusions are drawn from the study:

- In all the four selected residential zones, the noise levels are within the permissible limits.
- The noise levels are significantly reduced due to the lockdown effect in the sampling areas.

A few suggestions are floated to mitigate the noise pollution problem during normal days beyond lockdown period:

- Regular and proper maintenance of roads and highways
- Traffic flow should be optimized and carefully planned in the residential areas
- Encouraging plantation and installation of sound screening barriers
- Planning for bye-pass roads and diversion of traffic near residential and silent zones
- Display of minimum sound level signal boards at prominent places in residential areas

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