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Ambient Noise Level Prediction During Festival Season In Metro City Of South East Asian Region

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ABSTRACT
Physical pollutants such as noise, causes so much confusion regarding its effect, often take the back seat when deleterious effects to the environment are considered. Metropolitan city of South East Asian region was selected for the study where day and night noise is monitored in higher levels in festival seasons as well as in normal seasons in all zones. It was found that prescribed noise level were increased 19.23%, 19.33% and 23.08% near Courts, schools and hospitals respectively under the silent zone. Slum areas are already affected whole year and noise level in middle class areas recorded 7.69% higher in festival season where as high class residential areas are found safer than the other two types of areas under the residential zone. Almost 85% areas under commercial zone are affected by higher noise levels in both the seasons where as in festival season only 4% readings were increases in day and night. Over all 10.25% and 8.12% day & night noise level were increases where as hectic city traffic increases 36.58% rapidly in festival season in all the zones. The affects can also be seen in the form of variety of negative emotions including anger, disappointment, unhappiness, anxiety and even depression. Therefore to avoid the adverse effects there is an urgent need to control noise pollution by implementing strict rules and through launching awareness-campaign.
Keywords **-** Community noise, deleterious effects, mathematical models, traffic noise

I. Introduction

Environmental noise is any unwanted or harmful outdoor sound created by human activities that is detrimental to the quality of life of individuals. In urban areas noise level in ambient air is increasing day by day due to rapid Industrialization, road traffic, railways, aircraft's, along with this noise in communities is also generated by celebrations of festivals, functions and events on small to big levels at community wise, region wise and state wise with various means which are generating the noise like using crackers, drums, loudspeaker, and DJ sets.

Many festivals are celebrates in India throughout the year. These festivals are celebrating ranging from one day to 30 days. In this way people are celebrating the festivals in their season wise throughout the year. Peak season for the festival is covered mainly six months from September to February in which the main festivals are celebrated/ covered. Large number of people participates in this festival right from the first day to last day. But during this festival, noise level in ambient air increases more because of mass gathering of people and related activities like transportation, beating of drums, bursting of crackers blaring of loudspeakers and DJ's. Most of the communities/people are facing the problems generated by the noise but they do not aware about the bad effects of loud noise. Persons who know about the bad effects of the noise usually ignore high levels of noise but due to the whole community and the activity of the mass gathering of people and their bad habits and illiteracy, the literate and aware persons also suffer a lot. Noise pollution is also known as silent killer because most of the people are not aware about the direct or indirect effect of the noise.

Environmental pollution in general refers to befouling of air, water or food by chemicals. Comparatively more easy to tackle than chemical pollutants, physical pollutants such as noise, No environmental factors have caused so much confusion regarding its effect as has industrial noise, a nuisance of modern age, often take the backseat when deleterious effects to the environment are considered. Hence though not an environmental hazard, there have substantial studies proving that noise is a health hazard [1-4].

Exposure to noise levels greater than the Permissible Exposure Levels (PEL) is known to cause interferences in speech and audible warning signals as well as lead to temporary or permanent hearing loss. It is also known to cause physiological

and psychological effects such as fatigue, irritability, tension, anxiety, and circulatory effects [5] and possibly pathological reactions [6] as well. Long term ill-effects of noise are hearing loss.

The pollution level is increasing at an alarming rate with urbanization and corresponding increase in number of vehicles in metropolitan cities. Especially in developing countries more than 70% of total noise in our environment is contributed directly or indirectly by the vehicular noise. Noise levels are showing an alarming rise and infect level exceeds the prescribed levels in most of the areas comes under the various zones. In the past decades various investigations and related studies were conducted in several countries have shown that noise has adverse effect on human health, living in close proximity to busy road highways [7-12]. Chronic road noise can affect cognitive performance of children including attention span, concentration and remembering, poorer reading ability, and poorer discrimination between sounds. There is a clear dose-response relationship between environmental noise from traffic and high blood pressure. This is one of the major reasons to include the activities of vehicular traffic of these zones simultaneously in alternate three years.

Noise survey study performed in eight cities of Nigeria by Saadu and his team in 1998 showed that road traffic is the major source of noise pollution [13]. As per work carried out by Yoshida and his team in 1997 on densely traveled roads the equivalent sound pressure levels for 24 hours can reach up to 75–80 dB which is very dangerous especially for children [14]. Research conducted in 2004 by Ohrstrom and Skanberg has shown that sleep quality at home is reduced after exposure to traffic noise [15].

Many researchers revealed that noise annoyance produces a variety of negative emotions including anger, disappointment, unhappiness, anxiety and even depression [16-19]. Annoyance and sleep disturbance are considered to be the most important environmental noise effects. Work carried out by Ohrstrom and Rylander in 1982 showed that intermittent noise is more disturbing than continuous noise. In intermittent noise, subjective sleep quality, mood and performance on a reaction time task get affected [20]. Carter N.L. in the year 1996 has shown that exposure to noise during the night can lead to considerable disruption in the stages of the sleep cycle [21], and particularly deep sleep stages which are considered essential for physical recuperation [22]. Exposure to night-time noise can also produce a number of secondary effects (i.e. those that can be measured the day after the individual is exposed to night-time noise) including psychological and physiological symptoms as well as reduced performance in adults [23]. Levels of community noise above 55 decibels (dB) are associated with a large number of adverse health conditions. According to the World Health Organization, reductions of noise by 6-14 dBA ("A" = weighted) result in subjective and objective improvements in sleep. Loud noise destroys or creates damage to the buildings, bridges and monuments.

The Noise has been recognized as ambient air pollutant. Standards in this regard are laid down under the Environment (Protection) Act, 1986 (and rules made there under) and under the Model Rules of the Factories Act, 1948 for occupational health and safety purposes. In 1989, Central Pollution Control Board (CPCB), New Delhi, India promulgated the Ambient Air Quality Standards for Noise which is shown in Table 1, thereby establishing the noise limits for silence zone, residential zone, commercial zone, and industrial zone and areas [24].

Table 1: Ambient Noise Standard Prescribed by Central Pollution Control Board (CPCB), New Delhi, India.

Area Code	Category of Area	Noise level, Leq (dBA)		Day Time	Night Time
		Day Time	Night Time		
A	Industrial	75	70	6.00 a.m. To 10.00 p.m.	10.00 p.m. To 6.00 a.m.
B	Commercial	65	55		
C	Residential	55	45		
D	Silence zone*	50	40		

*Silence zone is defined as areas up to 100 m around such premises as hospitals, educational institutions and courts. These are to be declared by the Competent Authority. Use of vehicular horns, loudspeakers, bursting crackers shall be banned in this zone.

City which was selected for the present study is the metro city of South East Asian region having population of 4.0 million. On the basis of the data collected from the municipal corporation, selected city is situated in such a geographical area of the country, from where all major highways and railways pass. This has resulted in the city being a major trade and transportation centre which is connected to all metropolitan cities of the country by road as well as by air route. Total length of roads in the selected city is about 2000 Kms, Length of major roads are 500 Kms. and the length of internal roads are about 1500 Kms. on which 9,67,838 two wheelers, 19,078 three wheelers, 1,68,965 heavy and

light four wheelers and 1153 other vehicle where running per day [25]. About 280 vehicles are registered every day of which 250 are 2-wheelers, 7 to 8 are 3- wheelers, and 20 are 4-wheelers. In last three years total 33% vehicles were increase in the city. Rapid urbanization, industrialization, expansion of road network and infrastructure will causes severe noise pollution in the city.

Present study considers a systematic environmental urban noise study carried out over a three alternate years in various zones of the related important areas during normal days and simultaneously in the festival season to predict increase in the noise level due to the activity and habits of the mass gathering of people and same was tabulated in Table 2 and Table 3 respectively. Effect on various monitored places comes under the three major zones were also graphically presented via Graph no 1 to 4. The objectives of this study is to measure the generated noise level in normal days, in festival season and also measure the noise generated by the traffic in related areas and comparison with the related standards to assess the increased noise level of various places comes under the three major zones of the selected city, further it may help to implement remedies to reduce the noise levels.

II. Materials & Methods

2.1 Apparatus

One big metropolitan city of South East Asian region having the population of 3.0 million and advanced infrastructure was selected for the study purpose. This study was spread over a period of three alternate years (1st year, 3rd year and 5th year) during which a total of 2808 numbers of noise samples were collected. Out of these, half of the samples were monitored in various places belongs to three major zones in normal season while the remaining same nos. of samples were monitored in festival season. To measure area noise levels A systematic study was carried out by using digital Sound Level Meter (SLM) (Type I) (Model-1900, make-Larson and Davis, USA). The SLM was regularly calibrated with an acoustic calibrator (QC-20, QUEST Technologies, USA). All the measurements were done with a "Slow" response rate over a 60 second period and with an averaging time of 10 seconds with an Exchange Rate of 5 dB (A), using the "A" weighting in accordance with the OSHA standards. The instrument was calibrated with an acoustic calibrator at frequencies of 250 and 1000Hz for sound levels of 94 dB and 114 dB prior to each session.

2.2 Methodology

The sound level meter allows determining sound levels at specific locations at a given time. Such measurements are useful in locating excessively noisy areas, in determining which areas are the primary noise sources. The study was conducted for measuring the noise level of normal days, festival season, and traffic noise of related zones in three alternate years. To evaluate the noise exposure (area sampling), to which the nearby population are exposed, The L_{MIN}, L_{MAX} and L_{PEAK} levels were studied systematically at the various location of the city at a particular distance and directions wherever required and possible. SLM was set for recording in slow mode in weighting scale "A". The SLM was calibrated before the start of the each study. Due to unavailability of the suitable sampling spot some time distance have to be varied from 5 – 15 meters on the single/same/respective side.

2.3 Sampling

Noise level monitoring was carried out in metro city of South East Asian region and shown in related Fig. 1. Three different major zones where selected for measuring the sound level during the festival season celebrating approximately one day to one month. The monitoring stations were selected under various zones viz. Silence zone, Residential zone, and Commercial zone. Under the Silence zone the area near by Courts, hospitals and schools were selected where as under the Residential zone three types of colonies/areas were selected like slum areas, middle class areas and Higher class residential colonies. Whereas various hawkers lane, central market and big vegetable markets were selected under the commercial zone to measure the noise level in festival and normal days. Noise level monitoring was carried out in day time as well as night hours. 26 samples were taken in each year in this way 78 samples were monitored in three alternate years in each category of places. In the each zone three categories of places were selected to collect the representative samples. Like this 78x3= 234 samples were collected from all the places at day and in same manner 234 samples were collected in night time under the silent zone. In this way 234x2= 468 samples were collected/ monitored in each zone day and night and total 468x3= 1404 samples were d/ monitored in the entire zone day and night in normal days.

To monitor the increased noise levels in the same zones due to the festival and busy city traffic noise levels were monitored in same manner measured which was measured in normal days in this way again 1404 samples were again monitored in festival season. In the present study total 1404x2= 2808 samples were monitored. Each category of places 03 samples were collected in three years after this average value was calculated of these three readings collected in three alternate years and make one set of reading, in the same way 26 sets of

average value were made by using 78 readings taken at one category of places in night and day time and tabulated in Table 2 and Table 3. Finally mean value and Standard Deviation were calculated of these (26X3) 78 readings. Daily 6 hours sampling were carried out from 6.00 pm 10.00 pm (day time) – 10.00 pm to 12.00 mid night (night time). Along with this movement of vehicle (all classes) also counted at nearby square of the selected zones.

To predict the increased noise level due to the traffic two wheeler (Scooter, Motorcycle etc), three wheeler (Auto rickshaw, Tempo etc) and four wheelers (heavy four wheelers - Truck, Bus, Trailer, Tanker, Tractor etc. and light four wheelers -Car, Jeep etc.) were selected in each sampling site and were counted to predict the increased noise level in respected areas of related zones. Each month one reading was taken in this way 6 readings were taken in six months of normal days and festival season in one year of each selected zones. In this six months counting three readings of peak hour & rest of three of normal hours taken alternatively and tabulated in respected Zones. Total 18 samples were taken in each year in this way total 54 samples were taken in three alternate years. Each sample is the mean value of the three readings collected in each alternate year.

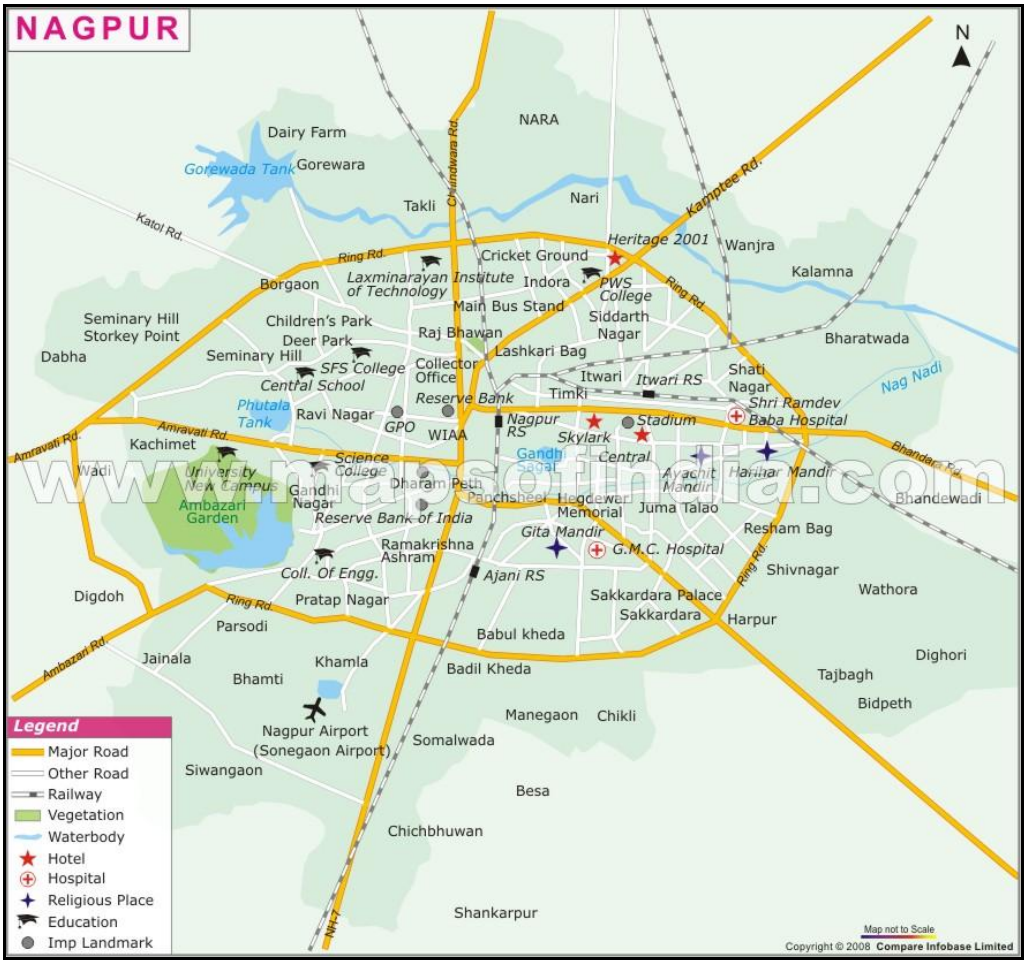

Figure 1 Noise level monitoring and counting of different category vehicles in various places of three different major zones in metro city of South East Asian region during normal and festival season.

III. Results and Discussions

To predict the increased noise level due to the various activities of the festival season, noise level were monitored in normal days as well as in festival season and tabulated in Table 2 and 3 respectively. To monitored the noise level in the festival season various zones were selected i.e. client zone, in which nearby area of Court, school and hospital were selected where as under the residential zone big slum area, middle class and higher class residential colony were selected and finally commercial zone was selected to predict the noise level. Under this zone main hawker's lane, big central market and finally main vegetable market were selected. To predict the actual noise increased due to the festival season and increased traffic noise levels were also measured in the same places and

same zones in normal days. All the readings were taken three years alternate and every week one sample was collected from these places belongs to the various zones and rest of the planning was followed as per the procedure given in the material and method section. Only forth zone i.e. industrial zone was not selected in this study because most of the areas come under this zone is none affected by the activity of festival. This zone is already affected by the major industrial activity and prediction of increased noise level due to especially festival season is another task. This study is mainly concerned about the activities of the communities in the normal and festival season.

Table 2: Leq Day and Night Noise Level Measured in Normal Days.

Silent Zone						**Residential Zone**						**Commercial Zone**					
Court		**Hospital**		**School**		**Slum Area**		**Middle Class**		**High Class**		**Hawker Lane**		**Central Market**		**Veg. Market**	
D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
56.9	43.1	65.6	60.8	58.3	36.8	77.2	63.8	71.3	59.4	66	55.3	71.7	66.4	74	60	78.3	72.8
47.2	37.4	68.5	37.8	61.1	63.4	79	67	73.8	58	61.6	53.4	70.6	70.3	63.8	66.4	73.8	73
54.4	43.1	47.3	60.1	60.4	65.6	54.4	67.2	74.7	44	65.6	47.8	63.5	60.8	72	52.8	76.5	75.8
60.1	44.3	68.4	58.9	48.2	63.2	81.6	74.7	74	62.2	58	43.4	69.6	53.3	73.1	60.3	63.5	70.8
48.5	48.6	66.4	61.2	61.3	64.8	83	72	67.8	59.7	53.4	52.5	72.3	63.3	63.1	69.7	76.7	53.6
56.1	36.9	68.4	63.7	47.6	64	79.7	66	53.4	73	64.4	43.4	80.4	59.2	68	64.7	74.8	77.2
64.8	46	48.6	37.9	65.6	37	81.6	73.8	71.6	65.3	57.5	46	78.8	73.3	67	53	63.8	67.2
52.4	47	67.4	60.8	67.2	66.4	82.8	68.8	73	64.7	67.2	54.7	75.6	78.6	67.3	53	75.3	67.2
46.3	46.2	68	62.2	70.5	62.5	68.4	69.7	76.6	62.5	60.3	51.3	71.9	72	76.5	62	62.5	79
61.3	37.4	67.4	62.4	49.1	64.3	79	75	75.6	67.5	69.4	63.4	82	76.4	69	64.2	75.6	53
56.5	47	47.7	61.3	70.8	38.4	76	73.4	71.6	70.3	53	57.5	72.5	73	68.5	61.4	80.6	65.6
46.5	38	67.8	62.4	67.5	62.1	82	71.3	53.8	64.7	61.3	58.4	85.4	78.3	72	66.4	80.2	53.3
54	46.5	69.7	38.3	68.2	68.5	79.4	67.2	70	60.6	53.8	43	84.4	76	73.1	59	78.1	56
71.2	46.6	67.5	62.7	47.6	38.4	82.8	68	73.4	64.4	66.3	61	63.5	75	71.5	71	77	63.3
54.6	51.8	64.2	37.8	68.4	63.5	76.3	70.6	84.4	44	61.6	62.8	71.5	53.3	75	64.4	80	73.6
47.8	37.9	67.3	66.4	70.6	65.2	81	73	84.4	68	65	62	83.5	54.4	76.3	70.3	79.8	78.3
53.4	46.2	61.2	64.3	66.5	65.2	84.7	67.2	74.4	72.8	67.2	47.8	77.7	66.4	71.5	53.3	84.2	72.2
53.1	49	47.3	39	65.3	61	85.3	76.6	77.2	70.3	67.5	58.4	78.1	79.7	71.7	62.8	86.3	72.8
47.6	43.4	64.9	60.1	67.6	62	78	68	83	73.4	53	64.7	73	65	63.3	77.5	79	72
58.6	38.2	46.3	58.6	69.7	62.4	86.3	70.5	79	74	63.8	63	84.6	69	70	58.6	78.3	78
48.3	41	67	55.6	70.2	61.2	54	73.8	75	67.8	70	62.2	83.8	59.7	72	62.8	80.4	76.7
47.	38.	68.	64	71.	64.	70.	72.	77.	67.	60.	43.	81.	65.	76.	60.	72	72.

3	4	9		1	2	6	8	5	2	6	4	9	3	7	8		2
48.3	47.3	65.4	38.3	64.5	61.8	78.4	76	73	73	54	64	82.3	70.3	70.2	59.4	88	80.6
59.6	46.2	66.5	59.5	48.3	38.8	74.7	72	84.7	65.3	67.8	61.6	84.2	70.8	71.5	61.7	78.5	81.7
53.4	37.4	46.8	55.8	68.7	63.1	78.4	74.7	86	70.6	72	67.8	80.4	61.7	75	70	77.7	72.8
48.1	43.8	68.8	63.9	71.5	66.2	89.1	76.3	81.8	72.8	66.3	66	81.7	69.4	72.7	64.2	77	79
53.7*	43.4	62.4	55.9	63.3	58.8	77.8	71.1	74.6	65.2	62.5	55.9	77.1	67.7	70.9	62.6	76.8	70.6
6.3**	4.42	8.61	10.2	8.30	10.5	8.29	3.57	7.93	7.85	5.73	7.99	6.50	7.81	3.86	6.07	6.11	8.57

Each data is the average of the three readings taken in three alternate years taken in Day (D) and Night (N) hours in Leq (dBA).
*Mean value and **Standard Deviation of 58 readings.

Table 3: Leq Day and Night Noise Level Measured in Festival Season.

Silent Zone						**Residential Zone**						**Commercial Zone**					
Court		**Hospital**		**School**		**Slum Area**		**Middle Class**		**High Class**		**Hawker Lane**		**Central Market**		**Veg. Market**	
D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
57.5	42	67.7	63.3	64.3	64.8	78.6	67.6	73.6	63	71.2	58.4	73.5	69.2	76.7	63.6	82.3	77.5
53.5	38.2	69.4	60.8	64.8	65.6	74.5	68.4	77.9	57	70.2	52	73.8	72	76.3	75.6	78.3	80.6
56.3	42.2	71.8	63	66.2	67.9	84.7	68.1	76.6	63.5	73.5	44	66.5	65.8	73.6	54	78.1	82
53	44.2	69.2	60.8	67.4	67.9	89	79	76.8	70.1	71	59.8	71	53.3	75.4	66.4	82.3	79.2
48.5	50.8	68.4	65.2	66.3	64.8	84.6	68.1	73.6	64.2	66.8	55.6	72.7	65.8	63.1	71.7	78.5	53.6
57	42.6	69.1	66.1	65.6	67.9	88.9	67.6	74.2	76.8	68.8	60.2	79.6	61.4	70.8	66.4	76.7	75.6
57	46.6	66.8	60.9	70.6	64.8	87.9	77.4	77.5	71.2	54	43.8	82.3	81.4	70.2	60	63	77.5
52.8	46.6	68.2	65.6	67.2	67.8	86.8	71.3	75.4	68	70.6	62	77	77	69	53	83.5	70.8
59	42	69.5	65.5	70.5	67.5	65.2	67.8	81.2	70.5	71.2	60.3	75.6	70.6	79.6	67	63.1	81
56.5	38.2	69.9	64.2	67.5	67.5	85.3	78.4	75.6	68.4	69.4	65.3	85.4	80.3	71.5	67	79.8	69.7
59.5	41.4	68	61.1	70.8	64.8	82.3	67.8	86	74.6	74.6	61.2	78.8	75	76.7	64.1	84	70.3
53.5	37.8	69	61	67.5	67.2	79.9	67.7	77.1	71.5	72.4	65	86	80.3	75	70	82.7	53.3
57.3	46.2	73	63.2	66.8	66.5	77.8	68.9	73	73.6	53.8	61.2	83	78	72	63	79.8	68.3
58.5	47.2	70	65.6	66	66.3	79.6	69.4	74.8	71	67.6	64	63	79	74.8	73.6	88.1	68
58.3	52.6	67.7	61.5	68.4	66	79.2	69.3	87	68.4	73.2	63.2	74.6	53.3	77.3	68.3	82.7	77.8
47.8	38	70.1	67	73	64.9	78.9	75	85.4	70.2	73.8	62	85.2	66.5	78.3	74	81	85.6
52	47.	67.	64.	70	67.	88.	68.	76.	73.	74.	43.	83.	76.	69.	64	88.	70.

	7	7	4		3	2	6	5	6	4	5	1	2	4		5	8
52.8	51.3	72.3	61.2	69.1	65.3	78.6	74.5	74.6	77.6	78.9	60.3	82.7	85.6	74	70	88.1	74.7
53.8	41.4	70.2	63.5	70.4	65.2	78	68	81	76	74.5	64.7	75.6	69.2	63.8	82.5	81.5	74.4
55	51	67.8	62.2	75.3	65	89.2	70.5	81.5	75.4	73.6	68.9	86	73.6	73	65.8	81.5	83.6
48.3	41.2	70.6	62	70.2	65.1	76.1	77.4	82	72	72.4	65.2	86.3	65.6	74.4	74	79	80.8
47.5	38.2	70.3	66.8	71.1	65.2	77.8	79.4	85.6	71.4	53.5	68.2	84	67	79.4	72	74.4	78.6
47.5	48.2	69.8	61.4	64.5	66.2	83.6	69.3	89.4	70.2	73	65.7	81.3	73	76.7	57.8	86	86.7
52.5	48.2	68.6	63.2	65.6	66.4	86.8	70	80	72.7	75.5	64	83.5	73.6	74.8	63.6	81	79.7
52.5	38.6	70.3	67.8	66.5	67.6	89.4	72.4	82.8	76	78.7	67	81.9	63.3	76.9	68.6	73.1	77.2
54.5	44.4	74.5	67.4	69.5	68	89.1	71	81.8	75.4	78.4	64.7	82.7	71	78.5	66.4	74.6	82.5
53.9*	44.1	69.6	63.6	68.3	66.3	82.3	71.2	79.2	70.8	70.5	60.4	79.0	71.0	73.8	67.0	79.6	75.3
3.7**	4.6	1.7	2.3	2.7	1.2	5.9	4.0	4.71	4.83	6.9	7.1	6.26	8.02	4.27	6.58	6.33	8.28

Each data is the average of the three readings taken in three alternate years taken in Day (D) and Night (N) hours in Leq (dBA).
*Mean value and **Standard Deviation of 58 readings.

3.1 Silent Zone

Under the silent zone the Court area noise level were monitored in the range of 47.5 dBA and 59.5 dBA in day time where as noise level were monitored in the range of 38.2 dBA and 52.6 dBA in night time with an average and Standard Deviation of (53.9±3.7) and (44.11±4.65) in day and night time respectively. Whereas the noise level were monitored nearby the school area shown in the range of 66.8 dBA and 74.5 dBA in day time where as noise level were monitored in the range of 60.82 dBA and 67.8 dBA in night time with an average and Standard Deviation of (69.63±1.78) and (63.67±2.30) in day and night time respectively. Under the silent zone various hospitals were selected to predict the noise level and which was found in the range of 64.34 dBA and 75.3 dBA in day time where as noise level were monitored in the range of 64.81 dBA and 68.0 dBA in night time with an average and Standard Deviation of (68.30±2.74) and (66.33±1.22) in day and night time respectively in festival season (Table 3).

If we compare this results with the standards promulgated by the national authority i.e. Central Pollution Control Board (CPCB), India, and mentioned in the table 1 shows that 80.77% & 76.92% readings were crossed the standards limits of day and night hours respectively in the nearby Court areas where as the 100 % readings were crossed the standard limits of day and night hours respectively in the nearby areas of school and hospital respectively under the silent zone in festival season. At the same time when the normal days levels, which was tabulated in the table 2 were compared with the related standards shows that 61.54% & 69.23% readings were crossed the standards limits of day and night hours respectively in the nearby Court areas where as 80.77% readings were crossed the standards limits of day and night hours respectively in the nearby schools and in case of hospitals 76.92% readings were crossed the standards limits of day and night hours respectively.

According to Graphical presentation shown in Fig. 2, If we compared the noise level broadly with respect to the client zone then it was seen that 73.08% & 75.64% readings were crossed the prescribed std levels of day and night hours respectively in normal days where as 93.59% & 92.31% readings were crossed the prescribed std levels of day and night hours respectively in festival season. Study conducted in various places of client zone showed that 20.51% readings were increased in day time and 16.67% readings were increased in night time due to the various activities of the mass gathering of various communities.

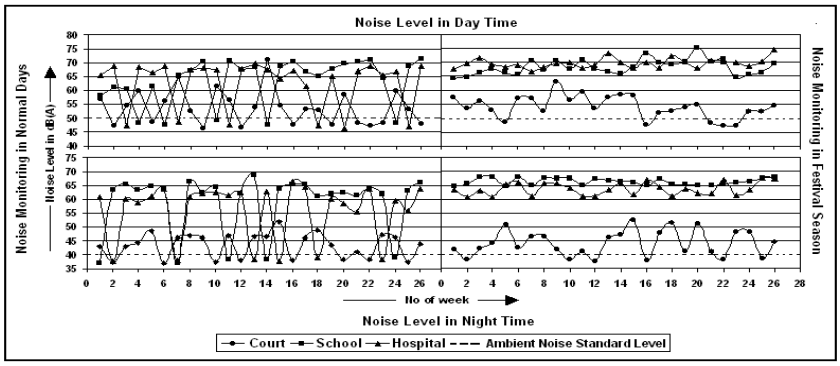

Figure 2 Leq Day and night noise level measured in normal days and festival season at silent zone.

3.2 Residential Zone

Under the residential zone the big slum area, noise level were monitored in the range of 65.2 dBA and 89.4 dBA in day time where as noise level were monitored in the range of 67.6 dBA and 79.4 dBA in night time with an average and Standard Deviation of (82.33±5.91) and (71.29±4.03) in day and night time respectively. Whereas the noise were monitored nearby the middle class residential colony were monitored in the range of 73.0 dBA and 89.4 dBA in day time where as noise level were monitored in the range of 57.0 dBA and 76.8 dBA in night time with an average and Standard Deviation of (79.28±4.71) and (70.88±4.83) in day and night time respectively. Under the silent zone and higher class residential colonies were also selected to predict the noise level and which was found in the range of 53.0 dBA and 78.98 dBA in day time where as noise level were monitored in the range of 43.5 dBA and 68.96 dBA in night time with an average and Standard Deviation of (70.58±6.91) and (60.41±7.16) in day and night time respectively in festival season (Table 3).

If we compare this results with the standards promulgated by the national authority i.e. Central Pollution Control Board (CPCB), India, shows that 100% readings were crossed the standards limits of day and night hours respectively in the nearby big slum area. In the similar way 100% readings were crossed the standard limits of day and night hours respectively in the nearby areas of middle class residential colony where as in higher class residential colonies 88.46% readings were crossed the standards limits of day and night hours respectively under the residential zone in festival season. At the same time when the normal days levels, which was tabulated in the table 2 were compared with the related standards shows that 96.15% & 100% readings were crossed the standards limits of day and night hours respectively in the nearby big slum area where as 92.31% readings were crossed the standards limits of day and night hours respectively in the nearby middle class residential colony and in case of higher class residential colonies 80.77% and 88.46% readings were crossed the standards limits of day and night hours respectively.

According to Graphical presentation shown in Fig. 3, If we compared the noise level broadly with respect to the residential zone then it was seen that 89.74% & 93.59% readings were crossed the prescribed standards limits of day and night hours respectively in normal days where as 96.15% readings were crossed the prescribed standards limits of day and night hours respectively in festival season. Study conducted in various places of residential zone showed that 6.41% readings were increased in day time and 3.85% readings were increased in night time due to the various activities of the mass gathering of various communities.

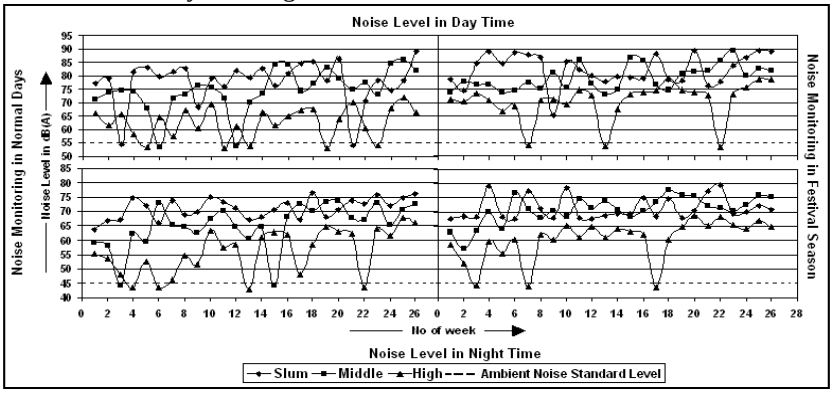

Figure 3 Leq Day and night noise level measured in normal days and festival season at residential zone.

3.3 Commercial Zone

Under the commercial zone the main hawker's lane, noise level were monitored in the range of 63.0 dBA and 86.31 dBA in day time where as noise level were monitored in the range of 53.3 dBA and 85.6 dBA in night time with an average and Standard Deviation of (79.04±8.07) and (71.04±8.027) in day and night time respectively. Whereas the noise were monitored nearby the big central market were monitored in the range of 79.6 dBA and 63.8 dBA in day time where as noise level were monitored in the range of 53.0 dBA and 75.6 dBA in night time with an average and Standard Deviation of (73.89±4.27) and (67.02±6.58) in day and night time respectively. Under the silent zone and main vegetable market of the respective areas were also selected to predict the noise level and which was found in the range of 63.0 dBA and 88.1 dBA in day time where as noise level were monitored in the range of 53.3 dBA and 86.7 dBA in night time with an average and Standard Deviation of (79.68±6.33) and (75.38±8.28) in day and night time respectively in festival season (Table 3).

If we compare this results with the standards promulgated by the national authority i.e. Central Pollution Control Board (CPCB), India, shows that 96.15% & 92.31% readings were crossed the standards limits of day and night hours respectively in the main hawker's lane where as the 92.31% readings were crossed the standard limits of day and night hours respectively in the nearby areas of big central market where as in main vegetable market 92.31% readings were crossed the standard limits of day and night hours respectively under the commercial zone in festival season. At the same time when the normal days levels, which was tabulated in the table 2 were compared with the related standards shows that 92.31% & 88.46% readings were crossed the standards limits of day and night hours respectively in the nearby main hawker's lane where as 88.46% & 84.62% readings were crossed the standards limits of day and night hours respectively in the nearby big central market and in case of main vegetable market 88.46 % readings were crossed the standards limits of day and night hours respectively.

According to Graphical presentation shown in Fig. 4, If we compared the noise level broadly with respect to the client zone then it was seen that 89.74% & 87.18% readings were crossed the prescribed standards limits of day and night hours respectively in normal days where as 93.59% & 92.31% readings were crossed the prescribed standards limits of day and night hours respectively in festival season. Study conducted in various places of commercial zone showed that 3.85% readings were increased in day time and 5.13% readings were increased in night time due to the various activities of the mass gathering of various communities.

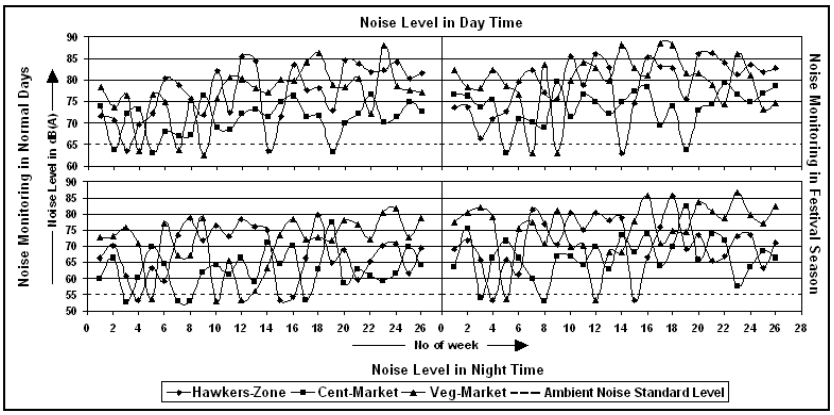

Figure 4 Leq Day and night noise level measured in normal days and festival season at commercial zone.

The overall scenario of noise level monitoring conducted at various places comes under the major three zones of the metropolitan city is graphically presented in Fig. 5 and the results shows that only 37 and 34 readings out of 234 readings were recorded under the prescribed limit on the other hand 84.19% and 85.47% readings were crossed the prescribed standard limit in day and night time measured in normal days where as 13 and 15 readings out of 234 readings were recorded under the prescribed limit on the other hand 94.44% and 93.59% readings were crossed the prescribed standard limit in day and night time measured in festival days.

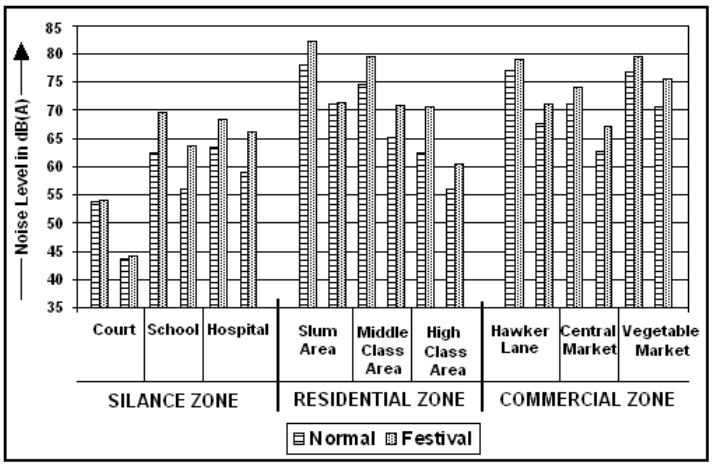

Figure 5 Leq Day and night noise level measured in normal days and festival season at various places under the various zones.

3.4 Traffic Noise

Traffic of all the 35 States and Union Territories including 35 numbers of million plus cities of India are increases day to day and up to the March, 2011 total vehicle registered was found approximately 141.87 million where as in Maharashtra State total registered vehicle was found to be 17.43 million. In the studied metro city (Nagpur) total registered vehicle was found to be 1.16 million. According to the collected data of 50-years of registered vehicles from 1961 to 2011 number of registered vehicle increase 213 times where as in only one year from 2010 to 2011 number of registered vehicle increase 1.11 times [25]. Detailed bifurcation is given in Table 4. Due to the related activities of the communities, traffic of the city is also affected. To create a healthy and noise pollution free environment a traffic noise prediction model can predict the noise level in a busy traffic of the particular city in advance during the planning and design process [26]. The level of traffic noise mainly depends on some important factors like volume of the total traffic, speed of the traffic and number of the heavy vehicles in the flow of traffic. Under this study there is no need to calculate the traffic noise level by the mathematical model because this is not the objectives of the present study. It was already proved by the Equation model (Leq = 19.92224log [Q (1+ 0.1x VP)] + 12.59764)--(1) developed by K. Kumar et al especially for the traffic conditions of Asian region in the year 2011 [27]. By counting and measuring the important factors of the related traffic tabulated in Table 5, one can predict the increased noise level in respected zones. As per present study, vehicular traffic were increased 27.31%, 36.33% and 46.11% in the areas comes under the silent zone, residential zone and commercial zone respectively in festival days which showed that commercial zone is more affected then residential zone and residential zone is more affected then silent zone. Frequency of 36 to 54 vehicles / minute has been also observed on the highways whereas it is 14 to 22 vehicles / minute on internal roads. On the basis of increased traffic in various zones predicted that most of the time traffic was generated higher level of noise in the related areas which causes severe noise pollution in the city and one can easily realized the increased level of noise with the help of increased vehicular traffic and related models.

Table 4: Total Number of Vehicle Registered in Metro City as On 31 March, 2011.

Sr. No.	Type of Vehicle		Number of Registered Vehicle in Million Plus City (Nagpur)	Number of Registered Vehicle in Maharashtra State	Number of Registered Vehicle in India from the Year 1961 To 2011
1	Two Wheelers		9,67,838	1,24,29011	1961 - 6,65,000
2	Three Wheelers		19,078	8,09,196	
3	Four Wheeler	Light Vehicles	1,42,990	33,95,326	2010 - 12,77,45,972
4		Heavy Vehicles	25,975	7,73,378	
5	Other Vehicles		1153	27,188	2011 - 14,18,65,607
Total Registered Vehicle (Transport + Non Transport)			11,57,034	1,74,34099	

Table 5: Counting of Each Category of Vehicle in Normal Days and Festival Season in Each Zone of Selected Metro City.

Sampling Frequency (Counting)	Normal Days				Festival Season			
	2 W*	3 W**	4 W***		2 W*	3 W**	4 W***	
			Heavy	Light			Heavy	Light
(No. of Vehicle Passes in 30 min. from Sampling Locations of Various Zones)								
Silent Zone								
1st Year	118	22	18	30	148	26	22	36
3rd Year	158	28	24	38	206	38	30	46
5th Year	180	36	34	52	248	50	44	60
Residential Zone								
1st Year	72	8	4	8	90	10	6	12
3rd Year	90	12	6	12	110	14	8	16
5th Year	116	18	8	18	152	24	14	24
Commercial Zone								
1st Year	460	80	52	96	674	108	76	136
3rd Year	590	122	76	130	870	164	118	190
5th Year	780	158	116	168	1166	228	180	242

*Two wheelers: Scooter, Motorcycle etc.; **Three wheelers: Auto rickshaw, Tempo etc.; ***Four wheelers: (Heavy vehicles: Truck, Bus, Trailer, Tanker, Tractor etc.; and Light vehicles: Car, Jeep etc.)

1. CONCLUSION

Normally the noise levels were found higher as compared to the prescribed standard in all the places under the three selected zones in festival season as well as in normal days.

Over all in normal days 84.19% and 85.47% observations were crossed the prescribed standard level where as in festival season 94.44% and 93.59% observations were crossed the prescribed standard limit of day and night. On the other hand 10.25% and 8.12% more observations were crossed the prescribed standard of day and night hours in festival season than the normal day's noise levels.

Under the silent zone 100% observations already were crossed noise levels near the schools and hospitals in day and night time even in normal days but due to the activities of the festivals the noise level were increased by 19.33% and 23.08% where as 19.23% and 7.69% observations of day and night were increased respectively nearby Court areas than the levels monitored in the normal days.

Under the residential zone slum areas were already affected even in normal days and due to the festivals 3.85% more observations were crossed the prescribed limit in day time where as in night no change was occur but the average of absolute value increased by 4.45 dBA in night time. In middle class areas 7.69% observations were increased in both the time where as in high class areas 7.79% observations were increased in both the time but increased in average of absolute values is very less as compare to the slum and middle class areas.

The areas comes under the commercial zone are already cross the limits in normal days where as 4% more observations were crossed noise levels in 85% areas of commercial zone in festival season. Results showed that areas come under this zone are highly affected than the other two studied zones.

Present study revealed that noise levels in metropolitan city of Asian region have reached to an alarming level and which may cause physiological and psychological disorders. Therefore to avoid such adverse effects there is an urgent need to control or reduce noise pollution by implementing strict rules and through launching awareness-campaign among people.

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