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Road Traffic Noise: A Case Study of Balasore Town, Orissa, India

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ABSTRACT: Transportation sector is one of the major contributors to noise in the urban areas. The traffic noise environment in Balasore, a city of Orissa, India in terms of standard noise indices, community response and community health effects are worked out in the present study. Noise Pollution is assessed in six different squares (road sections) of the town. It is inferred that the noise levels are more than permissible limit in all the six investigated locations of Balasore. A preliminary survey adopting questionnaire method amongst 212 local inhabitants also carried out to gather secondary information about the suffering of noise related health problems.

Key words: Road Traffic, Noise, Pollution, Balasore

INTRODUCTION

Recent researches clearly demonstrate that road traffic has been the predominant source of annoyance; no other single noise has been of comparable importance. It is due to the large number of automotive vehicles in comparison with other machines. The mechanism of radiation of noise to outside from a vehicle has been different from the generation of noise inside the vehicle. The noise emitted depends on the relative levels, characteristics and the interaction of the directly radiated noises from the vehicles. The most important noise source of the vehicles is the power unit and its auxiliaries. Other important generators have been the transmission system, tires and braking system (Kudesia and Tiwari, 1993). Monazzam and Nassiri (2009) concluded that reducing the design frequency of QRD shifts the performance improvement towards lower frequency and therefore the most efficient model for vertical profile parallel traffic noise barrier is a setup treated with QRD tuned to around 400 Hz. Each year there is an increase in the number of vehicles in India. Consequently, traffic noise is also increasing. Thus, primarily noise problem is the result of growing busy traffic. The noise levels are showing an alarming rise and in fact, the levels exceed the prescribed levels in most of the areas. The ambient noise standards being followed in India for different types of areas are given hereunder (CPCB, 2000).

Area	**Leq30 dB (A)**	
Day Time(6 AM- 10PM)		Night Time(10 PM-6 AM)
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

In India, few studies on traffic noise level have been carried out at different cities like Delhi, Bombay, Visakhapatnam, Baroda, Anantpur, Asansol, Nagpur, Chennai etc. (Pancholy *et al.*, 1967; Rathore, 1982, Dixit *et al.*, 1982; Roy *et al.*, 1984; Rao *et al.*, 1987; Ravindranath *et al.*, 1989; Kumar and Jain, 1994; Chakraborty *et al.*, 2002; Nirjar *et al.*, 2003; Banerjee and Chakraborty, 2006; Thakur, 2006). The average noise levels in residential areas of these cities are more than the recommended value i.e. 55dB (A).

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The traffic noise environment in major cities of Orissa State in terms of standard noise indices, community response and community health effects were not studied in depth till the date. Only there were records of high level of dissatisfaction due to noise incidence in different parts of Orissa. Particularly in Orissa, due to rapid population growth, the transportation sector is growing rapidly and the number of vehicles on roads is increasing at a rate of more than 7% per annum. This has led to overcrowded roads and pollution. Thus, with rapid urbanization and the corresponding increase in the number of vehicles on roads of Orissa after golden quadrilateral project, the pollution is increasing at an alarming rate in most of the important cities of the state.

Therefore, an attempt has been made for comprehensive study of Traffic Noise pollution in Balasore town (Fig. 1). Balasore town is the district head quarter of the Balasore District (a north-eastern coastal district of Orissa). The district is located between $21^0 03'$ and $21^0 59'$ North Latitude and between $86^0 20'$ and 87^0 East Longitude. The geographical area of Balasore town is 19.43 sq. km. Noise Pollution is assessed in different squares (road sections) of the town such as Remuna Golei Square, Fakir Mohan Square, Bus Stand, Cinema Square, Station Square and Police Line Square (Fig. 2). Fig. 2 is a graphic indicating the locations of the different road sections in Balasore that were investigated. The increase in number of urban highways constructed around residential and community areas of this town has inevitably caused major noise pollution problems to city dwellers. The objective of the study is to assess the level of noise exposure and its impact to residents residing around the vicinity of urban highways of this town.

MATERIALS & METHODS

The noise levels are measured following standard procedure using calibrated sound pressure level (dB) meter on 1st week of March, 2008 at selected places predominated by both commercial and residential tenements (Griffiths & Langdon, 1968; Robinson, 1971; Prabhu and Chakraborty, 1978; Kadiayali, 1978; Harris, 1979; Peterson, 1980; Cohn and Meroy, 1982; Kudesia and Tiwari, 1993; Pamanikabud and Chairsi, 1999; Jain and Parida, 2001; Pandya and Dharmadhikari, 2002; Krishna Murthy *et al.*, 2007). The motor vehicular traffic prone selected sites of the town are

Fig.1. map of India showing location of Balasoer town (study area)

Remuna Golei Square, Fakir Mohan Square, Bus Stand, Cinema Square, Station Square and Police Line Square; which are representatives of entire urban areas. All these sites have its unique characteristics i.e. having typical road width, roadside housing pattern, traffic flowing pattern in different directions and finally other socio-cultural activities. In each selected sites, noise levels were measured in four different spots. On each spot, the measurements were taken at sixteen different times during daytime.To delineate the perception about the noise and its significance on health of community, a reprehensive sample of public (212 local inhabitants) are interviewed on a very extensive scale in homes, Balasore Government Hospital using a questionnaire from 12th to 18th March, 2008. Questions in the questionnaire are drafted in an intricate fashion to detect the public's degree of tolerance and awareness to transport related noise with consideration to various parameters such as location, age of respondent, occupation and a number of general psychological, personal as well as physical aspects.

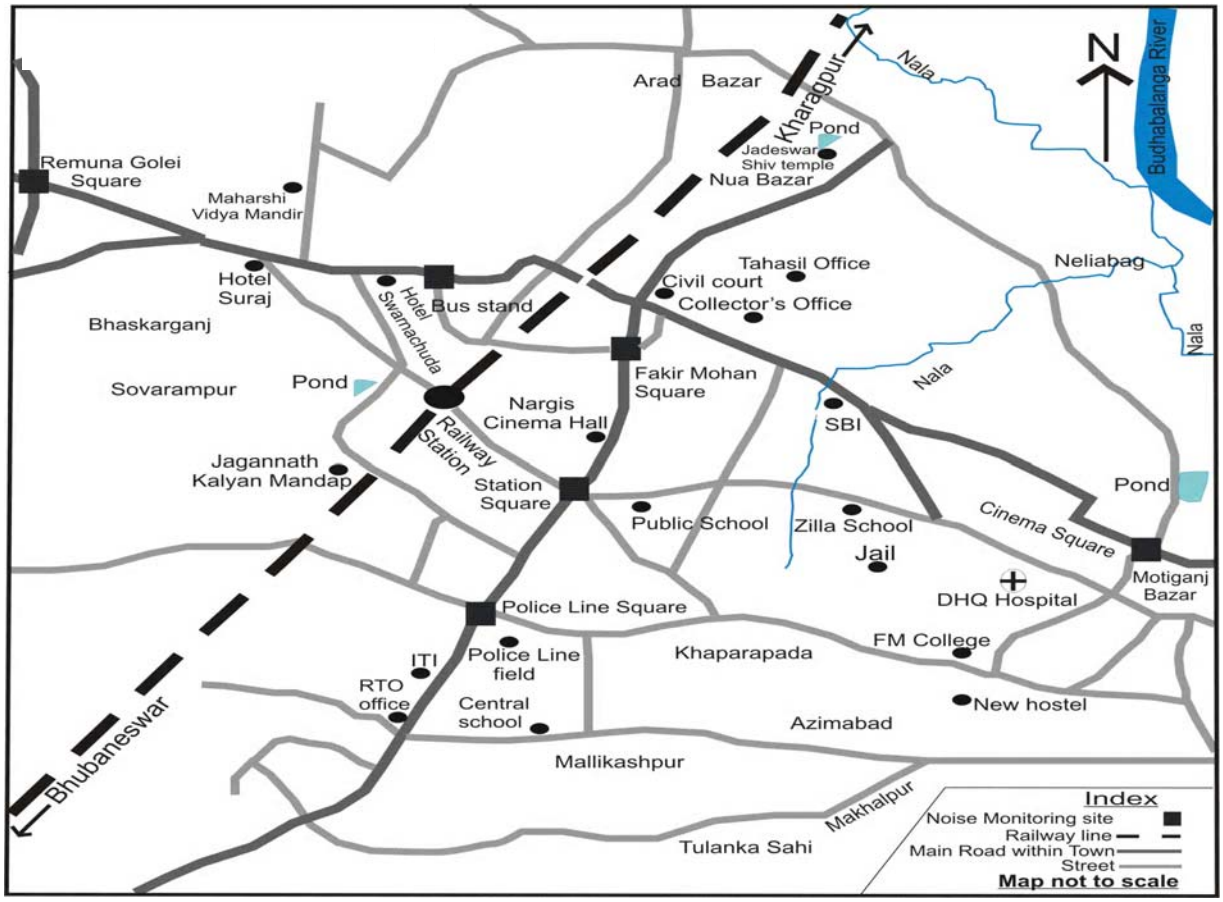

Fig. 2. Balasoer road map showing noise monitoring sites

RESULTS & DISCUSSION

Noise pollution is assessed and analyzed in different squares of the town (Table 1, Fig. 2). As there is no defined basic noise levels on the roads prescribed by Central Pollution Control Board (CPCB), India; the detected noise levels of Balasore town in day time are compared with the prescribed basic noise level (tolerance limit) on roads (traffic noise) during day-time at United Kingdom i.e. 70 dB (A) (Table 2) (Krishna Murthy *et al.*, 2007).

The traffic noise is measured at four different spots along highway areas at and around Remuna Golei Square, which are commercial in nature (Table 3). The minimum and maximum noise levels observed at the highway around Remuna Golei Square are 90.4 dB (A) and 122.5 dB (A) respectively. The source is predominantly attributable to motor vehicular traffic. The permissible level for road traffic noise is 70 dB (A) (Table 2, Krishna Murthy *et al.*, 2007). In all the locations, the noise level has increased due to vehicular noise. However, all the observations are made during daytime.The Traffic noise is measured

Table 1. The details of noise assessment sites

No.	Assessment location	Number of spots of noise assessment	Remarks
1	Remuna Golei Square	4	On each spot, the measurements were taken at sixteen different times during daytime.
2	Bus Stand	4	
3	Fakir Mohan Square	4	
4	Cinema Square	4	
5	Station Square	4	
6	Police Line Square	4	
Total number of spots		24	

at four various spots along the highway areas at and around Fakir Mohan Square during day time(Table 4). These four spots form the commercial center of Balasore Town. The minimum and maximum noise levels observed at the highway around Fakir Mohan Square are 88.0

Table 2. Tolerated noise levels on the main roads for United Kingdom (Krishna Murthy *et al.*, 2007)

Type of noise	Tolerance limit in dB (A)	
	Day	Night
Basic noise level	70	65
Frequent peaks	80	70
Infrequent peaks	90	80

Table 3. Traffic noise in Balasore along the Remuna Golei Square

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	Near Grid Corporation office	16	90.4	118.2
2	Below fly over	16	111.1	122.5
3	Near Chitrapuri studio	16	101.8	111.9
4	Near Golei Square bus stop	16	106.6	112.1

N=number of observations

dB (A) and 115.3 dB (A) respectively. The source is predominantly attributable to motor vehicular traffic. In all the locations, the noise levels are sufficiently increased due to traffic noise.In order to investigate the effect of noise levels along the bus stand, the noise levels have been measured for the four nearest sites at and around the Balasore bus stand. There are market complexes in both sides of the road in front of the bus stand. The data are presented in (Table 5). Overall noise levels in the vicinity of bus stand ranges from 89.2 to 118.6 dB (A) and are sufficiently increased due to traffic noise.The Traffic noise is measured at the four spots along the city roads at and around Cinema Square. The data are presented in (Table 6). This square is heart of the city and it is the entrance to the biggest market complex of Balasore and is the way to most important commercial area, Motiganj. The minimum and maximum noise levels observed at the roads of four different spots around Cinema Square are 94.4 dB (A) and 122.9 dB (A) respectively. The source is predominantly attributable to motor vehicular traffic and gathering of public for marketing and visiting cinemas. There are two cinema halls in two sides of this square. Moreover, this site is nearer to Balasore District Head Quarter Hospital. The noise levels at and around this locality are amply increased due to traffic noise.In order to investigate the effect of noise levels along the Station Square, the noise levels have been measured for the four nearest sites. The data are presented in (Table 7). Overall noise levels in the vicinity of Station Square ranges from 93.4 to 122.7 dB (A) and are more than the prescribed permissible limit. The source is predominantly attributable to motor vehicular traffic and gathering of public for various purposes. This is because, this site is nearer to Balasore Railway Station, Nargis Cinema Hall, New Modern Public School, Telephone Bhawan, many standard hotels and two petrol pumps.

Table 4. Traffic noise in Balasore along the Fakir Mohan Square

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	At Traffic Post	16	105.3	115.3
2	At Binayak book store	16	98.2	112.2
3	At Jhadeswar sweets shop	16	95.8	111.6
4	Near HDFC Bank	16	88.0	105.9

Table 5. Traffic noise in Balasore along the Bus Stand

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	Within bus stand premises	16	111.9	118.6
2	Entrance of the bus stand	16	109.3	112.4
3	Near fly over	16	102.3	112.5
4	In front of hotel Swarnachood	16	89.2	111.6

Table 6. Traffic noise in Balasore along the Cinema Square

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	At Cinema Square	16	105.8	122.9
2	At Town hall site	16	98.0	116.8
3	At District Head Quarter Hospital	16	100.5	112.8
4	Near Micky Mouse shop	16	94.4	118.7

Table 7. Traffic noise in Balasore along the Station Square

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	At Station Square	16	108.4	118.0
2	At Telephone Bhawan	16	96.0	111.4
3	At Durga Mandap	16	99.4	113.5
4	At Nargis Cinema Hall	16	93.4	122.7

In order to investigate the effect of noise levels along the Police line Square, the noise levels have been measured for the four nearest sites at and around the Police line. The data are presented in (Table 8). In three sides of this square, there are large market complexes. In addition, Axix Bank, Bazaj Allianze Insurance Office, Petrol pump and few restaurants are located nearer to the square. Overall noise levels near Police line Square ranges from 93.6 to 119.2 dB (A) and are sufficiently increased due to traffic noise.Maximum noise levels are assessed at Cinema Square (122.9 dB A) followed by at Nargis Cinema Hall (122.7 dB A) near Station Square and below fly over (122.5 dB A) near Remuna Golei Square, while minimum noise levels are monitored at HDFC Bank (88 dB A) near Fakir Mohan Square, followed by at Swarnachood Hotel (89.2 dB A) near bus stand and Grid Corporation office (90.4 dB A) near Remuna Golei Square (Fig. 3).

The exercise to point out the type of vehicles and its contribution to environmental noise brought out interesting findings. The objectives of measuring the noise levels firstly was to have an estimate of its individual contribution to the environmental noise and secondly to reflect the maintenance levels of the vehicles prevalent in the area. The vehicular noise levels are depicted in the (Table 9). It is observed that the cargo carrying trucks (118.9 dB (A)) is producing more noise followed by Town Bus (115.5 dB (A)). Noise produced from motor cycles, town buses, mini trucks, cars and tempos range between 98.3 and 112 dB (A); 115.5 and 132.4 dB (A); 105.2 and 115.3 dB (A); 103.3 and 112.1 dB (A) and 105.6 and 111.8 dB (A) respectively (Fig. 4). The findings of individual contribution of vehicle towards noise pollution give us a relative data on different noise producing vehicles. Therefore, Balasore administration should take some imperative steps and regulatory measures to abate such noise pollution. The authorities should remember that noise is not a measure of the progress of technology but it is a sign of regress.

The noise perception survey is carried out by a questionnaire, which is administered to 212 individuals in Balasore. This survey clearly demonstrates that most of the people including vehicle drivers were aware of noise pollution but they are ignorant of related health problems. 63% respondents were not satisfied about the noise level in their places in Balasore. They described themselves as being personally affected by noise pollution—more than for water, air or waste pollution. Of the sources of environmental noise, the most important was road traffic noise, with 49 % of the respondents describing it as the noise they would most like to get rid of. (Table 10). demonstrates that these 49 percentages of

Table 8. Traffic noise in Balasore along the Police Line Square

No.	Location	Number of observations	Sound pressure level in dB (A)	
			Min	Max
1	At Police line field	16	98.6	109.2
2	At Police line Square	16	112.0	119.2
3	Near petrol pump	16	102.5	117.4
4	Near Axix Bank	16	93.6	116.6

Table 9. Episodic and impulsive noise levels by the air- horn of motor vehicles in Balasore

No.	Type of Vehicle	Number of experiments	Sound pressure level in dB (A)	
			Min	Max
1	Motor cycle	20	98.3	112
2	Mini truck	20	105.2	115.3
3	Town bus	20	115.5	132.4
4	Tempo	20	105.6	111.8
5	Truck	20	118.9	136.8
6	Car	20	103.3	112.1

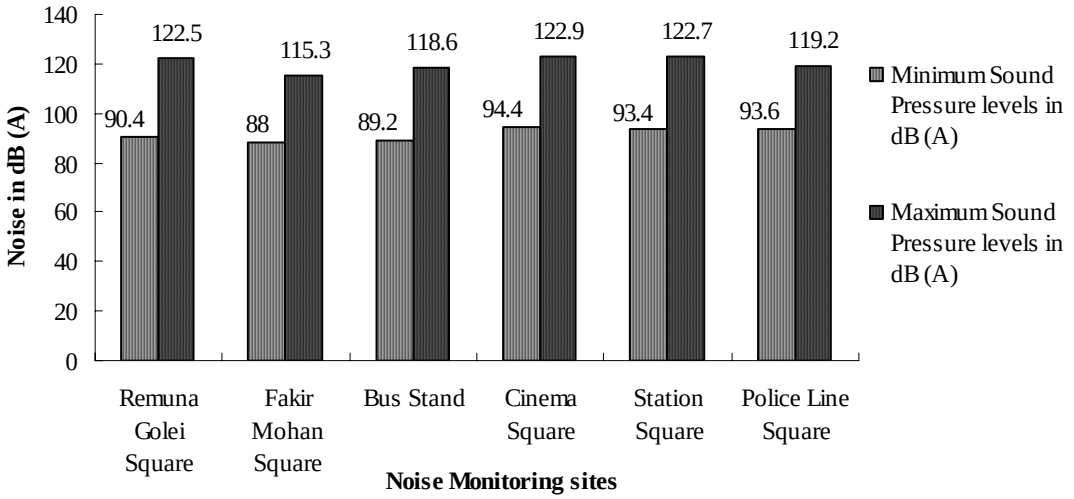

Fig. 3. Range of Noise levels in different noise monitoring sites at around Balasore, Orissa, India

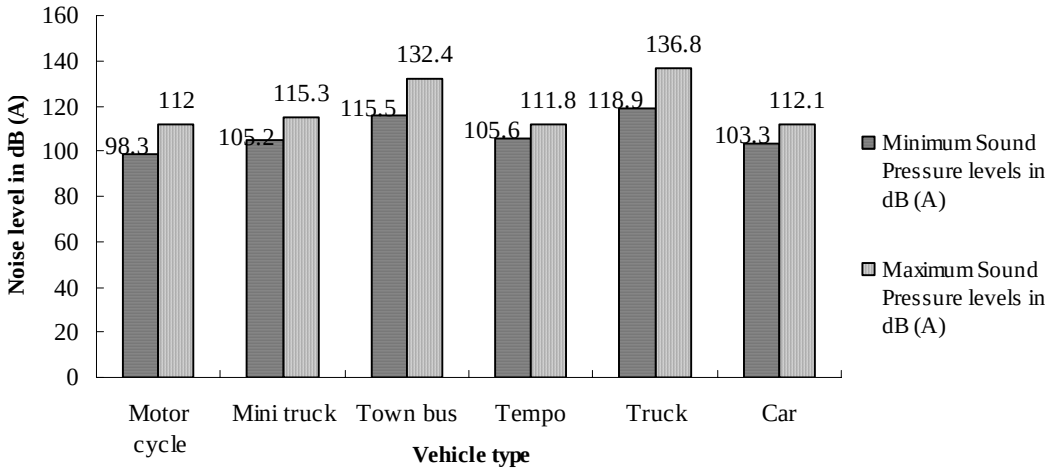

Fig. 4. Episodic and impulsive noise levels by the air horn of motor vehicles in Balasore, Orissa, India

respondents are highly annoyed by different types of vehicular source. Amongst them, 15.5% respondents are irritated with the air-horn noise from motor cycle. As motor cycles are fuel efficient and cheaper, most of the people are riding the same in Balasore. Numbers of motorcycles are increasing day by day in an alarming rate throughout India.

Most of respondents told that they have had at least one experience of being temporarily "deafened" by a loud noise. This sort of partial hearing loss is called Temporary Threshold Shift (TTS). If anybody suffers frequently TTS, he may suffer complete hearing loss. Headache, bad temper, hearing problem, loss of concentration were some of the significant effects manifested by noise pollution. 47% respondents identified headache as the main health effect of noise pollution and 39% respondents have visited to Ear Nose Throat specialist doctors for treatment of

Table 10. Percentage of respondents highly annoyed by different source

Source	Rank	% of respondents highly annoyed by source
Motor cycle	1	15.5
Mini truck	6	4.2
Town bus	3	7.4
Tempo	4	4.6
Truck	2	8.9
Car	5	4.4
Constant traffic	7	4.0
Total		49

health problems. 96% of students reported that their study was disrupted by frequent air horns of vehicles. 28% of people shared their sleep disturbance due to traffic noise during night-time. It warrants a systematic survey of sleep quality, number of awakenings or number of changes in sleep state to estimate the extent of sleep disturbance. The general public strongly supported actions from the government to reduce noise pollution. Most of them supports the ban of hydraulic horn, improved traffic control, banning very old vehicles, banning of high-noise creating industries such as stone crushing machines according to their noise ranges and banning of usage of sound amplifying mikes for processions, advertising and election campaigns.

CONCLUSION

Noise pollution is not properly recognized despite the fact that it is steadily growing in developing countries like India and in particular in the state Orissa. It is well established now that noise is a potential hazard to health, communication and enjoyment of social life. It is becoming an unjustifiable interference and imposition upon human comfort, health and quality of modern life. Noise pollution is an interfering air-pollutant, which possesses both auditory, and a host of non-auditory effects on the exposed population. Since there is no medicine to cure hearing loss, prevention to overt exposure is the only alternative left (Roy, 1984; Ravindranath *et al.,* 1989; Rathore, 1982; Pancholy *et al.,* 1967; Dixit *et al.,* 1982; Rao *et al.,* 1987; Kudesia and Tiwari, 1993; Krishna Murthy *et al.,* 2007). In rapidly urbanizing and industrializing Balasore, the transportation sector is growing rapidly. This has led to overcrowded roads and noise pollution in the city. Transportation sector is one of the major contributors to noise in this urban area. The present study explicitly reveals that the noise levels are more than the permissible limit in all the six locations including 24 sites.

The individual can control noise from his own vehicle by adequate maintenance, by fitting a suitable silencer and even by considering noise as a criterion when purchasing the vehicle. It is also worth noting that from the noise point of view, it is better to concentrate traffic along main roads (that are already noisy) then to distribute between parallel roads. By double-glazing the windows of homes, facing the road will reduce the level by up to 20 dB (A). Some other suggestions such as banning hydraulic horns, improvement and streamlining of roads and parking system, discouragement of high sound producing vehicles, industries and public awareness would also be helpful in reduction of the present noise level in Balasore. Vegetation buffer zones must be created in different parts of the city. Efforts should be made for roadside plantations, which absorb the sound. In the noisy places, we should wear earplugs and earmuffs. Communities should be educated on the negative effect of noise. The role of NGOs, researchers and professionals, media and concerned individuals is significant in minimizing the environmental hazard of noise pollution.The present study demonstrates that we need programs to complement strategies that are geared towards reducing motor vehicle use with more effective ways of managing existing levels of traffic noise, through influencing the nature of road design, road use and development adjacent to roads. In addition, design and fabrication of silencing devices and their use in all types of vehicles would also be an effective measure to abate noise pollution. Direction and resources should be given to develop quiet and safe tires with low rolling resistance to reduce noise pollution. It is certainly important to optimize combustion and noise in vehicles in parallel. The following range of strategies should be applied to reduce traffic noise.

- Land use planners should consider noise impacts in selecting location and design of development. Before commencing any project, potential sources of noise pollution associated with the proposed project should be identified.
- Launching programs to monitor and control noisy vehicles on the roads.
- Controlling noise from heavy vehicle exhausts and engine brakes
- Restricting trucks movement within the town
- Encouragement to use public transport
- Driver education Program
- Sustainable traffic management
- Proper town planning

Thus, Integrated Road Traffic Noise Strategy (IRTNS) must be developed at government level to minimize noise pollution. CPCB, India should lay down legal standards for noise levels from roads and Ministry of Environment and Forest should

launch programs to reduce noise from the motor vehicle. The following essentials should be focused on IRTNS

•*the motor vehicle* –reducing noise from individual vehicles and reducing use of the motor vehicle;
•*roads* – reducing noise emitted from traffic flows on the road network; and
•*the noise receptor* – reducing noise impacts on people at homes or noise-sensitive buildings.

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