Indian Journal of Air Pollution Control Vol. IX No.1 March 2009 pp90-98

Monitoring of Noise Levels at Selected Cities in North India

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Abstract

A monitoring investigation has been carried out in selected areas of northern India, viz. Agra, Mathura, Firozabad and Bharatpur. It reveals that Noise Level Standards and Guidelines as notified in the Environment (Protection) Rules, 1986 are yet to be complied at almost all areas, particularly during night hours. The monitoring investigation shows that L_{eq} is largely influenced by L_5. This means that stipulated standard can easily be complied upon implementation of regulatory measures for 5% and 10% of the exceeding data.

Key words: Noise Level, Leq, National Standard

Introduction

Noise affects both health and behaviour of mankind. Noise pollution caused by loud music, blowing horns, drums, loudspeakers, crackers etc. disturbs sleep, increases stress, causes distraction & discomfort and deprives peace of mind. It disturbs the students, is a hazard to the aged and the sick and is a sign of disrespect to the community at large. Intense sounds can damage physiological and psychological health. Long exposure to noise can cause noise-induced hearing loss. High noise levels can also contribute to cardiovascular effects. Noise can have a detrimental effect on animals too. One of the best known cases of damage caused to animals by noise pollution is the death of certain species of beached whales due to the loud sound of military sonar. Noise also makes species communicate louder, which is called Lombard vocal response.

Realizing the need to control and regulate noise levels, the Ministry of Environment and Forests, Government of India, have notified Noise Level Standards and Guidelines under Environment (Protection) Rules, 1986, known as Noise Pollution (Regulation & Control) Rules, 2000. The specific standards as described in the rules are:

Area Code	Category of Area Limits dB(A), L_{eq}	Day	Night
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone	50	40

Note:

- Day time is reckoned in between 6 a.m. and 10 p.m.
- Night time is reckoned in between 10 p.m. and 6 a.m.
- Silence zone is referred as areas up to 100 meters around such premises as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
- Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.

Methodology

The ambient noise level was monitored using Integrating / logging Sound Level Meter (Quest Technologies, Model 1900, USA). Each set of data was calculated for its L_{eq} to see the compliance of prescribed noise level standard for respective L_5, L_{10}, L_{50} and L_{90} to examine the profile of noise at

different times of the day. The profile for noise has been described by Sharma and John (2007) and other aspects by Sengupta (2007). Monitoring precautions were taken to avoid direct impact of source / echo / resonance by selecting a suitable location for monitoring of ambient noise. To avoid manual interference to monitoring, the sound level meter was programmed for each time slot. Finally each set of data was compared with day and night standard vis-à-vis compliance of the rules.

Monitored Data

Ambient noise levels were monitored at Agra (the city of Tajmahal), Mathura (the birth place of Lord Sri Krishna), Firozabad (the city of glass bangles) and Bharatpur (town of Keoladevi National Bird Sanctuary) during October to December 2008.

Monitoring at Agra

Monitoring was carried out here at various occasions viz. (a) Pre-Deepawali, Deepawali, and post Deepawali days (i.e. during 26- 30 November, 2008), and (b) on a marriage day (i.e. 9-10 November, 2008). The basic objective was to see the impact on the ambient noise level of the bursting of crackers on the Deepawali occasion, and of beating of drums and blaring loudspeakers particularly at night during a marriage event. Monitoring was also carried out exclusively at Tajmahal on December 17-18, 2008 on a normal day to compare it with a noisy event day. The data and results are as under:

(a) For collecting data of pre-Deepawali, Deepawali, and post-Deepawali days, monitoring was undertaken at five identified locations during evening (2000 to 2200 hrs.) and night (2200 to 0400 hrs) on all 5 days. The observed data of L_{eq} at each monitoring slot is presented in Table I as also graphically [Figure I(a) & I(b)] along with reference applicable area standard for monitoring days / nights.

Table I: Noise Monitoring Data (During Deepawali Days), Agra

Location/Area	Time	Observed L_{eq} [all values are in dB(A)]					Applicable Std.
		26/10/08	27/10/08	28/10/08	29/10/08	30/10/08	
Taj Mahal (Silence)	2000-2200	48.0	66.0 ↑	64.0 ↑	71.0 ↑	58.0 ↑	50
	2200-0000	47.2 ↑	46.5 ↑	63.8 ↑	60.7 ↑	65.1 ↑	40
	0000-0200	-	43.1 ↑	45.6 ↑	54.0 ↑	53.4 ↑	40
	0200-0400	-	42.7 ↑	44.0 ↑	45.9 ↑	54.2 ↑	40
Dist. Hospital (Silence)	2000-2200	59.0 ↑	61.0 ↑	76.0 ↑	73.0 ↑	65.0 ↑	50
	2200-0000	53.5 ↑	66.5 ↑	75.4 ↑	67.9 ↑	57.5 ↑	40
	0000-0200	-	47.4 ↑	65.0 ↑	61.2 ↑	71.1 ↑	40
	0200-0400	-	46.5 ↑	50.1 ↑	58.2 ↑	59.8 ↑	40
Dholpur House (Residential)	2000-2200	56.0 ↑	55.0	66.0 ↑	72.0 ↑	61.0 ↑	55
	2200-0000	62.4 ↑	66.4 ↑	66.7 ↑	72.2 ↑	60.1 ↑	45
	0000-0200	-	55.4 ↑	60.7 ↑	60.9 ↑	64.7 ↑	45
	0200-0400	-	46.2 ↑	57.6 ↑	61.7 ↑	68.9 ↑	45
Taj Ganj (Residential)	2000-2200	74.0 ↑	70.0 ↑	73.0 ↑	77.0 ↑	69.0 ↑	55
	2200-0000	60.9 ↑	65.1 ↑	69.5 ↑	71.2 ↑	70.5 ↑	45
	0000-0200	-	52.0 ↑	50.9 ↑	50.9 ↑	66.1 ↑	45
	0200-0400	-	52.9 ↑	55.9 ↑	53.7 ↑	63.9 ↑	45
Sadar (Commercial)	2000-2200	83.0 ↑	82.0 ↑	82.0 ↑	80.0 ↑	86.0 ↑	65
	2200-0000	76.4 ↑	87.3 ↑	78.6 ↑	76.7 ↑	78.3 ↑	55
	0000-0200	-	59.6 ↑	71.9 ↑	72.5 ↑	72.2 ↑	55
	0200-0400	-	54.7	44.4	60.1 ↑	54.8	55

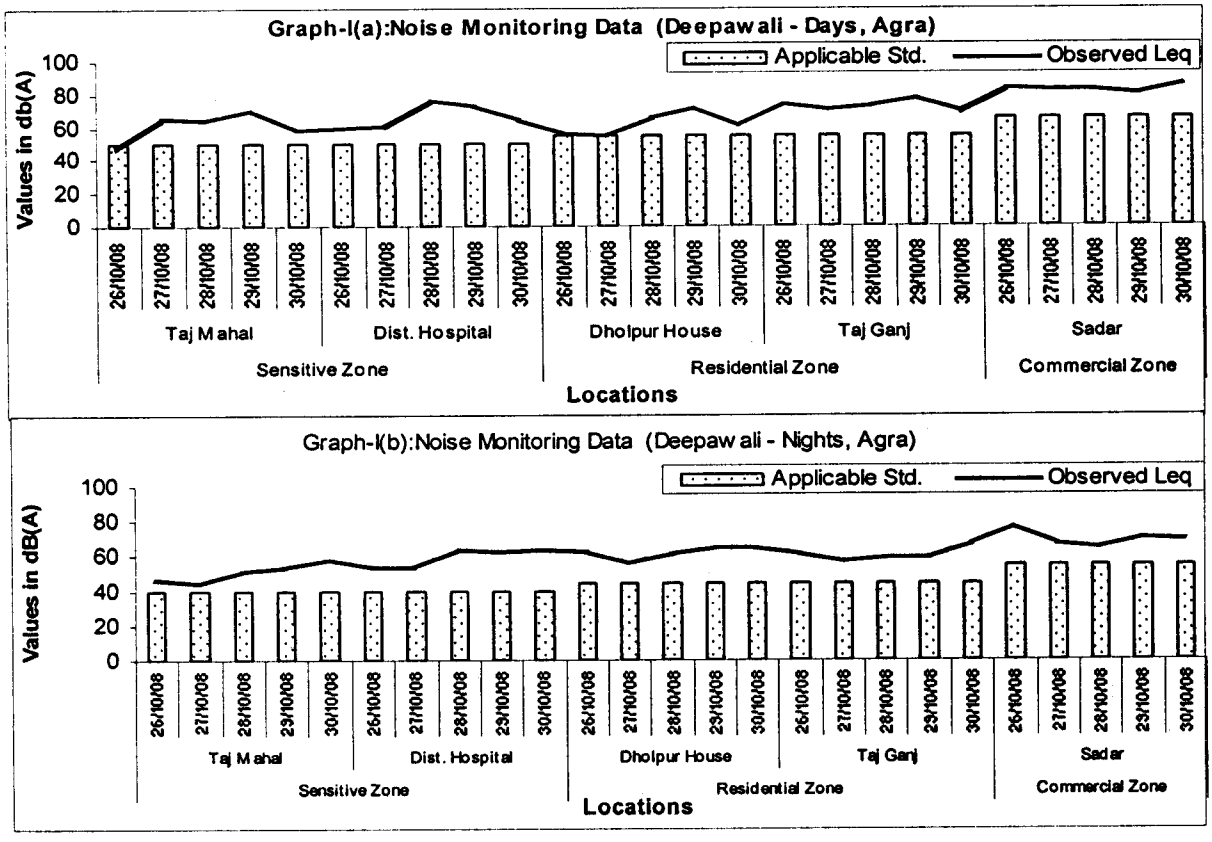

Figure 1: Noise Monitoring Data at Agra on the occasion of Deepawali.

(b) For collecting data on marriage days, monitoring was carried out at 4 identified locations in five time slots viz. morning (1000-1130 hrs), afternoon (1300-1430 hrs), evening (1700-1830 hrs), early night (2200-2330 hrs) and late night (0000-0130 hrs). The graphical presentation of data in terms of L_{eq} with reference to applicable area standard is shown at figure-II, while data in terms of L_5. L_{10}, L_{50} and L_{90} are given in Table-II.

Table II: Noise Monitoring Data (08-09 November 2008 - Marriage Day), Agra [All values are in dB(A)]

Location/Area	Time (Hrs.)	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	Applicable Std.
	1000-1130	64.3	62.5	56.9	51.8	59.9 ↑	55
	1300-1430	67.5	65.8	60.8	57.9	62.9 ↑	55
	1700-1830	64.3	62.4	56.3	52.1	58.9 ↑	55
	2200-2330	69.2	66.9	61.6	56.8	63.9 ↑	45
	0000-0130	65.9	63.2	57.1	52	60.7 ↑	45
Kamla Nagar (Residential)	1000-1130	59.3	56.5	46.8	41	53.6	55
	1300-1430	52.8	56.1	47.8	41.8	52.8	55
	1700-1830	64.2	62.9	60.3	43.4	59.9 ↑	55
	2200-2330	54.8	51.5	41	38.6	49.8 ↑	45
	0000-0130	56.3	55.7	37.7	35.7	47.7 ↑	45
St John.	1000-1130	68.2	66.2	59	51.1	62.7	65

(Commercial)	1300-1430	70.4	68	59.8	52.4	64.4	65
	1700-1830	76.8	74.3	67.3	60.2	71 ↑	65
	2200-2330	72.3	70.2	64	57	67.7 ↑	55
	0000-0130	69.8	67.3	58	49.5	63.7 ↑	55
Mughal Road (Commercial)	1000-1130	63.6	61.3	55.5	50.6	58.6	65
	1300-1430	62.2	60.2	53.8	48.5	56.6	65
	1700-1830	71.9	71.8	58	50.4	67.1 ↑	65
	2200-2330	75.5	72.5	65.3	50.3	68.5 ↑	55
	0000-0130	67.1	63.9	56.6	48.2	62.2 ↑	55

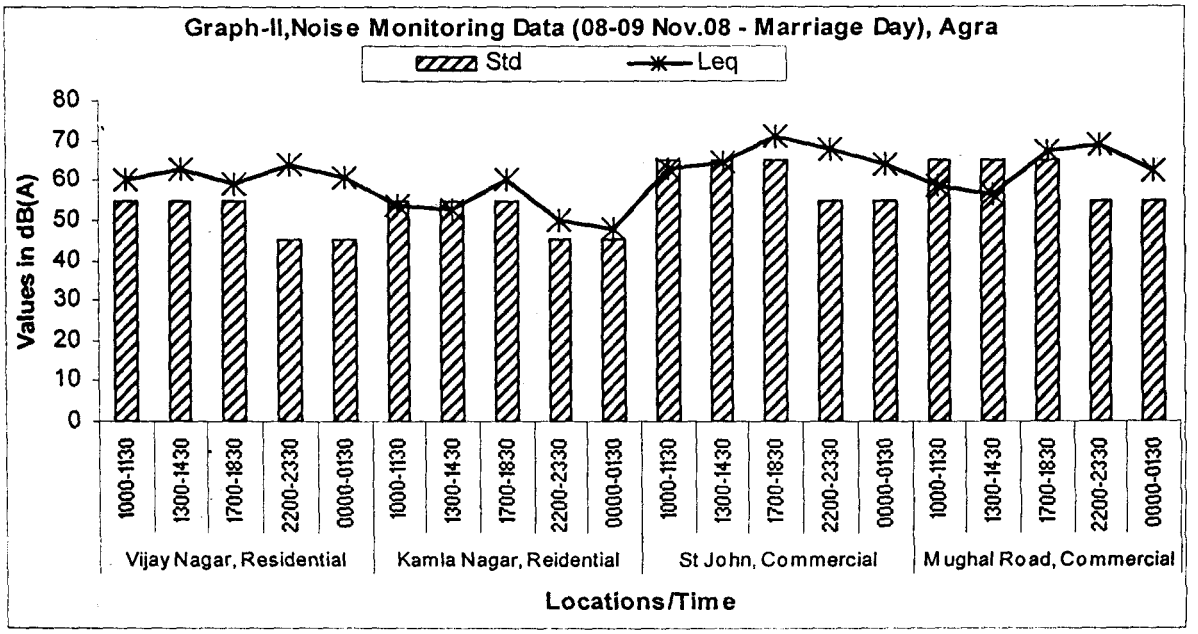

Figure II: Noise Monitoring Data at Agra during the Marriage Event.

(c) To compare the noise level on the noisy festival occasions with the ambient noise level on a normal day especially at the world famous heritage building Tajmahal, monitoring was also carried on a normal day (December 17-18, 2008). The recorded hourly data for the whole day is given graphically at figure-III, while the analyzed data with respect to L_5, L_{10}, L_{50}, L_{90} and L_{eq} is presented in Table-III.

Table III: Noise Monitoring Data (17-18 December 2008) - Tajmahal, Agra [all values are in dB(A)]

Time (Clock Hours)	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	Std.
0700-0715	62.8 ↑	61.6 ↑	57.2 ↑	55.1 ↑	59.4 ↑	50
1000-1015	64.8 ↑	63.5 ↑	60.0 ↑	58.1 ↑	61.0 ↑	50
1300-1315	60.4 ↑	59.2 ↑	55.5 ↑	53.1 ↑	56.5 ↑	50
1600-1615	61.7 ↑	60.6 ↑	57.4 ↑	55.3 ↑	58.4 ↑	50
1900-1915	56.9 ↑	56.3 ↑	52.8 ↑	43.9 ↑	53.9 ↑	50
2200-2215	56.1 ↑	56.0 ↑	47.1 ↑	43.3 ↑	52.7 ↑	40
0100-0115	48.2 ↑	42.8 ↑	40.5 ↑	39.4	47.5 ↑	40

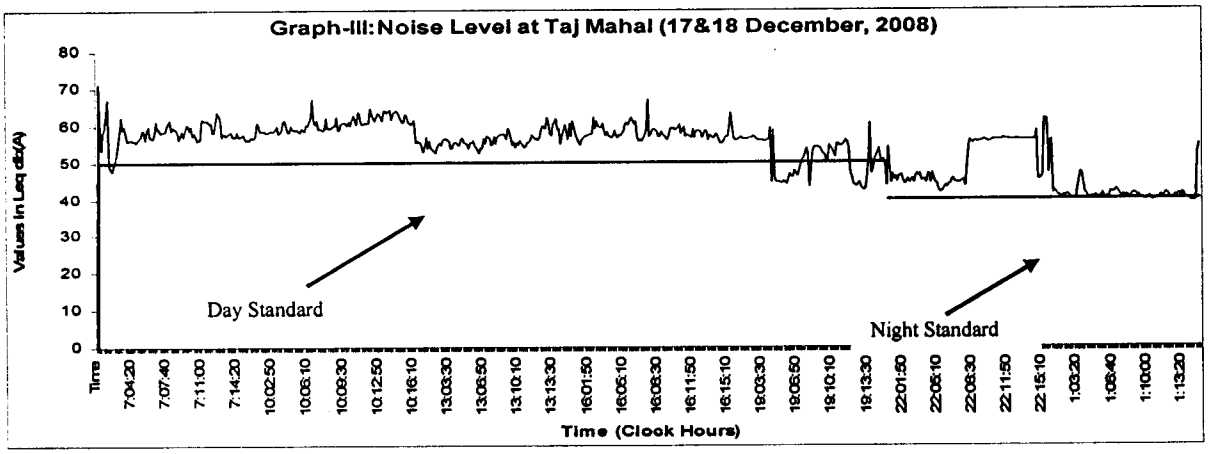

Figure III: Noise Monitoring Data at Taj Mahal Agra on a normal day.

Monitoring at Bharatpur

Monitoring here was carried out on a non-festive day on November 14, 2008 at 4 identified locations in five time slots viz. morning (1000-1130 hrs), afternoon (1300-1430 hrs), evening (1700-1830 hrs), early night (2200-2330 hrs) and late night (0000-0130 hrs). The objective was to know general noise levels in the town including at the Keoladevi National Park. The analyzed data for L_5, L_{10}, L_{50}, L_{90} and L_{eq} along with respective area standard is given in Table-IV, while graph showing L_{eq} and applicable standard of this monitoring study is shown at Figure IV.

Table IV: Noise Monitoring Data (14/11/2008) - TTZ Bharatpur[all values are in dB(A)]

Location/Area	Time	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	Applicable Std.
District Hospital (Silence)	1000-1130	62	60.4	55.8	51.2	57.4 ↑	50
	1300-1430	58	55	48.7	44.5	54.5 ↑	50
	1700-1830	62.8	61.2	54.9	52.7	57.7 ↑	50
	2200-2330	67.5	65.1	52.7	50.1	60.8 ↑	40
K.N.P. (Silence)	1000-1130	44	40.8	36.5	35.6	42.5	50
	1300-1430	50.3	50	49.6	36.3	48.9	50
	1700-1830	36.6	32.7	26.7	24.9	31.2	50
	2200-2330	40.2	35.2	28.6	26.4	41.2 ↑	40
Bijli Ghar Chauhara (Commercial)	1000-1130	68.3	66.4	61.3	57.7	63.4	65
	1300-1430	71.1	69.1	63	59.2	65.7 ↑	65
	1700-1830	68.7	67	61.7	57.3	63.6	65
	2200-2330	67.2	64.9	58.7	53.8	63.4 ↑	55
RIICO (Industrial)	1000-1130	54.7	53.4	49.9	47.7	51.0	75
	1300-1430	57.4	56.1	51.8	48.9	53.3	75
	1700-1830	59.6	58.4	55.4	54	56.5	75
	2200-2330	59.1	57.3	52.1	49.1	54.6	70

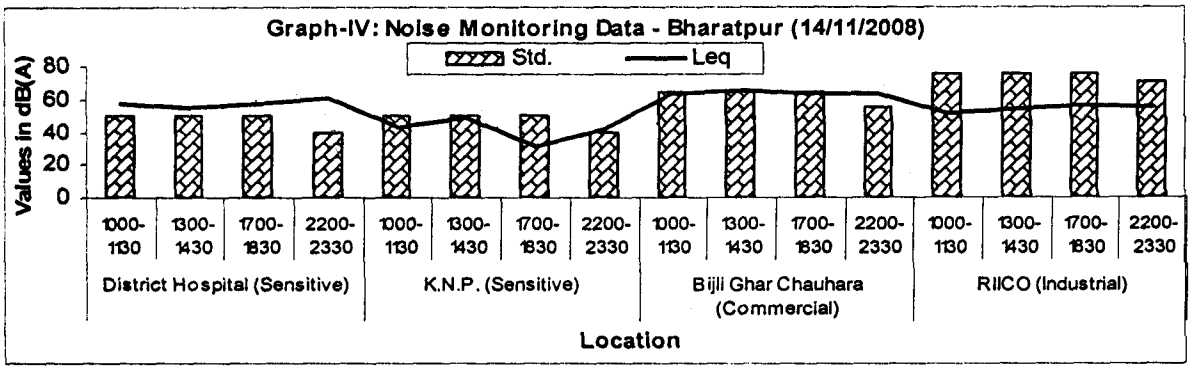

Figure IV: Noise Monitoring Data at Bharatpur on a normal day.

Monitoring at Firozabad

The monitoring was carried out on a non-festive day on November 21, 2008 at 3 identified locations at five time slots viz. morning (1000-1130 hrs), afternoon (1300-1430 hrs), evening (1700-1830 hrs), early night (2200-2330 hrs) and late night (0000-0130 hrs). The objective was to know general noise levels in this industrial town in UP. The data obtained for L_5, L_{10}, L_{50}, L_{90} and L_{eq} including a comparison with respective noise level standard is given in Table V, while a comparison of L_{eq} and applicable standard has been shown at figure V.

Table V: Noise Monitoring Data (28/11/2008) – TTZ Mathura[all values are in dB(A)]

Location/Area	Time	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	Applicable Std.
District Hospital (Silence)	1000-1130	65	63.5	59.7	53.9	61.3↑	50
	1300-1430	65.7	60.7	54.5	50	64.2↑	50
	1700-1830	62.8	60.2	53.4	49.3	60.7↑	50
	2200-2330	70.3	69.9	69.4	55.5	68.6↑	40
Shri Krishna Janm Sthan (Residential)	1000-1130	55.7	54	49.4	46.8	52.4	55
	1300-1430	75.7	67	50.5	44.6	67.7↑	55
	1700-1830	82.5	82.3	63.8	54.4	75.6↑	55
	2200-2330	64.6	64.1	61.9	60.9	62.5↑	45
State Bank Chauraha (Commercial)	1000-1130	84.9	82.7	75.8	70.7	78.9↑	65
	1300-1430	85	83.8	76.5	68.2	79.8↑	65
	1700-1830	82.6	80.4	73.2	67.3	76.8↑	65
	2200-2330	81	78.7	66.1	59.3	73.7↑	55

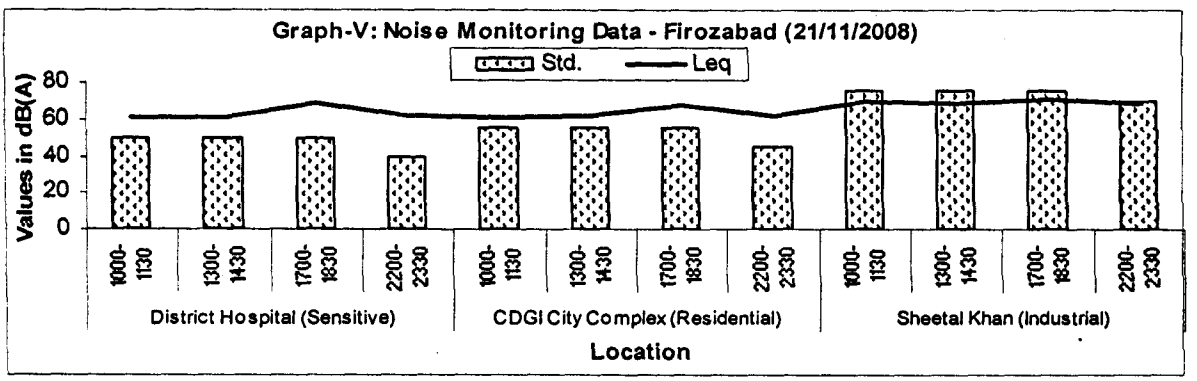

Figure V: Noise Monitoring Data at Firozabad on a normal day.

Monitoring at Mathura

Monitoring at Mathura was carried out on a non-festive day on November 28, 2008 at 3 identified locations at five time slots viz. morning (1000-1130 hrs), afternoon (1300-1430 hrs), evening (1700-1830 hrs), early night (2200-2330 hrs) and late night (0000-0130 hrs). The objective was to know general noise levels in Mathura town including at the birth place of Lord Krishna. The data analyzed for L_5, L_{10}, L_{50}, L_{90} and L_{eq} are tabulated at Table VI and a comparison of L_{eq} and respective noise level standard is shown at figure VI.

Table VI: Noise Monitoring Data (21/11/2008) – Firozabad[All values are in dB(A)]

Location/Area	Time	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	Applicable Std.
District Hospital (Silence)	1000-1130	65.5	63.7	58.5	53.9	60.6↑	50
	1300-1430	66.3	63.8	57.6	54.6	61.1↑	50
	1700-1830	74.3	72.6	66.7	59.5	68.9↑	50
	2200-2330	65.8	63.7	59.8	56.7	61.9↑	40
CDGI City Complex (Residential)	1000-1130	64.4	62.7	59	56.5	60.8↑	55
	1300-1430	67.4	65.5	58.8	53.6	62.0↑	55
	1700-1830	73.2	70.7	63.8	59.4	67.2↑	55
	2200-2330	67	64.6	59.8	56	62.5↑	45
Sheetal Khan (Industrial)	1000-1130	77.3	72.4	65	61.9	70.3	75
	1300-1430	73.1	71	66.4	63.4	68.4	75
	1700-1830	74.2	73.5	70.2	65.2	70.6	75
	2200-2330	68.9	68	66.3	65.5	69.2	70

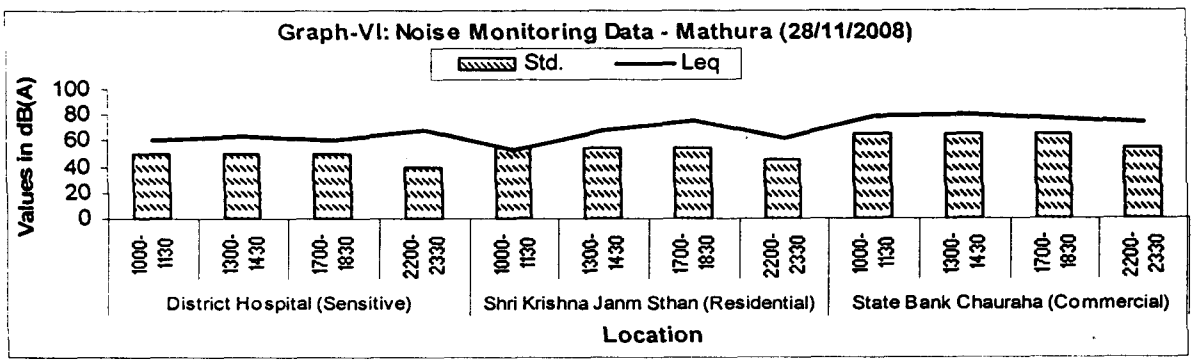

Figure VI: Noise Monitoring Data at Mathura on a normal day.

Discussion

Upon review of the monitoring data, it may be observed that monitoring was carried out for 157 time slots in 12 days at 20 identified locations (covering 7 silence, 6 residential, 5 commercial and 2 industrial areas in 72 day time slots and 85 night time sampling /monitoring slots) at 4 towns. The compliance of prescribed noise level standard was found to comply at 25 monitoring time slots out of a total of 157 slots. These were 4 out of 59 silence, 4 out of 54 residential, 9 out of 36 commercial and 8 out of 8 industrial zones. It may be further seen that the noise level was found to achieve the prescribed level only at 20 time slots during the day, and 05 time slots during the night i.e., the nights were more noisy than the day times,a scene that can be attributed to beating of drums, use of loud speakers, bursting of crackers, mass gatherings in open areas besides honking of pressure horns by heavy tonnage

vehicles especially during festival periods. The analysis of these data sets is shown in Table VII (a) and VII(b).

Table VII(a): Analysis of the Observed Data

Locations	No. of Locations	No. of Shifts Monitored			Total No. of Time L_{eq} equal or below the Standard		Total No. of Time L_{eq} equal or higher than the Standard
		Day	Night	Total	day	night	
Sensitive	07	27	32	59	04	-	55
Residential	06	22	32	54	04	-	50
Commercial	05	17	19	36	06	03	27
Industrial	02	06	02	08	06	02	00
Total	20	72	85	157	20	05	132

Table VII(b): Analysis of the Observed Data

Locations	Total No. of Locations	No. of shifts Monitored	Total No. of values>1 (Ratio=L5/Leq)	Total No. of values>1 (Ratio=L10/Leq)	Total No. of values>1 (Ratio=L50/Leq)	Total No. of values>1 (Ratio=L90/Leq)
Sensitive	05	23	16	06	10	22
Residential	04	18	16	08	11	18
Commercial	04	18	18	10	10	18
Industrial	02	08	07	01	01	07
Total	15	67	57	25	32	65

With a view to understand the above observed / monitoring sets of data including data trend, a critical examination of sound pressure level profile data at all areas in terms of L_5 (five percentile noise exceeding 5% of the observed values), L_{10} (ten percentile noise exceeding 10% of the observed values), L_{50} (fifty percentile noise exceeding 50% of the observed values), and L_{90} (ninety percentile noise exceeding 90% of the observed values) values was made and is shown in Table VII. It may be observed that L_{eq} values comparable with the given standards are largely dependant on L_5 values (as ratio was observed to be in the range of 1.06 at Mathura to 1.09 at Agra, for non-attainment values), followed by L_{10} values (as ratio was observed to be within a range of 1.03 at Mathura to 1.06 at Agra for non-attainment values). The ratio was noted to be 0.9 in case of L_{50} followed by 0.8 in case of L_{90}. Thus, it may be said that observed L_{eq} was mostly dependant on L_5 followed by L_{10} and not really dependant on L_{50} (as the ratio was noted to be less than one). The overall ratio of L_5 and L_{eq} was 1.1 and the statistical correlation (or dependency of variables) was calculated to be 0.95 at 9 locations out of total 15 monitored locations (data not considered for deepawali days) and while the overall ratio of L_{10} and L_{eq} was 1.0 and its correlation was calculated to be 0.95 at similar locations, while the ratio of L_{50} and L_{eq} was noted to be 0.9 and its correlation was 0.95 at 7 locations. Thus the observation as has been made by Bhattercharya, 2003 that the noise levels in all the cities / towns in India are above the permissible limits do hold good for the present investigation also.

The above observation indicates that in most areas ambient noise level may be reduced or controlled close to L_{eq} upon imposing restriction on the generation of L_5 values (i.e. 5% excess data) and L_{10} values (10% of excess data) and through launching of large scale mass awareness-campaign. However, if the L_{eq} would have depended on L_{50} (as has been observed at 7 locations out 15 locations), a comparatively larger effort would be needed to be initiated at the local level, while dependence of noise level on L_{90} (none was observed in this preset investigation), the control and regulation would have been the most challenging task for the local government including installation of noise absorbing

barriers at major roads, demarcation of residential areas, sensitive areas like health care institutes, monuments, courts etc. besides implementation of rules described in motor vehicles act.

Acknowledgement

The authors express their sincere thanks and gratitude to the CPCB Chairman Shri J. M. Mauskar IAS and the Member Secretary CPCB for encouragement and support. Sincere thanks are also expressed to all Regional Officers of State Pollution Control Boards (UP and Rajasthan) for extending local support during monitoring.

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