

A Comparative Study of Ambient Noise Level During Diwali Festival in Agartala City, Tripura, India

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Abstract—Ambient noise level plays a great role for human health and control the creative performance of our society. So study of ambient noise pollution is an important parameter to assess the environment health. In this study ambient noise level has been recorded for three successive years (2011-2013) in different locations of Agartala city to assess the temporal and spatial fluctuation of noise level between normal days and Diwali festival. Analytical results of the study revealed the fact that the noise pollution of the studied areas (Residential, Commercial and Silent Area) are exceed the normal standards prescribed by CPCB for different areas/zones. Residential and Silent areas have been severely affected by noise pollution during Diwali nights. Ambient noise level have been increases due to firecrackers, traffic noise and heavy vehicular movement during Diwali season and thus producing huge adverse effects on human health. Therefore, immediately proper noise control measures are needed to be taken for protection of the citizens of the city from unpleasant effects of noise.

Keywords—Ambient noise; Diwali festival; Tripura; Residential area; Commercial area; Silent area.

I. INTRODUCTION

Noise is unwanted, unpleasant and infuriating sounds which cause a significant environmental problem in many urban areas [1, 2]. Noise pollution considered as an environmental stressor which now become a problem of all over the world especially in developing countries like India [3]. According to the World Health Organization, noise pollution is the third most hazardous environmental pollution [4]. Steady increase of noise level has not been properly recognized due to incapability of our auditory system and thus goes unnoticed in real time [5]. So, the effects of noise pollution on humans and control of environmental noise pollution has been hampered by insufficient knowledge and lack of defined criteria [6]. The effects of noise pollution have not been realized as have air and water pollution because of three valid reasons as a subjective experience, short decay time, and

difficulty to associate cause with effect on human health [2]. Noise not only distracts our mental concentration but also causes numerous hazardous effects on the urban environment [1,7]. Adverse effects due to exposure to noise may include interference with speech communication, declining children's learning skills, hearing impairment, disturbance of rest and sleep, mental health and performance effects, effects on residential behavior and irritation and interference with intended activities [8,9,10]. The sources of noise pollution are extremely varied and they are mainly classified as community noise and industrial noise.

In India, festivals are traditionally celebrated with loudspeakers accompanied with songs and dance which include musical instruments; drums etc. and thus consequently produce a lot of infuriating noise. High frequency impulse noise produced by fire crackers during celebrations cause noise pollution beyond tolerable limits which disturbs social as well as human life [3,11]. Diwali, the festival of lights in India, is regarded as one of the most important and glamorous festival among all the events celebrated in India. It is also known as the festival of crackers which is celebrated almost all parts of the country with brighter sparkles, louder noise, and aesthetic forms of light. The varieties of crackers which consists several chemicals like copper, cadmium, lead, magnesium, zinc, nitrate and cyanide are harmful to the human health and leads to intense hazardous air and noise pollution [12, 13]. It is rather observable that when a number of crackers bursting serially, a continuous band of noise can form in the presence of reflecting surfaces which prolongs the time interval of prevailing sound strength and the continuous band of noise thus formed certainly affects the ambient level in close proximity [14,15,16].

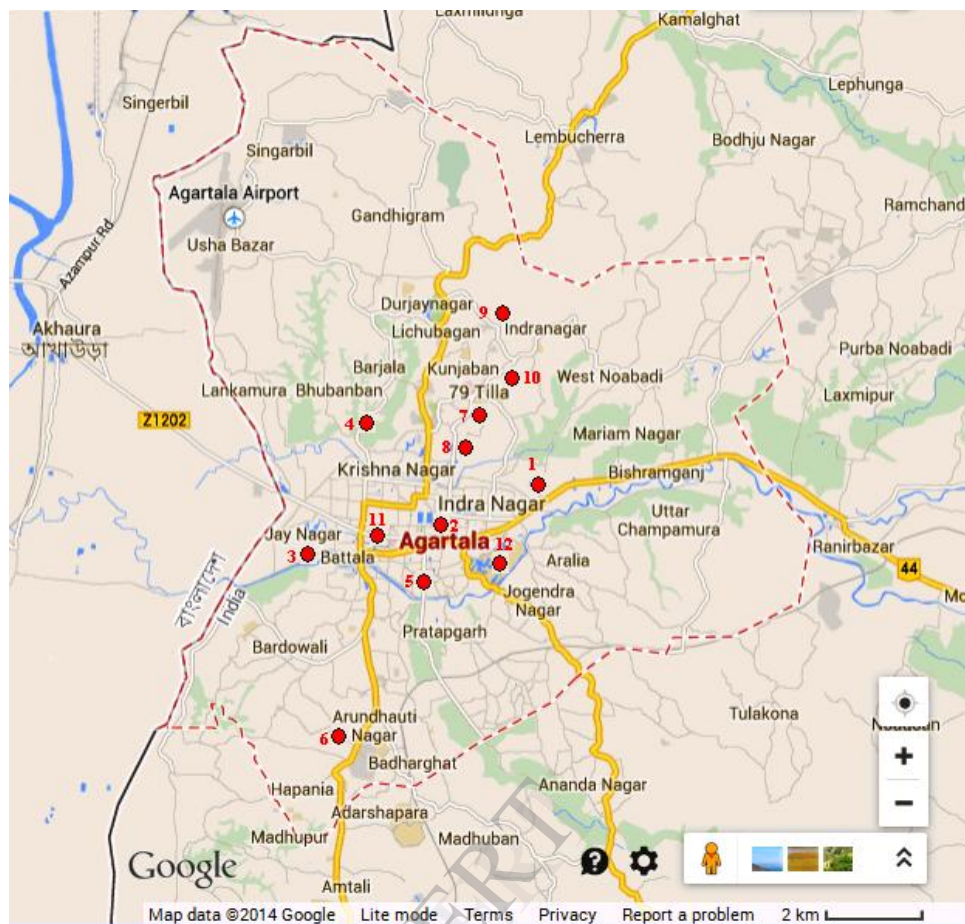


Fig.1. Map showing sampling locations of the study area of Agartala City.

Numbers in the map indicating location names are as – 1. Ashram Chowmuhani, 2. Astabal, 3. Battala, 4. Durga Chowmuhani, 5. Netaji Chowmuhani, 6. A.D. Nagarr, 7. Capital Complex, 8. Circuit House, 9. Indranagar, 10. G.B. Hospital, 11. I.G.M. Hospital, 12. M.B.B. College

In Tripura also Diwali is celebrated with the adoration of Goddess Kali with great ecstasy and exuberance. The rapidity of development, playing of mikes and thrashing of drum (Dhaak) in the puja pandals, vehicular movement, public address system, bursting of fire crackers and other influences contribute to an increasing noisy environment both in day and night time on Diwali occasion. This study was focused on monitoring of noise level of Agartala city during Diwali festival. Motive of the study was to have a clear idea about the spatial and temporal fluctuation of ambient noise level on Diwali day and normal day by assessing Equivalent noise level (L_{eq}) in different locations of the city located in various zone viz., commercial zone, residential zone and silent zone.

II. STUDY AREA

The Agartala city is located between latitude $23^{\circ} 86' N$ and longitude $91^{\circ} 24' E$ in the western part of Tripura, India (Figure 1). The city is spread over 58.84 sq. km. area and

inhabited by the population of 4.39 Lakhs. To study the intensity of noise pollution in Agartala city during Diwali festival, monitoring of noise level has been conducted in three different zones. The zones are Commercial zone, Residential zone and, Silent zone as per categorization of the Central Pollution control Board (CPCB) India. In total 12 locations has been identified prior to monitoring that includes 5 locations namely Ashram Chowmuhani, Astabal, Battala, Durga Chowmuhani and Netaji Chowmuhani in Commercial zone, 4 locations namely A.D. Nagar, Capital Complex, Circuit house and Indranagar in Residential zone and 3 locations in silence zone which includes G.B Hospital, IGM Hospital and MBB College (Figure 1).

III. METHODOLOGY

Sound level is measured by following standard procedure prescribed by CPCB using calibrated Sound Level Meters (SLM) [SL-4001] between 6.00 pm to 12.00 am during

Diwali and normal day in the year 2011-2013. Standard noise level for different zones during day and night time is followed according to CPCB guideline (Table 1). Our monitoring period comprises of 3 hrs. of day time and 3 hrs of night time (Total 6 hrs.). 5 readings has been made from each location within one hour duration i.e. 30 readings for each location and 360 readings in total, from 12 locations has been taken within 6 hrs., at one minute interval during six specified times (6 - 7 pm, 7.00 – 8.00 pm, 8.00 – 9.00 pm, 9.00 – 10.00 pm, 10.00 – 11.00 pm and 11.00 pm – 12.00 am). It is essential to declare here that there was good climatic situation on both normal and Diwali day and the monitoring of sound level on normal day was done prior to the onset of Diwali festival, continue regular activities. Noise descriptor L_{eq} for equivalent noise has been assessed to reveal the extent of noise pollution during Diwali and normal days for three consecutive years (2011-2013). L_{eq} calculate using the following formula-

$$L_{eq} = 10 \log \left(\sum_{i=1}^{n=0} f_i (10^{L_i/10}) \right) \text{ dB (A)}$$

Where, f_i = fraction of time for which the constant sound level persist (SPL), i = time intervals, n = number of observations, L_i = sound intensity level at a time interval.

L_{min} and L_{max} were also assessed for each location to observe minimum and maximum sound level respectively in specific time gap during the sampling period. L_{min} and L_{max} have been calculated by average of 5 sets of contemporary readings at one minute interval which includes 10 readings in total (5 minimum noise level and 5 maximum noise levels).

Table 1. Prescribed ambient Noise Standards [L_{eq} dB (A)] by CPCB for different Areas or Zones.

Sl. No.	Area+	Leq dB (A)	
		Day Time*	Night Time*
1.	Industrial Area	75	70
2.	Commercial Area	65	55
3.	Residential Area	55	45
4.	Silent Zone****	50	40

* Day time - 06.00 am to 10.00 pm

** Night time - 10.00 pm to 06.00 am

**** Areas up to 100 meters around certain premises like Hospitals, Educational Institutions, Courts, Religious places may be declared as Silence Zones by the Competent Authority. Honking of vehicle horns, use of loudspeakers, bursting of crackers and hawkers' noise should be banned in these zones.

+ Mixed area should be declared as one of four aforesaid areas by the Competent Authority and the corresponding limit is applied.

IV. RESULTS AND DISCUSSION

From the analytical results it has been evident that the noise pollution level on Diwali days was more than the normal days in the location for all the studied years. Analytical results are presented in the Table 2. and has been described below as per area (zone) level-

A. Commercial Area:

In all the locations which are located in Commercial areas the noise level was ranged between L_{min} 41.55 dB (A) to L_{max} 83.98 dB (A) on normal days whereas on the Diwali days it was ranged between L_{min} 55.10 to L_{max} 80.83 dB (A). Among the studied locations comparatively Netaji Chowmuhani, Ashram Chowmuhani and Durga Chowmuhani has less noise pollution on both normal and Diwali days during entire study period. Battala location has been severely suffering from harsh noise pollution both on normal and Diwali days which is ranged between 55.11 to 72.35 dB (A) of L_{min} and 68.56 to 87.58 dB (A) of L_{max} . The L_{eq} dB (A) was ranged between 46.14 to 63.92 dB (A) on normal days and 64.85 to 73.20 dB (A) on Diwali days in the year 2011. In the year 2012 the L_{eq} on normal days ranged between 64.94 to 71.99 dB (A) and on Diwali days it was ranged between 65.50 to 75.64 dB (A). Same trend has been follows for the year 2013 where on normal days the noise level ranged between 56.86 to 63.37 dB (A) and on Diwali days it was ranged between 62.13 to 72.82 dB (A).

B. Residential Area:

In case of residential areas noise level was ranged between 39.16 dB (A) to 67.31 dB (A) on normal days whereas on Diwali days it was ranged between 46.33 to 78.31 dB (A). During the study period comparatively capital complex was found to have less noise pollution on both normal and Diwali days. Nasty noise pollution was noticed in all of the studied locations of Residential area on both normal and Diwali days. Moreover during the year 2011 the L_{eq} dB (A) was ranged between 39.16 to 61.03 dB (A) on normal days and 51.51 to 78.31 dB (A) on Diwali days. In the year 2012 the L_{eq} dB (A) on normal days ranged between 46.03 to 67.31 dB (A) and ranged between 48.68 to 74.41 dB (A) on Diwali days. In 2013 the noise level was ranged between 39.71 to 61.05 dB (A) and 46.33 to 74.60 dB (A) for normal and Diwali days respectively.

C. Silent Area:

The noise level of silent zone was found in between 40.48 dB (A) to 60.73 dB (A) on normal days and 46.75 to 75.23 dB (A) on Diwali days. The I.G.M hospital area has been anguish from nasty noise pollution both on normal and Diwali days. The L_{eq} dB (A) was ranged between 42.02 to 49.84 dB (A) on normal days and 56.65 to 62.53 dB (A) on Diwali days in the year 2011. In the year 2012

the L_{eq} dB (A) on normal days ranged between 50.52 to 55.90 dB (A) and on Diwali days it was ranges between 57.76 to 61.29 dB (A) whereas in 2013 the noise level of the normal day was ranged between 42.18 to 53.84 dB (A) and on Diwali day it was ranged between 53.07 to 56.53 dB (A).

From this study temporal fluctuation has been clearly visualized in all of the studied locations (Figure 2). Sequential variation in noise level was noticed to be increase gradually from 6.00 – 7.00 pm time phase followed by 7.00 – 8.00 pm, 8.00 – 9.00 pm, 9.00 – 10.00 pm, 10.00 – 11.00 pm and 11.00 pm – 12.00 am time phase in both normal and Diwali days. The highest noise level was recorded 71.48 dB (A) and 79.90 dB (A) during 6.00 – 7.00 pm on normal and Diwali days respectively. Lowest noise level on normal days

was recorded 31.43 dB (A) at 10.00 – 11.00 pm whereas on Diwali days it was recorded 52.46 dB (A) at 11.00 am – 12.00 pm. Temporal L_{eq} was ranged between 49.24 – 60.27 dB (A) and 62.36 – 67.18 dB (A) during normal and Diwali days respectively. Likewise spatial fluctuation is found to be highest in Battala which was recorded as 71.99 dB (A) on both normal days and 75.64 dB (A) during Diwali days. In all of the studied locations the noise level was measured beyond the standard level during both normal and Diwali days (Figure 3). Only in Ashram Chowmuhani the noise level was recorded in between 55.75 to 65.5 dB (A) during the whole span of this study. Among the locations of silent area G.B Hospital area was found to has highest

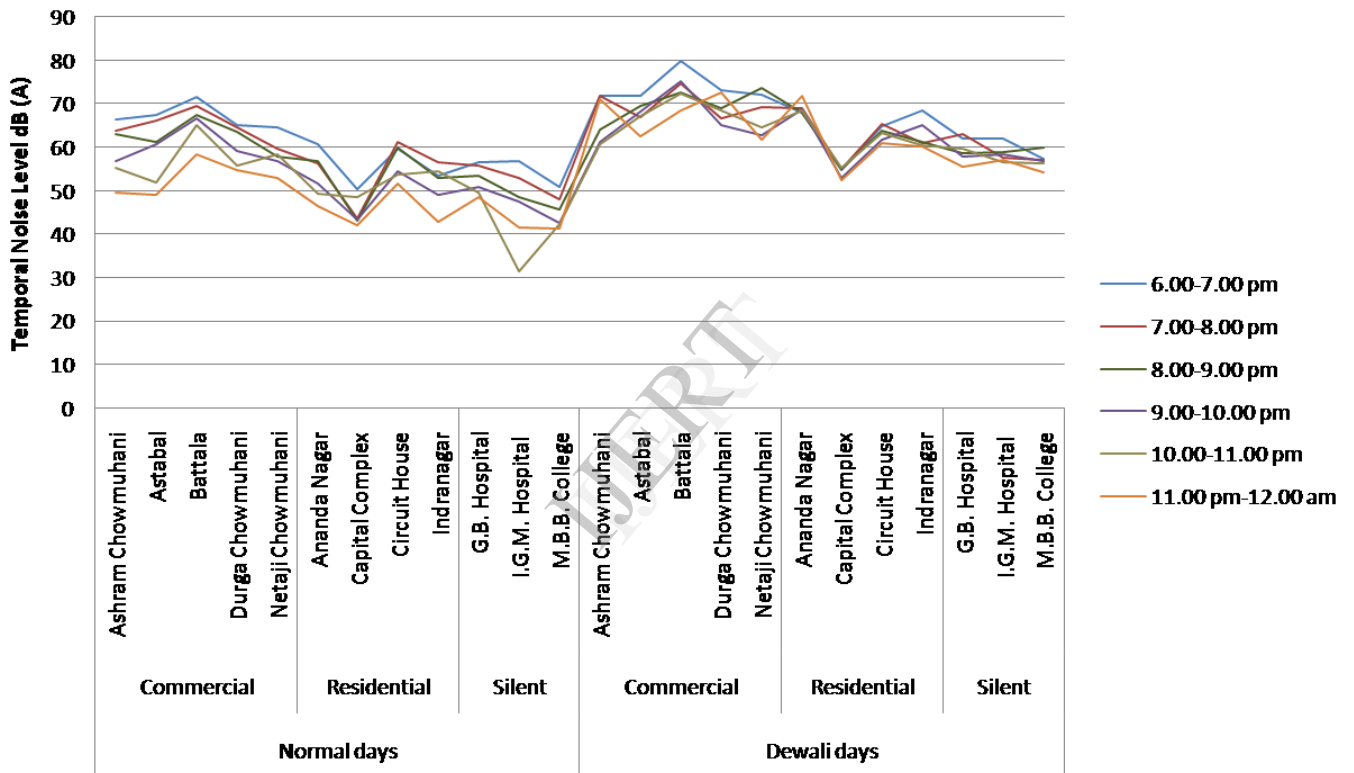


Fig. 2. Temporal pattern of noise level variation in Agartala city during normal days and Diwali festival.

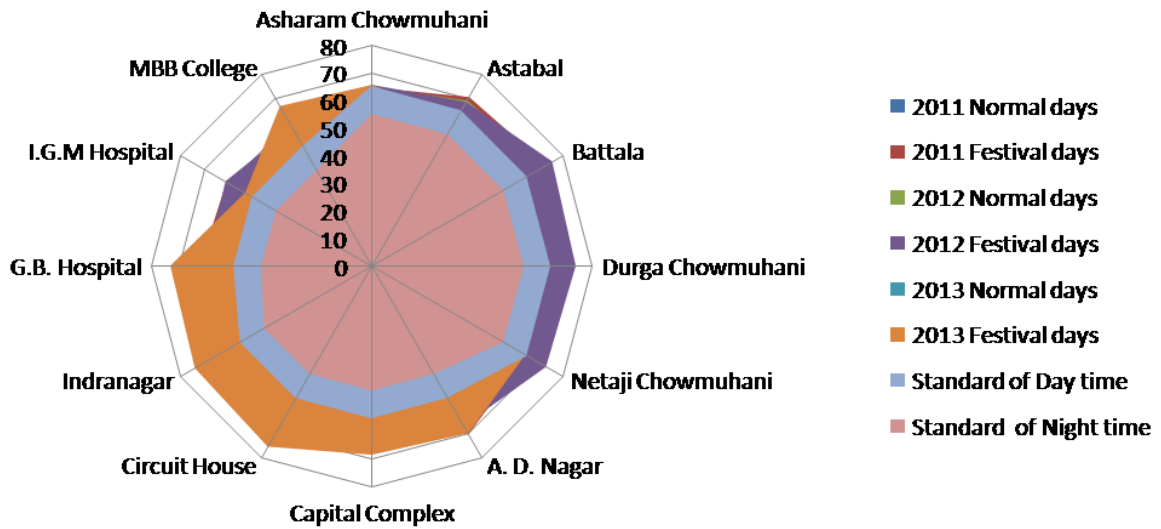


Fig. 2. Spatial pattern of noise level variation in Agartala city during normal days and Diwali festival.

Table 2. Noise level dB (A) variations at different locations of Agartala city during six specified times on normal and Diwali days of the years 2011 to 2013.

Year	Zones	Monitoring Sites	Mean $L_{min} \pm SD$ Normal days	Mean $L_{max} \pm SD$ Normal days	Mean L_{eq} dB(A) Normal days	Mean $L_{min} \pm SD$ Dewali days	Mean $L_{max} \pm SD$ Dewali days	Mean L_{eq} dB(A) Dewali days
2011	Commercial	Ashram Chowmuhani	50.20±7.8	60.80±12.2	55.75±9.6	58.30±2.8	73.10±2.4	64.85±2.4
		Astabal	46.85±5.8	57.26±10.8	51.78±7.0	66.03±4.2	76.88±3.7	70.76±3.8
		Battala	55.11±4.3	69.00±6.9	63.92±5.7	70.91±9.4	80.03±5.5	73.20±6.4
		Durga Chowmuhani	51.46±5.3	59.13±6.3	55.10±5.5	62.56±11.2	78.60±11.9	71.39±9.9
		Netaji Chowmuhani	41.55±4.5	50.08±7.6	46.14±6.2	55.10±2.7	71.90±5.9	64.92±4.8
	Residential	A.D Nagar	46.55±7.0	61.03±10.0	55.21±9.9	61.26±3.9	75.71±7.5	70.31±1.9
		Capital Complex	39.16±2.8	44.23±4.3	41.46±3.6	51.51±0.6	62.93±3.1	56.50±0.7
		Circuit House	48.98±3.9	60.50±1.7	55.39±4.9	60.50±1.7	77.63±5.8	69.52±3.1
		Indranagar	39.70±1.4	48.60±7.3	44.50±4.8	54.50±6.0	78.31±5.7	69.52±5.6
	Silent	G.B Hospital	44.23±5.9	50.75±8.8	47.63±6.9	55.23±2.1	64.23±6.3	62.53±5.5
		I.G.M Hospital	44.81± 9.5	52.58±11.4	49.84±10.2	53.78±1.0	73.03±9.3	60.85±4.1
		M.B.B College	41.11±6.1	44.93±6.0	42.02±4.1	52.83±0.6	61.06±1.3	56.65±0.5
2012	Commercial	Ashram Chowmuhani	55.73±4.8	70.85±5.6	64.94±5.3	57.28±2.6	73.31±4.4	65.50±2.6
		Astabal	60.15±6.6	74.85±7.7	69.44±6.3	60.33±4.9	75.13±10.6	68.46±6.1
		Battala	61.60±6.0	83.98±3.7	71.99±2.8	72.35±12.7	87.58±2.9	75.64±1.7
		Durga Chowmuhani	58.30±6.3	79.10±6.7	67.95±5.0	65.63±4.6	85.58±4.2	74.09±3.2
		Netaji Chowmuhani	55.63±5.4	82.43±5.4	67.81±4.8	61.33±4.5	83.80±7.3	73.05±6.6
	Residential	A.D Nagar	48.25±2.8	63.35±2.6	54.50±2.0	60.20±3.4	74.41±5.6	66.73±3.7
		Capital Complex	46.03±2.9	54.73±3.4	50.65±3.2	48.68±3.4	57.66±2.7	54.04±2.4
		Circuit House	56.93±6.2	67.31±7.1	62.99±6.8	54.50±4.4	68.66±4.7	61.56±3.8
		Indranagar	49.21±6.1	62.31±6.8	55.69±7.1	53.48±1.9	66.36±5.0	60.25±3.0
	Silent	G.B Hospital	50.50±1.9	60.63±2.0	55.90±1.0	54.90±3.3	67.93±5.3	60.37±3.1
		I.G.M Hospital	44.98±3.9	60.73±8.6	50.52±5.3	50.91±1.5	75.23±4.2	61.29±2.6
		M.B.B College	46.61±4.2	55.13±4.5	51.17±4.7	51.95±2.0	64.31±5.0	57.76±2.5
2013	Commercial	Ashram Chowmuhani	50.95±4.2	63.33±6.0	56.86±4.8	62.81±13.2	75.21±11.6	70.14±12.9
		Astabal	52.25±8.0	62.56±7.1	57.05±7.1	60.25±3.9	68.50±7.1	63.85±4.9
		Battala	58.56±4.9	68.56±5.3	63.37±5.3	67.16±5.5	76.73±4.4	72.82±5.6
		Durga Chowmuhani	53.00±5.6	63.23±4.5	58.36±4.6	55.68±3.0	68.18±7.1	62.13±3.4
		Netaji Chowmuhani	50.43±5.0	65.80±6.3	61.17±5.3	57.98±8.0	69.05±7.2	64.28±7.2
	Residential	A.D Nagar	45.40±5.7	58.50±7.8	51.00±6.4	63.76±6.5	74.60±2.3	69.99±4.1
		Capital Complex	39.71±5.1	47.93±7.4	43.47±5.5	46.33±1.5	58.73±1.8	52.04±2.9
		Circuit House	47.25±2.3	57.28±3.8	52.17±1.8	54.28±3.4	62.05±6.9	59.22±3.8
		Indranagar	47.40±10.0	61.05±10.2	54.46±9.2	49.73±2.0	64.95±5.9	58.44±8.0
	Silent	G.B Hospital	49.51±4.3	59.00±3.7	53.84±2.9	50.15±0.3	63.50±7.3	55.64±2.6
		I.G.M Hospital	44.53±2.9	51.53±5.0	47.53±3.5	46.75±3.6	61.10±5.9	53.07±2.6
		M.B.B College	40.48±3.2	44.05±3.4	42.18±3.1	51.71±2.6	61.58±4.7	56.53±3.4

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level of noise pollution which is measured maximum of 73.05 dB (A). Noise level of IGM Hospital area was found beyond standard level in 2012 during Diwali days.

From this study it is revealed that in almost all of the locations of the studied areas are suffering from the cause of increasing ambient noise level. Ambient sound levels were compared

with that of the standards prescribed in Environmental Protection Act, 1986 and standards of CPCB (Tripathy, 1999). The average L_{eq} of Agartala city was ranged between 50.63 ± 6.73 to 65.92 ± 5.76 , 60.30 ± 8.03 to 64.90 ± 6.86 and 53.38 ± 6.55 to 65.55 ± 7.36 for the year 2011, 2012 and 2013 respectively. Permissible noise level during such festival is 100 dB (WHO, 1999). The studied locations do not exceed this standard but not in prescribed standard range by CPCB for different category of Area (CPCB, 2000). The louder noise for short exposure has lethal effect on human health (Muzet, 2007; Ouis, 2001). The permissible limit of noise for residential areas is only 55 dB (A) during day time and 45 dB (A) during night time (CPCB, 2000). Analysis of data recorded in this study revealed the fact that during Diwali days the ambient sound level in residential areas is above the prescribed standard. However, it is evident that the noise of silent areas was found always above the prescribed standard by CPCB (50 dB for day and 40 dB for night). The average value of L_{eq} in silent area was analysed 54.35 ± 8.14 . Though the sampling locations of silent area include two Hospital areas, fruitful preventive measure is needed to be taken immediately. From the assessed ambient noise level it was observed that the noise level is in its peak during 7-10 pm throughout the study years. It is clearly evident from this study that the noise levels are not within prescribed standard for respective areas/zones and the situation is more vulnerable during Diwali days. Noise levels are elevated in residential area mainly because of firecrackers. Commercial as well as silent areas have increasing noise level during Diwali days due to heavy traffic and vehicular movement. To protect the citizens of Agartala city from various effects of noise, proper noise control measure need to be adopted soon.

ACKNOWLEDGMENT

The authors are warmly thankful to the Chairman, Tripura State Pollution control Board for his support and encouragement all through the study period. Thanks are also due to Member Secretary, Tripura State Pollution Control Board for providing facilities to accomplish the study and analysis of data.

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