*Eco. Env. & Cons. 29 (April Suppl. Issue) : 2023; pp. (S191-S205)*
*Copyright@ EM International*
*ISSN 0971–765X*

**DOI No.: http://doi.org/10.53550/EEC.2023.v29i02s.036**

# Traffic Noise and its Risks on Human Health in India: A Systematic Review from 1990 To 2022

**Hira Lal Yadav[1] and Janhavi Yadav[2]**

***[1]Department of Civil Engineering, Govind Ballabh Pant Institute of Engineering and Technology, Pauri Garhwal, India***
***[2]Department of Civil Engineering, Madan Mohan Malaviya University of Technology, Gorakhpur, India***

(Received 15 September, 2022; Accepted 14 November, 2022)

**ABSTRACT**

This literature reviews article based on the systematic study of research conducted during the most recent thirty years on traffic noise and its effect in Indian occupants. Studies on road traffic noise was only restricted to the metropolitan territories all through the country. The studies on the noise level have determined only on the monitoring, recording, analysis, modelling, and mapping to some level and related to themes. Negligible findings are found in the exposure-effect sense of physiological and sleep research areas. Nearly all of studies related to noise pollution have been uniquely connected with disturbance and behavioural surveys. In the Indian situation a very few studies associated to human physiology by traffic noise were found and study also outlook very less study are accessible related to traffic noise and its sever impacts on human health. This study review reveals that highway traffic noise is a main cause of aggravation in respondents. Traffic noise could lead to more severe psychological effects in human. A simplification of influence and meta-analysis was not probable in the study due to the many changeable features in the designs and favoured outputs.

***Key words :*** *Road traffic noise, Noise modelling, Social survey, Exposure-effect study, Organized review Noise descriptors, CPCB recommendations.*

## Introduction

In India, traffic noise pollution is becoming a severe problem due to inappropriate accessibility of reasonable and capable public transportation system in urban areas. The population in metropolitan areas has risen dramatically in recent decades, from 109 million in 1971 to 160 million in 1981 and 217 million in 1991 and 285 million in 2001, respectively (Gozalo *et al.*, 2018; Mishra *et al*., 2010) due to rapid enhancement in population, industrialization, urbanization, transportation sectors and communication systems during last 100 years, it is continuously growing due to continuous expansion of infrastructure, transportation systems, in the air traffic and road networks (Ross *et al*., 2011). India's urban population grew to 34.9 percent in 2020, rising at an annual average rate of 1.15 percent and may be reached 416 million in 2050 (UNWUP, 2018). Presently due to many man-made structures, noise pollution in the urban area has reached a very alarming degree across the world over the years. This is now in the mode of replication after every ten years (Pandey, 1992). A number of studies are already done all over the world which supports the relationship between environmental noise and human health. The excess exposure of noise pollution may be cause of several severe health related problems

in human like, ischemic heart disease, cardiovascular failure, sleep disturbance with waking up ( Miao *et al*., 2016; Roswall *et al*., 2017; Skoe and Tufts, 2018). During the last century, significant analysis has been carried out by many researchers to examine the exposure of highway traffic noise to human response, irritation, uneasiness, and sleep annoyance. Most researchers follow the trends of monitoring, modelling and questioning studies in laboratory and field types (Kawada *et al*., 2001; Schomer *et al*., 1996; Saletu *et al*., 1989; Valet *et al.,* 1983). Compared to other contaminants, noise related to road traffic is peculiar in the Indian perspective, as elsewhere, because noise pollution has no visible stable indicator to act as a systematic relic of its offensiveness, unlike water, air or soil pollution. While its extreme impacts are generally like any other pollutant, in India very less priority are given to control the noise pollution from the sources of generation and its appropriate management.

While road traffic is a very considerable component of the urban atmosphere and major sources of urban noise emission in the inner-city areas are due to narrower, congested, and medium to heavy overcrowded highway network circumstances (Banerjee *et al.,* 2008; Rajakumara and Gowda, 2008). Globally the growing number of vehicles emits additional uninhibited noise pollution, which are the key causes to both short and long-term psychiatric and physiological problems related to human health. Such as "sleep disturbance" "lack of concentration" and "communication disturbance" are the most feasible impacts that the population can consider to be directly triggered by highway traffic noise. The population, particularly survive in the Indian subcontinent, is unaware that noise may be a source of health associated nuisance and, on the other hand, studies worldwide have provided substantial evidence that road traffic noise in urban areas has a serious harmful effect on the human health and animal life (Dhole and Kadu, 2018). The contribution of road noise in urban areas is more than 55% of the overall ambient noise (Goswami *et al.,* 2013). A very small research on exposure-effect studies of road traffic noise is currently available with respect to the Indian scenario; most data are only available on the quality of noise. The current review is intended to perform an intensive systematic review and possible meta-analysis of well-known research articles published in India during the last 30 years.

## Materials and Methods

To examine the significance of noise pollution levels generated by road traffic in India is examined by many renowned researchers linked with fitness of human being. In general, 61 journal articles and 3 proceedings in conference) accessible in last 33 years (1990 to 2022) were selected for reviewed as per the guidelines recommended by (Omlin *et al.,* 2011) for conducting this types of systematic literature review to reveal the significance of environmental noise and its effects on Indian population. The present study was base on the articles available in different data base like, Elsevier, Google scholar, PubMed, Scopus, Springer, Wiley online library, Taylor Francis, conference proceedings search" and other searches incorporated the terms, specifically "noise pollution," "transportation noise," "road traffic noise," "sleep disturbance," "frustration," "road traffic noise modelling and mapping," and " impacts of noise on human health". The following parameters is included to determine the content of the papers

Population research is straight forward (i.e., age, gender, and number of inhabitants)

Subjective exposure to noise is clear defined (i.e., audiometric study, site, specific time, and monitoring time of noise or presentation, volume of traffic, questionnaire survey)

Statement of used statistical methods

Sample size: small (less than 50), medium (in the range of 50 to 150) and big (greater than 150)

Random collection of sample

## Results and Discussion

In this systematic literature review 64 articles, related to traffic noise is taken for systematic review including two conference proceedings (Table 1). The specifics of the studies described and incorporated in this analysis are shown in Table 1. The approach of study, results, and also discuss its assessment of superiority of articles consider for systemic reviewed are given below.

### Studies with Special importance on highway Traffic Noise and its impacts on human life

Sarin *et al.* in 1990 carried out their study near a busy highway intersection to assess the problems of road traffic noise in the residential apartments in Delhi. The noise level at all the seven floor the residential apartments was found to be upper level than

**Table 1.** Studies investigate the risk of road traffic noise in the Indian circumstances on the inhabitants from 1990 to 2022

| Name of author | Locationof the study area | Nature of study | Sources of data | Noise measurement | Measurement of effects | Method applied Modeling | Modeling used | Sample size |
|---|---|---|---|---|---|---|---|---|
| Sarin *et al.* 1990 | Delhi. | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Rao and Rao (1991-1992). | Visakhapatnam, Andhra Pradesh | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 1195 |
| Rao and Rao (1991-1992). | Visakhapatnam, Andhra Pradesh | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 1195 |
| Rao and Rao (1991-1992). | Visakhapatnam, Andhra Pradesh | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 1195 |
| Yagnarayana and Ramalingeswara Raoin 1994 | Ramagundam | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Yogamoorthi and Beena, 1996 | Pondicherry Town | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Chakrabarty *et al.* (1997) | Kolkata West Bengal | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 1100 |
| Pandya and Verma (1997) | | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Ravichandran *et al*. | Tiruchirapalli | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Koijam *et al.* (1998) | Imphal valley. | Fields Study | Journal articles | Yes | No | No | Yes | No |
| Chakraborty *et al.* 1998 | Kolkata | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 1100 |
| Mohan *et al.* 2000 | New Delhi. | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 500 |
| Naik and Purohit, 2001 | Bondamunda, Odisha | Journal articles Fields Study | Yes | No | Yes | No | No | |
| Chakraborty *et al*. (2002) | Calcutta Metropolis | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Naik and Purohit, 2003 | Bondamunda, Raurkela Odisha | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Sampatfa *et al.* (2004) | Kerala | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Jain and Parida, 2004 | | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Ingle and Pachpande, 2005 | Jalgaon, Maharashtra | Fields Study | Journal articles | Yes | Questionnaire | No | No | Not Reported |
| Pachpande *et al.* 2005 | Jalgaon, Maharastra | Fields Study | Journal articles | Yes | Questionnaire | No | No | Not Reported |
| Kisku *et al.* 2006 | Lucknow | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Tripathi and Tiwari, 2006 | Ahmadabad, Gujarat | Fields Study | Journal articles | Yes | Questionnaire | No | No | 86 |
| Ziauddin *et al.* 2007 | Dehradun, uk | Fields Study | Journal articles | Yes | No | No | Yes | No |
| Banerjee *et al.* 2008 | Asansol, West Bengal | Fields Study | Journal articles | Yes | Questionnaire | Yes | Yes | 869 |
| Chauhan, 2008 | Haridwar and Dehradun | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Agarwal and Swami in 2009 | Jaipur | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 350 |
| Nandewar *et al.* 2009 | Nagpur, Maharastra | Fields Study | Conference | Yes | Questionnaire | Yes | No | 378 |
| Kerketta *et al.* 2009 | Arati, Odisha. | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Goswami, (2009) | Balasore, Odisha | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 212 |
| Mishra *et al.* 2010 | Delhi | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Wani and Jaiswal, 2010 | Gwalior, Madhy Pradesh | Fields Study | Journal articles | Yes | Questionnaire | Yes | Yes | 100 |
| Chauhan and Pande, 2010 | Dehradun, Uttarakhand | Fields Study | Journal articles | Yes | No | Yes | No | No |

**Table 1.** *Continued ...*

| Name of author | Locationof the study area | Nature of study | Sources of data | Noise measurement | Measurement of effects | Method applied Modeling | Modeling used | Sample size |
|---|---|---|---|---|---|---|---|---|
| Sharma and Joshi, 2010 | Haridwar, Uttarakhand | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Bhosale *et al.* 2010 | Aurangabad Maharastra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Goswami, 2011 | Bhadrak, towns | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 136 |
| Gupta and Ghatak, 2011 | Burdwan | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 52 |
| Patil *et al.* (2011) | Amravati, Maharashtra | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | 500 |
| Pramendra and Vartika, 2011 | Dehradun, Uttarakhand | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Pradhan *et al*. 2012 | Sambalpur Orrisha | Fields Study | Journal articles | Yes | Questionnaire | Yes | Yes | 502 |
| Mangalekar *et al.* (2012) | Kolhapur, Maharashtra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Goswami *et al*. 2013 | Rourkela City Chhattisgarh | Fields Study | Journal articles | Yes | Questionnaire | No | No | 256 |
| Swain *et al.* 2013 | Bhadrak | Fields Study | Journal articles | Yes | Questionnaire | No | No | 202 |
| Tiwari *et al.* (2013) | Amravati, Maharashtra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Swain *et al*. 2014 | Balasore town, Odisha | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Ahirwar and Bajpai, 2015 | Raipur, Chhattisgarh | Fields Study | Conference | Yes | No | Yes | No | No |
| Chowdhury *et al.* 2015) | Kolkata, West-Bengal | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Vijay *et al.* 2015 | Nagpur, Maharashtra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Patel and Pandey, 2016 | Varanasi | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Swain, *et al*. 2016 | Balasore Odisha | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Singh *et al*. 2016 | Vadodara Gujaratat | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| De *et al.* 2017 | Puri | Fields Study | Journal articles | Yes | No | No | Yes | No |
| Khan and Ahmad, 2017 | Noida, Uttar Pradesh. | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Myrthong *et al.* 2017 | Allahabad city, Uttar Pradesh | Fields Study | Journal articles | Yes | Questionnaire | Yes | No | Not Reported |
| Ramakrishna *et al.* 2017 | Ramavarappadu, Vijayawada | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Dhole and Kadu, 2018 | Washim, Maharashtra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Kumar and Koshta, 2018 | Madhya Pradesh. | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Lokhande *et al.* 2018 | Nagpur, Maharashtra | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Kumar *et al.* 2019 | Vellore city | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Ramakrishna *et al.* 2019 | Aurangabad Maharastra | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Ranpise *et al.* 2019 | Surat, Gujarat | Fields Study | Conference | Yes | No | Yes | Yes | No |
| Archana and Harshan, 2020 | Calicut City | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Sahu *et al.* 2020 | Burla town | Fields Study | Journal articles | Yes | Yes | Yes | Yes | 775 |
| Upreti *et al.* 2020 | Dehradun, Uttarakhand | Fields Study | Journal articles | Yes | No | Yes | No | No |
| Mishra *et al*. 2021 | Kanpur | Fields Study | Journal articles | Yes | No | Yes | Yes | No |
| Roy, *et al.* 2022 | Asansol | Fields Study | Journal articles | Yes | No | Yes | Yes | No |

the acceptable limits of 65 dB(A) as per the recommendation of Central Pollution Control Board (CPCB).

Rao and Rao, (1991-1992) conducted a study to measure the noise levels an industrial and sea port city of Visakhapatnam, Andhra Pradesh, India. In the present study, the mean emission level was found such as 73.3 dB (A) and 87.42 dB (A) for least noisy and noisiest vehicles correspondingly. This analysis also concluded that the expected values from the regression equations were found to be correct relative to the values obtained by previous researchers from earlier studies.

Yognarayana and Ramalingeswara, in 1994 made assessment of traffic noise levels to monitor traffic noise levels at the 11 (eleven) selected intersections to determine the overall environmental noise issue in the city of Ramagundam, Karimnagar district of Telengana State. Throughout the study period, $L_{10}$, $L_{50}$, $L_{90}$ and Leq had been acknowledged. The TNI and LNP have been determined and evaluated on the basis of these values. The findings show that, due to excess movement of motor vehicles at all locations in the study area, there was a higher noise pressure level than the specified limits of the Central Pollution Control Board.

Yogamoorthi and Beena in 1996 made a study to determine the noise level in the Pondichery Town, South India in the four zones of forty two important locations such as commercial, traffic signal points, silence and special zone, i.e. central bus stand. The noise level in the commercial zone ranged between 60 to 65 dB (A) but at certain times when trucks used air horns the noise level increased up to 70 to 75 dB(A). The noise level in the commercial, traffic signal points and special zone ranged between 60-75 dB(A), 70 to 80 dB(A) and 70 to 100 dB(A) correspondingly where as noise levels was found higher than the permissible limits in the silent zone.

Shastri *et al* in (1996) conducted a research to determine the normal noise level of four noisiest metropolitan cities such as Delhi, Kolkata Madras and Mumbai, India. The noise level for Mumbai metropolitan has been found to be 90 dB (A) and the Jaipur noise level ranges from 64 to 80 dB(A) in industrial zones. The maximum noise level in the vicinity of Anna Statue in Madras was recorded to be 117 dB (A) in day hours.

Chakrabarty *et al.* (1997) examined noise levels in 1993, at 24 traffic junctions of Calcutta, West Bengal, India in summer season to assess the different noise parameters such as $L_1$, $L_{10}$, $L_{50}$, $L_{90}$, $L_{99}$ and descriptors like Leq(24), Lnp, Ldn and TNI for all twenty four locations. The study results were found in the range of 89.0 dB (A), to 102.5 dB (A), 84.3 dB(A) to 97.0 dB (A),77.5dB (A) to 87.1dB (A), 63.1 dB (A) to 74.9dB (A), 52.9 dB (A) to 63.9dB (A), 82.2 dB (A) to 92.0 dB (A), 85.7dB (A) to 95.4 dB (A), 99.2 dB (A) to119.9 dB (A),112.2 dB (A) to150.4 dB (A) respectively and regression equations are also developed to forecast ambient noise levels. The observed noise levels were found higher than the standard permissible limit set by Central Pollution Control Board for Indian cities.

Ravichandran *et al.* (1997) conducted a study to assess the noise levels in selected area at the city Tiruchirapalli, Tamil Nadu. The obtained results from the residential, silence and commercial locations were found higher than the maximum permissible limit specified by the Central Pollution Control Board.

Pandya and Verma (1997) carried out noise pollution studies near major traffic intersections for residential, commercial and sensitive zones and Leq value varies in the range of 58 to 75 dB (A) and 48 to 66 dB(A) during day and night hours correspondingly.

Koijam *et al* in (1998) examined noise levels in some selected portion of urban areas at Imphal valley. The study results show that minimum and maximum noise levels, such as 72 to 77 dB(A), 71 to 77 dB(A) and 60 to 68 dB(A), were observed in the morning, after noon and at night hours respectively. The observed noise levels were found higher than the standard permissible limit set by Central Pollution Control Board for Indian cities.

Chakraborty *et al.* (1998) have explained, in order to understand the consequence of highway traffic noise and its impacts on the public in Kolkata urban area. The results of the study show that 30% of the inhabitants' were extremely irritated due to highway traffic noise. The used models for study noise impacts and annoyance were also correlated with each other.

Mohan *et al.* (2000) carried out an evaluation of the level of traffic noise to determine the effect of road traffic noise and the response of residents living very close to the New Delhi arterial road. The study results indicate that dwelling communities up to 30 metres from the arterial road are very irritated due to high level of traffic noise. The effects of traffic noise were also studied at various levels of multi-

storey apartments. About 70 percent of inhabitants were prepared to change their houses away from the busy road due to noise pollution in the study area.

Naik and Purohit (2001) conducted a study of noise pollution at eight specific locations at Bondamunda of Rourkela industrial capital of Odisha state, India. The results of noise levels was varied from 47.8 to 103.6 dB(A). The average Leq values at individual place ranges from 66.22 to 93.67 dB(A). Lnp and TNI were also computed for that hour during daytime.

Chakraborty *et al.* (2002) conducted a comprehensive study for 2880 observations to assess the traffic noise level at 24 preselected locations near road transaction for continuously recording the data for 24 hours at Kolkata Metropolis, West Bengal, India in a period of 1993-94. The values of Leq, exceedence levels, LD, LN, LDN, LNP and TNI were measured. The evaluated maximum and minimum value of Leq was varies from 80.3 dB (A) to 92.1 dB (A).

Naik and Purohit (2003) measured levels of traffic noise in the vicinity of ten residential areas at the city Bondamunda, Raurkela Odisha in day and night hours. The noise levels was found in the range of 42.5 to 75.6 dB (A) and 41.3 to 64.7 dB (A) and average Leq values ranges from 55.03 to 67.15 dB (A) and 45.6 to 56.81 dB (A) during day and night period correspondingly.

Sampatfa *et al.* in (2004) carried out noise pollution studies to examine the noise levels in the residential, commercial and silence zone at 21 locations at three main cities like Kochi (26, locations), Kozlii Kode (21, locations) and Thiruvananthapuram (21, locations), in Kerala state. The average noise level was recorded in the study area such as 78.5 dB (A), 77.5 dB (A), 81.3 dB (A) for Kochi, Kozlii Kode and Thiruvananthapuram respectively. This is found greater than the standard values allowed by Central Pollution Control Board (CPCB) for Indian cities.

Jain and Parida, (2004) develop a standard prediction model to study the level of noise pollution in different important cities of India like, Allahabad, Chandigarh, Delhi, Lucknow and Jaipur. To observe the appropriateness of the model of the FHWA and CORTN along with techniques focused on regression and statical analysis. The % difference between experiential and expected noise levels for the FHWA model range from 0.42 to 10.25, 0.58 to 12.25,0.49 to 10.25, 0.75 to 10.78, 0.56 to 10.25, Allahabad, Chandigarh, Delhi, Lucknow and Jaipur area, respectively.

Ingle and Pachpande (2005) conducted a survey to assess the traffic noise among inhabitants of city Jalgaon, Maharashtra state, India. The findings of this research showed that moderate hearing impairment was found in exposed and unexposed group of populace in the study area. This research also reveals that mild hearing loss was observed in many people's among residents of the exposed groups. This study also reveals that 81% of interviewer was affected by traffic noise in association to the unexposed interviewer group (61%).

Pachpande *et al*. (2005) measured traffic noise level during day time to assess the effect of noise pollution on the health of students and teachers in the vicinity of Jalgaon city, Maharastra, India. Approximately 84%, 92% of teachers and school students reported hearing complexity in the questionnaire survey. In audiometric investigation gentle hearing loss (25-35dBHL) was observed among students and teachers. It was concluded that strategies require using suitable safety during working hours of the students and teachers from the higher noise exposure.

Kisku *et al.* (2006) studied the noise levels at 12 locations in the state capital (Lucknow) of Uttar Pradesh to assess the noise levels in residential, commercial and industrial area. This study also reveals that the obtained noise level was higher than the specified values of Indian standards for residential, industrial and commercial area. The noise level varies from 67.7 to 78.9 dB(A) and 52.9 dB(A) to 56.4 dB(A), 74.8 dB(A) to 84.2 dB(A) and 68.2 dB(A) to 74.9 dB(A) and 76.9 dB(A) to 77.2 dB(A) and 72.2 dB(A) to 73.1 dB(A) respectively in day and night hours. This study also revealed that higher noise level in study area creates a considerable impact on the human health.

Tripathi and Tiwari (2006) conducted a survey based on questionnaire to study the impacts of noise pollution on the traffic personnel in the city Ahmadabad, Gujarat. The survey results show that 11.6 percent of inhabitants complained of disorder related to circulatory system in daily life, while 62.8 percent had only suffered tinnitus during working hours. This study also reveals that 2.3 percent respondents were noticed a self-assessed prevalence of diminished hearing.

Ziauddin *et al.* (2007) measured traffic noise level to assess the noise pollution level in Dehradun city Uttarakhand state. This study report say that the

maximum noise level was found such as 102.7 dB (A) and Leq was 83.7 dB (A) due to high traffic noise in the metropolis area.

Banerjee *et al.* (2008) conducted a study to observe the connection between traffic noise levels and irritation at 25 locations of Asansol town in the West Bengal, India. To measure the effect of traffic noise, 869 individuals were surveyed. The outcomes of this study show that the average value of Ldn was ranges from 73.28±8.51 dB(A) to (55.1-87.3). The traffic noise index varies in the range of 80.62± 15.88 dB(A) to (49.4-115.8) dB (A). The inhabitants was highly Annoyed (% HA) and its mean value ranges from 26.50±3.37 (19.44-33.2) due to road traffic noise. Although the mean unhappiness score (MUS) was found as 2.96 ± 0.90. This study also reveal that the inhabitants exposed to much higher noise level including silence zone like schools and hospitals mainly due to road traffic. The study also observed the relation between few models, and reported like that, vehicular input based models were found less effective than the noise index-based models for enhanced irritation predictions and also report two important impacts of noise pollution on human health due to higher traffic noise, such as nosiness and sleep disturbance during the day and night times respectively.

Chauhan, (2008) carried out their study at 32 locations for two famous cities such as Haridwar and Dehradun Uttarakhand at four zones viz residential, commercial, silence and industrial zones. In residential areas of Haridwar and Dehradun the noise level varies from 77.40±4.52 to 89.90±8.87 dB (A) and 70.70±8.55 to 92.30±10.41 dB (A), respectively, although in commercial areas noise ranged between 80.20±10.61 to 96.60±10.23 dB (A) and 80.90±6.63 to 89.10±9.81 dB (A), for Haridwar and Dehradun correspondingly.

Agarwal and Swami (2009) made evaluation of traffic noise levels in Jaipur city, India and also assess its impacts on human being through questionnaire survey. A questionnaire survey's result show that 52, 46, and 48.6% of the interviewee were suffering from annoyance, hypertension, and sleep trouble due to excess noise produced by transport sector, respectively. This study also suggests that the height of the noise barrier should be raised in order to reduce the effect of road noise in the study area.

Goswami (2009) studied the noise levels to measure the indices of noise, respond of vicinity, and its health effects on the community at the city Balasore in the state of Odisha, India. 63 percent of interviewees were found unhappy due to higher level of traffic noise in the surrounding area. May causes of ambient noise, here road traffic noise was the main causes of excess noise, with 49 percent of interviewees reporting heavy road traffic annoyance, 28 percent of respondents reporting sleep disturbance due to movement of heavy vehicle in night time.

Kerketta *et al.* (2009) conducted a research to determine outdoor noise levels from various workplaces in Arati steel plant in the Odisha state, India. The highest noise level attenuation was recorded as 84 dB(A) near the colony of employees and 92 dB(A) in the steel plant.

Nandewar *et al.* (2009) conducted a study at major road intersections to determine the effect of heavy traffic noise on the quality of human life in the Nagpur town, Maharashtra state India. The everyday performances of greater number of the resident were affected by aggravation due to high traffic noise. 29%, 24%, 22%, 19%, population were experience with extremely, very much, to some extent, and little irritated correspondingly. 33% inhabitants were experience excessive irritation in evening time as compare to day time. Most harmful impact on the human health was documented due to traffic noise such as nuisance, anxiety, and hearing trouble. In their study, they concluded that many health-related variables were depended on the education quality and income of inhabitants.

Sharma and Joshi (2010) studied traffic noise levels in two important zone like residential and commercial within the Haridwar City, Uttarakhand on the occasion of festive and non-festive day by using noise level meter. The result shows that the usual noise levels during festive and non-festive day were found higher than the normal day for residential (29.6%) and commercial (18.1%) area. When it is compared to the values defined by the Central Pollution Control Board (CPCB).

Mishra *et al.* (2010) made evaluation of traffic noise levels in Delhi city beside a rapid bus transportation passage. The study results show that 68% of the people facing the anxiety due to vulnerability of heavy traffic noise. This study also acknowledged 64%, 56%, 48%, 36%, 12% inhabitants feels loss of hearing; high blood pressure, hopelessness, anxiety and tiredness correspondingly dwell near to the rapid bus transit system. This report also suggests that the height of the noise barrier should be raised

in order to reduce the effect of road noise in the study area.

Wani and Jaiswal in 2010 studied the traffic noise level in the city Gwalior of Madhy Pradesh state on the basis of questionnaire survey. The survey results shows that 50% of the inhabitants were always feel irritated and 33% had regular problems of headache. As per the survey results the impacts of noise on human health were found such as 43%, 21%, 32% and 4% for interference in communication, subjects reported extremely affected, fairly affected, low, and slightest affected correspondingly.

Chauhan and Pande (2010) measured traffic noise levels at twenty different sites with the help of sound level meter to measure the traffic noise in day and night time in the Dehradun City of Uttarakhand State. The study report show that high level of noise may produces many severe health associated problems in populace like, stress on the auditory and nervous system. The key source of noise pollution in Dehradun city is highway traffic and the observed noise level has also been found to be much higher than the recommendations of CPCB, for Indian conditions.

Bhosale *et al.* (2010) studied vehicular noise level at six different site viz Baba petrol pump, CIDCO bus stand, Dhoot Hospital, Kranti Chowk, Nagar Naka and Railway station, on working and holiday in city Aurangabad Maharastra.The minimum and the maximum noise levels were reported such as 74 dB (A) to 86 dB (A) and 70 dB (A) to 81 dB (A), respectively, for working and holiday. The calculated values of noise level were found beyond the prescribed limit.

Goswami (2011) studied the sounds cape and conducted a questionnaire survey for silence, residential, commercial, and heavy traffic area for four different locations in the Bhadrak towns. Noise descriptors such as $L_{10}$, $L_{50}$, $L_{90}$, Lmax, Lmin were monitored and Leq, NPL and NC were calculated, which were found more than the permissible limit.

Gupta and Ghatak (2011) carried out their study to assess the traffic noise at Burdwan town in the state of West Bengal at five different locations along a National Highway. Survey based on the questionnaire was also made among the 52 individual of 10 households residing in very long time near the surrounding area. The results of the questionnaire based survey shows that 36%, 53%, 40% 36%, 15%, 67% and 61% of people were suffered from anxiety, headache, hypertension, hearing loss, cardiovascular disorder, petulance and sleeplessness in the study area respectively. This study also reveals that many physiological and psychological effects were also seen in human such as abnormal heart beat, hearing loss, sleep disturbances and complexity in convey.

Pramendra and Vartika (2011) conducted a study on monitoring of noise pollution in an Indian city. The study suggested many feasible improvements to decrease noise pollution, together with regular monitoring, appropriate maintenance of vehicles, replacement of old vehicles, suitable plantations and buffer zones, widening of roads width and appropriate awareness in the vicinity concerning noise pollution. While the authors also claim various disorder in human, animals and plant due to the higher noise pollution. Several health related problem were also monitored in many inhabitants like cardiovascular tribulations, hypertension, increased diabetes levels, many stern changes found in social activities and raise the possibility of clinical depression.

Pradhan *et al.* in 2012 has conducted a study to assess main noise parameters such as $L_{10}$, $L_{50}$, $L_{90}$, and descriptors like Leq, NC, NPL, TNI, volume of traffic, truck-traffic mix ratio, Lden of Sambalpur city, Odisha. The obtained result based on the noise analysis and based on questionnaire survey. The lowest values of Leq, NPL, and TNI in the study area were identified among 502 local residents for aggravation in day hours, such as 98.7 dB(A) and 104.7 dB(A) correspondingly. This is found excess than the given standards of Central Pollution Control Board (CPCB) for Indian cities.

Mangalekar *et al.* (2012) made assessment of traffic noise to measured the vehicular noise at 8 locations for the growing industrial and commercial area of City Kolhapur, situate at Western part of Maharashtra, India. The average noise level obtained from silence, residential, commercial and industrial zones were found such as 50.02 dB(A), 58.88dB (A), 65.52 dB(A) and 74.28 dB(A) correspondingly. The results confirmed that there is a greater stress of noise than the given limits of CPCB, India due to excess movement of motor vehicles at all sites surrounding the study area.

Goswami *et al*. (2013) studied traffic noise levels along road side in 12 different locations in the Rourkela town, Chhattisgarh state, India during times schedule of (7 a.m. to 12 midnight and 4-6 a.m.). The essential noise parameters such as Leq, TNI, NC, Lday, Levening, Lnight and Lden includ-

ing episodic and impulsive noise were monitored and evaluated to examine the effect of heavy traffic flow. The obtained results showed that the minimum values of Leq and NPL were found such as 82 dB (A) and 96 dB (A), 69 dB(A) and 91 dB(A) during day time and night time correspondingly. The values of Lden were range from 83.4 to 86.1 dB (A). In the current research, noise prediction model was used instead of Leq to estimate the level of noise pollution.

Swain *et al.* (2014) studied noise levels in different workplaces in the city Balasore. The obtained results shows that the highest value was found for Leq, NPL, and NC such as 83.4 dB(A), 96.6 dB(A), and 26.5 dB(A), correspondingly. Study also conclude that excess noise level decline workers working efficiency and causes of various health related problem like, unbearable temper, nuisance, speech interference, loss of concentration and hearing problem were also found during working times on the place of work.

Tiwari *et al*. (2013) made evaluation of traffic noise levels on the road side and railway cross-roads in the Amravati city, Maharashtra state, India via the usage of digital sound meter for the assemblage of noise information from the traffic volume and train frequency. This research also studies the discrepancy of traffic noise level whilst train passage the highway.

Swain *et al*. (2014) conducted an evaluative study to assess the noise levels in different public places and government offices in and around the Balasore, a city in the state of Odisha, India in different time duration such as (10-12 noon hours, 1-3 pm and 3-5 pm). The obtained results of equivalent noise level at different offices was varies from 43.7 dB(A) to 83.4 dB(A) and values of noise pollution level (NPL) and Noise Climate (NC) varies from 11.2 dB(A) to 96 dB(A) respectively.

Ahirwar and Bajpai in 2015 measured stages of noise in the residential, silence and industrial zones of Raipur metropolis, Chhattisgarh during the Diwali festival. The recorded noise level was as 68.42 dB (A), 66.28 dB (A) and 81.45 dB (A) at residential silence and industrial zones correspondingly, which is establish greater than maximum value set by (CPCB), Central Pollution Control Board India. Therefore increase in noise level during Diwali festivals' are the more uses of firecrackers burning and heavy traffic.

Vijay *et al.* (2015) performed a study to assess traffic noise due to some critical elements like volume of traffic, honking, vehicles speed, road geometry and situation of the highways surroundings Nagpur city, Maharashtra state, India. The study shows that movement of heavy motor vehicles had more noise on highway noise as contrast to mild and medium motor vehicles. This study also assesses the influence of honking on the traffic noise. Honking generate 2 to 5 dB (A) an extra noise to normal traffic noise. Speed of motor vehicle are also causes of an extra noise and provide 4 to 5 dB(A) an additional noise, when the speed of all group of motor vehicles increases from 35 to 55 km/hr.The study will also facilitate to defining new 'No Honking zones and assessing existing horn prohibited areas.

Patel and Pandey (2016) made evaluation of noise level at different location viz. silence, residential, commercial and industrial zones in the city Varanasi, Uttar Pradesh, India. The results show that the percentage of noise increase the ranges of 155.46 % to 177.34 %, 132.47% to 182.67%, 122.58% to 161.57% and 172.35% to 188.67%, 111.84% to 179.11%, 31.35%, to 146.87%, respectively for silence, residential and commercial zones during day and night time given by CPCB of India.

Swain *et al.* (2016) studied highway noise along seven different squares beside the National Highway-316,linking Bhubaneswar to Jagannath Dham, Puri, Orisha in day i.e. morning, afternoon and evening to measure the level of noise pollution in close proximity to different squares. In this study a methodical comparison was also made on the different location to analysis the accuracy and performance of the model in different condition of Indian highway. This research also indicates that the transportation sectors are the key source of environmental noise surrounding the study area.

Singh *et al.* (2016) has conducted an evaluative study to assess the traffic noise levels at city Vadodara, Gujarat state, India at four different area such as residential commercial, industrial and silence area. The study reveals that the sequence of Leq ranges in order of commercial zone 93.7 dB (A) >industrial zone 85.5 dB (A) >residential zone 73.2 dB (A) >silence zone 70.2 dB (A). That is higher than the prescribed range specified in Pollution Control Rules, 2000. These continuous exposures on a regular basis may lead to much health related problems in people such as aggravation, hearing problems in the company of some other general health's inconvenience.

Khan (2017) has conducted a study to examine traffic noise level (i.e. 9:00 am to 9:00 pm) at four different zones in the fast developing city Noida, Uttar Pradesh. The analysis of results shows that in day time noise level was found higher than the permissible limits in commercial and industrial zones due to high traffic, in the residential zone noise limits are establish in the acceptable limit. Sensitive zone of the study area was also found much closed to vulnerability level.

Myrthong *et al.* (2017) studied the traffic noise level to assess its effect on human being at the Allahabad city, Uttar Pradesh. This study reveals that the values for continuous sound equivalent Leq for different area like Civil Lines, Chowk, Rambagh, Katra and Alopi Bagh was varies from 80 dB (A) to 83 dB (A), 78 dB (A) to 82 dB (A), 75 dB (A) to 82 dB (A),75 dB (A) to 83 dB (A), 79 dB (A) to 82 dB (A) respectively. This is found higher than the prescribed standards by CPCB for Indian cities. It was observed that 69-79% 62-78% 63-85% 61-79% 86-93%24 -67% 39-64% inhabitants are exposed to daily noise, experienced tinnitus, face sleep disturbance, say loss in working efficiency, feel upset, trouble with cardiac and blood pressure, aware with problems related to noise respectively.

Ramakrishna *et al.* (2017) made evaluation of traffic noise pollution at 9 different locations viz, Benz Circle, Krishna Lanka, Bhavani Puram, Mogalrajpuram, Ramavarappadu Ring, Ramesh Hospital , Satyanarayana Puram, Mylavaram and Ramavarappadu at the city of Vijayawada for assess the noise parameters like $L_{10}$, $L_{50}$, $L_{90}$, and descriptor NPL, NC Leq and TNI. The obtained result based on the noise monitoring of noise level for residential, industrial, commercial and silence area for Lavg, Leq, NC, NPL were ranges from 48.4 dB(A) to 80.0 dB(A), 51.2 dB(A) to 82.7dB(A) 9.0 dB(A) to23.7 dB(A), 64.3 dB(A) to 107.9 dB(A) correspondingly. 2 and 3-wheelers vehicle had 69% contribution of higher noise the studies area.

Singh and Shekar (2017) assessed the noise levels in educational, commercial, residential and silence area to assess the different noise descriptors like percentile, Leq, TNI, NPL, NC, in the very oldest living cities in the world, Patna, the state capital of Bihar .The obtained result based on the noise monitoring was found such as the average Leq of 87.25 dB(A), 86.88 dB(A), 88.4 dB(A), 86.77 dB(A) respectively for residential, commercial, educational and silence area, which make the alarming circumstances to the city.

De *et al.* (2017) conducted an evaluative study to record average value of noise level during day, evening and night time for some noise parameters such as noise levels, age group of the exposed populace, contact time to build a model to assess the adaptive ability of few residents in Puri city to disregard the consequence of noise pollution within considerable range. This study also recommended the graphical illustrations for justification of the model for noise mapping.

Dhole and Kadu (2018) measured noise pollution in four different zones to assess the noise quality of Washim town, a district place belonging to Vidarbha area of Maharashtra state in India. The values of Leq, NPL, TNI, NC, Lmax and Lmin values were varies from 78.4 dB(A) to 93.4 dB(A), 99.4 dB(A) to 118.4 dB(A), 115 dB(A) to 139 dB(A), 19 dB(A) to 25 dB(A), 99.9 dB(A) to 103.9 dB(A), 55.4 dB(A) to 62.7 dB(A), respectively. In order to prevent noise-induced hearing loss, safety steps must be taken for the inhabitants residing in noisy vicinity particularly noise level greater than 70 dB (A).

Kumar and Koshta (2018) carried out a study to assess the vehicular noise pollution at different square like Shastri Bridge, Ranitaal, Damoh Naka and Collectorate office to measure the noise parameters $L_{10}$, $L_{50}$, $L_{90}$ and its descriptors Leq, NC, TNI, NPL, in the city of Jabalpur Madhya Pradesh during morning, afternoon and evening period. The obtained result based on the noise level monitoring for the area such as Shastri Bridge, Ranitaal, Damoh Naka and Collectorate Square was found such as 82.1 dB(A) to 84.4 dB(A), 79.0 dB(A) to 81.9 dB(A) ,83.6 dB(A) to 85.2 dB(A), 6.2 dB(A) to10.1 dB(A), 73.2 dB(A) to 83.5 dB(A) and 88.7 dB(A) to 90.8 dB(A) respectively. The major part of public buildings situated near the study area was directly affected by high traffic noise.

Lokhande *et al.* (2018) measured noise pollution level at six different squares, to assess the noise quality of Nagpur city, a mini capital of Maharashtra State in India. The noise percentile such as $L_{10}$, $L_{50}$, $L_{90}$, and equivalent noise level, Noise Climate, Noise Pollution Level, and Traffic Noise Index were measured during study period. The LAeq values in peak and off peak hours ranged from 71 to 76 dB(A) and 71.6 to 76.3 dB(A) correspondingly. The noise level in the peak hours found higher than the allowable limit of 70 dB(A) World Health Organization (W.H.O). The findings of this study also indicate

that citizens of the city of Nagpur are facing issue of heavy transport noise.

Kumar *et al.* (2019) studies the noise levels on weekday and weekend at different six an important places at Vellore city in Tamil Nadu State, India during morning, afternoon and evening hours. The Highest Leq values was reported in the range of 57.52 to 78.41 dB (A) and 58.76 to 76.39 dB(A) in evening and afternoon hours for weekday and weekend, correspondingly. This study also reported the mean value of TNI for Weekend was found more than the mean value of TNI of weekday. This study also suggested that to take urgent defensive action by using appropriate noise barriers or diverting heavy traffic to another routes.

Ramakrishna *et al.* (2019) conducted an evaluative study to assessment of traffic noise level in different area like residential, industrial, commercial and silence area for monitoring the percentile values $L_{10}$, $L_{50}$, $L_{90}$ and descriptors Leq, TNI, NC, NPL, in the city of Aurangabad Maharastra. Based on the noise level monitoring, the results for the residential, industrial, commercial and silent area for Leq, NC, TNI were varies from 68.6 dB(A) to 69.2 dB(A)(A), 16.5 dB(A) to 18.6 dB(A), 92.5 dB(A) to 102.1dB(A), 72.6 dB(A) to 75.3 dB(A), 72.9 dB(A) to 73.8 dB(A), 15.3 dB(A)to 17.1dB(A), 61.4 dB(A) to 64.3 dB(A), 12.3 dB(A) to 14.3dB(A) 82.4 dB(A) to 85.6dB(A) respectively.

Ranpise *et al.* (2019) developed a road traffic noise prediction model to determine noise pollution levels among three urban road networks in Surat city, Gujarat state of India by using advanced computational tools such as genetic algorithms, neural networks to overcome the problems of MLR Modelling. On the basis of obtained data from the detailed survey this study reveals that the minimum equivalent traffic noise level is higher than the permissible limits on all roads.

Archana and Harshan in 2020 conducted a GIS based noise assessment for various areas viz. residential, industrial, silence and commercial along with major traffic intersections at the city Calicut in Kerala State. The main purpose of this study was making the awareness in residents more accurately by using QGIS Software.

Sahu *et al*. (2020) studies the noise levels in important places such as PC Bridge Chak, VSSUT , Kirba Chak, Prof Colony Chak, PG Chak, VIMSAR, Petrol Pump Chak, Planetarium and Sambalpur university at the Burla of Odisha state. For the monitoring the percentile values as $L_{10}$, $L_{50}$, $L_{90}$ and Leq were found in the range of 68.77 dB(A) to 76.7 dB(A), 55.1 dB(A) to 69.8 dB(A) for day and night time. This study shows that about 34%, 26.2 %, 22% of inhabitants were suffering from annoyance, insomnia and decrease in work efficiency respectively, those who spend 6 hours/day in the area expose to highway traffic noise. In this study regression equations were also acknowledged for connecting indices of noise with highly irritated inhabitants with higher values for correlation. The highway traffic noise levels at the majority of monitoring stations were found more than the national standard.

Upreti *et al.* (2020) studies the noise levels in important places in the city Dehradun Uttarakhand at different locations such as Mandakni Vihar enclave, Paltan bazaar and Sahastradhara crossing, during weekends and vacation period to assess the traffic noise levels. The study has revealed that traffic noise level was found beyond the upper level than the suggested value by CPCB for residential and commercial areas of Indian cities.

Mishra *et al.* (2010) studies the noise levels in six different location of Kanpur city, India during COVID-19 lockdown period to examine the impacts of COVID-19 lockdown on the changes in levels of noise pollution before, during, and after lockdown period in residential, commercial, industrial, and silence zones. The Highest Leq values was reported in the range of 57.52 to 78.41 dB (A) and 58.76 to 76.39 dB (A) in evening and afternoon hours for weekday and weekend, correspondingly. The average noise levels for different selected zones before lockdown and during lockdown were found to be in the range of 44.85 dB to 79.57 dB and 38.55 dB to 57.79 dB, respectively. While a considerable decline in noise levels were observed throughout the lockdown period. Although the irritation level in residential (86.23%), industrial (87.44%), and silence zone (84.47%) was found higher in pre-lockdown period, it reduced to 41.25, 50.28, and 43.07% in the lockdown phase. Even the risk of sleep disturbance in the residential zone was found to reduce from 37.96% during pre-lockdown to 14.72% during lockdown phase.

Roy *et al*. (2022) conducted an evaluative study to evaluation of traffic noise level in three semiurban towns for monitoring the percentile values L1, L5, L10, L50, L90, L95, L99 and descriptors Leq, TNI, NC, NPL, for evaluation of noise pollution at 69 locations in Asansol, Bankura, and Midnapore town

with the Silent, Residential, Commercial, and Industrial zone. The obtained results show that the equivalent sound pressure level (Leq) are found higher than the standards prescribed by CPCB in all selected locations of the silent zones. Noise pollution level (Lnp) and Noise traffic Index (TNI) are also found high in commercial and heavy traffic areas. The values of Noise climate (NC) not much variation in noise power with pre-post and monsoon climates.

## Discussion

This systematic literature review shows the outcomes of the some famous Indian research related to noise pollution, based on the highway traffic noise and its effects on human wellbeing during different environmental circumstances and exposure of the dose-response condition. The selected article used for this review is listed in (Table 1). From this literature review, 80 percent of the researchers referred to the status of inhabitants like age, gender, and number. In these studies, 61% of Indian researchers incorporated the pattern of noise exposure, as well as its localities, period of sampling, and management of results records. The studies also showed that size of sample used during the questionnaires survey were considered, only medium (sample size less than 50, sample size in the range of 50 to 150, and sample size greater than 150). The Polysomnography techniques were not used to identify sleep disorders problems in human being. In the reverence of national scenario, similar studies on traffic noise have been recognized over the last thirty three years. The present literature review reveals that in India only a very small number of analyses were conducted based on the exposure-effect of highway traffic noise throughout this period. Only questionnaires based survey was ultimate practice for the appraisal of vehicle noise and its impacts on human health. India is a much inhabited nation so the entire evade of noise pollution not feasible, although some precautionary actions may be taken to minimize the noise pollution levels. Presently central and state governments of all state monitoring noise levels in the guidance of Central Pollution Control Board at different major location all over the India to proper maintain noise level within the permissible limits. Present time implementation of the environmental laws and regulations required more attentions to decrease noise pollution level in Indian cities. Unluckily, all rules, policies, and programs associated to noise pollution are initiated in pen and paper only. Therefore, at the present time, it is very important for the State Pollution Control Boards and Central Pollution Control Boards to work towards reducing the adverse effects of noise with coordinated strategies and sustainable planning with policy makers, NGO, and local people.

## Conclusion

The present review, carefully observes that only few data are available on the health effects due to traffic noise, this review may be very helpful to present and future researchers, acousticians and policy makers. These study carefully review, more than 33 years of research from 1990 to 2022 associated to impacts of highway traffic noise on the daily life of populace and it also includes qualitative essentials of the papers examined and assist prospective of researchers and policymakers as a reference. While due to publication bias, some research paper had been not here consider, if they not properly accessible in conferences, books or journals. This study reveals that local inhabitants can be very upset, due to high road traffic noise, although no simplification may be made due to the insufficient availability of renowned research papers. The correlation models reported by the articles for noise assessment would be very cooperative to a certain level in the prediction of the irritation. Therefore, it is now time to develop comprehensive policies and appropriate planning for federal and state pollution control boards with other responsible agencies to reduce the risky effects of noise pollution from urban areas.

## References

Agarwal, S. and Swami, B.L. 2009. Noise annoyance under interrupted traffic flow condition for Jaipur city. Int. *J. Appl. Sc. Engg*. 7 : 159-68.

Agarwal, S. and Swami, B.L. 2011. Road traffic noise, annoyance and community health survey - a case study for an Indian city. *Noise Health.* 13: 272-6.

Ahirwar, A.V. and Bajpai, S. 2015. Assessment of noise pollution during Deepawali Festival in Raipur City of Chhattisgarh, India. *International conference on Chemical, Environmental and Biological Sciences* (CEBS-2015), 88-90.

Archana, R. andv Harshan, K. G. 2020. Mapping and assessment of noise pollution using GIS in calicut city. *International Research Journal of Engineering and Tech-*

*nology (IRJET)*. 7: 1215-1222.

Banerjee, D., Chakraborty, S.K., Bhattacharyya, S. and Gangopadhyay, A. 2008. Attitudinal response towards road traffic noise in the industrial town of Asansol, India. *Environ Monit Assess.* 151 : 37-44.

Banerjee, D. 2012. Research on road traffic noise and human health in India: Review of literature from 1991 to current. *Noise Health.* 14: 113-118.

Banerjee, D., Chakraborty, S. K., Bhattacharya, S. and Gangopadhyay, A. 2008. Evaluation and analysis of road traffic noise in Asansol: An industrial town of eastern India. *International Journal of Environmental Research, Public Health*. 5(3): 165-171.

Bhosale, B. J., Late, A., Nalawade, P. M., Chavan, S. P., Mule, M. B. 2010.Studies on assessment of traffic noise level in Aurangabad city, India. *Noise Health.* 12: 195-198.

Canter, L.W. 1996. *Environmental Impact Assessment*. USA: McGraw-Hill: 304-40.

Chakrabarty, D., Santra, S.C., Mukherjee, B., Roy, B. and Das, P. 2002. Road Traffic Noise in Calcutta Metropolis, India. *Indian J. Environ. Health.* 44 (3): 173-180.

Chakrabarty, Debashis, Santra Subhas Chandra, Mukherjee, Abirlal Roy, Biva and Das, Prasun,1997. Status of road traffic noise in Calcutta metropolis. *India J. Acoust. Soc. Am.* 101 (2): 943-949.

Chakraborty, D., Santra, S.C. and Roy, B. 1998.Survey of community annoyance due to traffic noise-exposure in Calcutta metropolis. *J Acoust Soc Ind*. 26 : 39-43.

Chauhan, A. and Pande, K. K. 2010. Study of noise level in different zones of Dehradun City, Uttarakhand. *Report and Opinion*. 2(7): 65-68.

Chauhan, A. 2008. Study of noise pollution level in different places of Haridwar and Dehradun City (India) *Environment Conservation Journal*. 9(3): 21-25.

De, S.K., Swain, B.K., Goswami, S. and Das, M. 2017. Adaptive noise risk modelling: fuzzy logic approach. *Systems Science & Control Engineering.* 5(1): 129-141.

Dhole, A. D. and Kadu, P. A. 2018. Study of noise pollution in Washim Town. *International Journal of Engineering Sciences and Research Technology*. 7(4): 137-143.

Goswami, S., Nayak, S.K., Pradhan, A.C. and Dey, S.K. 2011. A study on traffic noise of two campuses of University, Balasore, India. *J Environ Biol*. 32: 105-9.

Goswami, S., Swain, B.K. and Panda, S.K.2005. Assessment, analysis and appraisal of residential population to highway traffic noise in Jalgaon urban center. *Advanced OR and AI methods in Transportation.* 94-8.

Goswami, S. 2011. Soundscape of Bhadrak town, India: an analysis from road traffic noise perspective. Asian *Journal of Water Environmentand Pollution*. 8(4) : 85-91.

Goswamim, S. 2009. Road traffic noise: a case study of Balasore town, Orissa, India. *Int J Envt Res.* 3: 309-316.

Goswami, S., Swain, B.K. and Panda, S. 2013. Assessment, analysis and appraisal of road traffic noise pollution in Rourkela city, India. *Journal of Environmental Biology.* 34 5: 891-895.

Gozalo, G.R., Morillas, J.M.B., González, D.M. and Moraga P.A. 2018. Relationship among satisfaction, noise perception, and use of urban green spaces. *Sci Total Environ.* 624: 438-450.

Gupta, Srimanta and Ghatak Chitralekha, 2011. Environmental noise assessment and its effect on human health in an urban area. *International Journal of Environmental Sciences.* 7 : 1954-1964.

Ingle, S.T. and Pachpande, B.G. 2013. Monitoring and assessment of daily exposure of road traffic noise pollution in Rourkela city. *India. J. Environ Biol.* 34: 891-895.

Jain, S. S. and Parida, M. 2004. Urban transport environment interaction. AICTE Nationally coordinated project final report submitted to AICTE, New Delhi, India.

Kawada, T., Xin, P., Kuroiwa, M., Sasazawa, Y., Suzuki, S. and Tamura, Y. 2001. Habituation of sleep to road traffic noise as determined by polysomnography and an accelerometer. *J Sound Vib.* 242: 169-178.

Kerketta, B.S., Dash, P.K. and Narayan L.T.P. 2009. Work zone noise levels at Aarti steel plant, Orissa and its attenuation in far field. *J Environ Bio.* 30(5) : 903–908.

Khan, Asma and Ahmad, S. Khursheed 2017. Noise Monitoring and Analysis at Various Zones of Noida City. *International Journal of Engineering Research and Applications*. 7(10) : 04-13.

Kisku, G.C., Sharma, K., Kidwai, M.M., Barman, S.C., Khan, A.H., Singh, R., Mishra, D. and Bhargava S.K. 2006. Profile of noise pollution in Lucknow city and its impact on environment. *J Environ Biol.* 27(2) : 409-412.

Koijam, K.K., Singh, M.B. and Sharma, G.T. 1998. Noise Level in selected Urban Areas of Imphal Valley. *Indian J. Env. Prot.* 18(3): 215-217.

Kumar, S., Kalamdhad, A. and Ghangrekar, M. 2019 .Sustainability in Environmental Engineering and Science. *Lecture Notes in Civil Engineering*. 93. Springer, Singapore. http:// doi-org-443.webvpn .fjmu. edu.cn /10.1007/978-981-15-6887-9_21

Kumar Sumit and Koshta, M. K. 2018. Assessment of Vehicular Noise Pollution at Different Squares in Jabalpur City, MP (India). *International Research Journal of Engineering and Technology.* 5(3) : 2534-2537.

Kumar, Manoj, N., Basha, Khadar and Srimuruganandam, Srimuruganandam, B. 2019. Assessment, Prediction and Mapping of Noise Levels in Vellore City, India. *Noise Mapp.* 6 : 38-51.

Kundu Chowdhury, Debsarkar, Anupam, and

Chakrabarty, 2015. Critical assessment of day time traffic noise level at curbside open-air microenvironment of Kolkata City. *J Environ Health Sci Eng.* 13 : 65.

Lokhande, S., Pathak, S., Kokate, P., Dhawale, S.A. and Bodhe, G. 2018.Assessment of Heterogeneous Road Traffic Noise in Nagpur. *Archives of Acoustics.* 43: 113-121.

Mangalekar, S.B., Jadhav, A.S. and Raut, P.D. 2012. Universal. *Journal of Environmental Research and Technology.* 2(1) : 65-69.

Miao, W., Wang, L., Cui, Y., Zhang, F., Wang, S., Liu, N. an Cai, X. 2016. Noise exposure could increase the mortality of coronary heart disease: Evidence from a meta-analysis. *International Journal of Clinical and Experimental Medicine.* 9(6) : 11030-11036.

Mishra, R.K., Parida, M. and Rangnekar, S. 2010. Evaluation and analysis of traffic noise along bus rapid transit system corridor. *Int J Env Sc Tech.* 7 : 737-50.

Mohan, S., Dutta, N. and Sarin, S.M. 2000. Subjective reaction to road traffic noise of residents living in Delhi City. *Poll Res.* 19 : 353-6.

Myrthong, Ibadaiahun, Lal, S.B. and Synrem, Gideon, J. 2017. Commercial areas of Allahabad city and its impact on contour traffic noise pollution of the environment. *International Journal of Advance Research in Science and Engineering.* 6(8): 40-45.

Naik Shrikanta, Purohit, K.M. 2003. Studies on noise pollution levels in residential areas at Bondamumba of Rourkela industrial complex. *Poll. Res.* 22(3): 433-438.

Naik, Ashrikanta and Purohit, K. M. 2001. Status of Noise Pollution Level at Bondamunda of Rourkela Industrial Complex. *Pollution Research.* 20(0): 41-46.

Nandanwar, D.R., Parbat, D.K. and Deshmukh, S.K. 2009. Study on resident's perception and attitudes towards urban traffic noise in Nagpur city. *2nd International Conference on Emerging Trends in Engineering and Technology. Nagpur: ICETET*. 585-588.

Omlin, S., Bauer, G.F. and Brink, M. 2011. Effects of noise from non-traffic related ambient sources on sleep: Review of the literature of 1990-2010. Noise Health. 13 : 299-309.

Ozkurt, N., Hamamci, S.F. and Sari, D. 2015. Estimation of airport noise impacts on public health. A case study of Izmir Adnan Menderes Airport. *Transp Res Part D: Transp Environ.* 36 : 152-159.

Pachpande, B.G., Patel, V.S., Patil, R.D., Girase, M.R. and Ingle, S.T. 2005. Assessment of hearing loss in school teachers and students exposed to highway traffic noise pollution. *Journal of Ecoph Occu Health*. 5 : 123-6.

Pandey, Vandana, 1992. *Encyclopaedic Dictionary of Environmental Pollution.* New Delhi: Himalaya Publishing House.

Pandya, G.H. and Verma, R.R. 1997. Noise Scenaria in Relation to Vehicular Traffic in the City of Nagpur. *Indian J. Env. Prot.* 17(4): 241-247.

Patel, R. and Pandey, Govind, 2016. A study of noise in Varanasi city, Uttar Pradesh (India). *International Journal of Engineering Researches and Management Studies.* 3(12) : 16-26.

Patil, C.R., Modak, J.P., Choudhari, P.V. and Dhote, D.S. 2011. Subjective analysis of road traffic noise annoyance around major arterials in intermediate city. *Eur J Appl Sci.* 3 : 58-61.

Pradhan, A., Swain, B.K. and Goswami, S. 2012. Road traffic noise assessment and modeling of Sambalpur city, India: a comprehensive, comparative and complete study. *J Ecophysiol Occup Hlth.* 12(2) : 51-63.

Pramendra, Dev and Singh Vartika, 2011. Environmental Noise Pollution Monitoring and Impacts on Human Health in Dehradun City, Uttarakhand, India. *Civil and Environmental Research.* 1: 32-39.

Rajakumara, N. H. and Gowda, R.M.M. 2008. Road traffic noise prediction model under interrupted traffic flow condition. *Environmental Monitoring and Assessment*. 146 : 117-124.

Ramakrishna, V., Saigiri, N., Chakri Babu, K. 2019. A Study on Noise Pollution in Vijayawada, Andhra Pradesh. *Journal of Applied Science and Computations*. 6: 384-388.

Ramakrishna, V., Ashwani, D., Durga, M. N. V., Vamsikrishna, D. and Ramkumar, T. 2017. A study on Ambient and Traffic Noise Pollution in Vijayawada. *International Journal of Current Research.* 9(7) : 53943-53951.

Ranpise, R.B., Tandel, B.N. and Darjee, C. 2019. Assessment and MLR Modeling of Traffic Noise at Major Urban Roads of Residential and Commercial Areas of Surat City. In: *International Conference on Sustainable Environmental Engineering and Science Sees.* 136.

Rao, P.R. and Rao, M.G. 1991. Subjective response to traffic noise and its effects. *Indian J Environ Proc.* 11 : 430-2.

Rao, P.R. and Rao, M.G. 1992. The prediction of annoyance due to heavy vehicular traffic. *Energy Env Moni.* 8:13-7.

Rao, P.R. and Rao, M.G. 1992. Community reaction to road traffic noise. *Appl Acous.* 37 : 51-64.

Ravichandran, C., Chandrasekaran, G.E. and Madhu, S. 1997. The status of Noise Pollution in Tiruchirapalli City. *Indian J. Env. Prot.* 17 (11) : 806-808.

Ross, Zev., Kheirbek, Iyad., Clougherty, Jane., Ito, Kazuhiko, 2011. Noise, air pollutants and traffic: Continuous measurement and correlation at a high-traffic location in New York City 2011. *Environmental Research.* 111(8) : 1054-1063.

Roswall, N. Ammitzboll, G. Christensen, J.S., Nielsen, O. Raaschou, S.S. Jensen, Tjonneland, A. Sorensena Mette 2017. Residential exposure to traffic noise and leisure-time sports – a population-based study. *Int.*

*J. Hyg. Environ. Health.* 220 : 1006-1013.

Roy, Misha, Shamim, Farzana, Majumder, Rahul, Ghosh, Chaitali and l Chatterjee, Saiba 2022. Evaluation of Environmental Noise in Urban areas: A Noise Pollution Assessment Approach. *Medicon Agriculture & Environmental Sciences.* 2(2) : 21-40.

Sahu A. K., Pradhan M. Mohanty, C. R. and Pradhan P. K. 2020. Assessment of Traffic Noise Pollution in Burla Town, India. *An Inclusive Annoyance Study.* 54(1) : 27-42.

Saletu, B., Frey, B. and Grunberger, J.1 989. Street noise and sleep: whole night somnopolygraphic, psychometric and psychophysiologic studies in comparison with normal data. *Wien Med Wochenschr*. 139 : 257-63.

Sampath, S., Das, S.M. and Kumar, V.S. 2004. Ambient noise levels in Major Cities in Kerala. *J. hid. Geophys.* Union 8(4) : 293-298.

Sarin, S. M. 1990. Evaluation of road traffic noise problem at scientist apartment in Delhi. A Report, Environmental and Road safety Division Central Road Research institute (CRRI) New Delhi, India.

Schomer, P.W. and Wagner, L.R. 1996. On the contribution of notice ability of environmental sounds to noise annoyance. *Noise Control Eng.* 44 : 294-305.

Sharma Vijay and Joshi, B. D.2010.Assessment of noise pollution during Deepawali festival in a small township of Haridwar City of Uttarakhand, India. *Environmentalist.* 30 : 216-218.

Shastri, S.C., Bakre, P.P. and Khan, T.I. 1996. *Industry, Environment and the Law.* Jaipur, I-Publication, RBSA Publishers.

Singh Neha, Dhiman Hitesh, Shaikh Sadaf, Shah Purvish, Sarkar Roma and Patel Shash. 2016. High ambient noise levels in Vadodara City, India, affected by urbanization. *Rev Environ Health.* 31(4): 409-414.

Singh, R. and Shekar, S. 2017. Assessment of noise Pollution Indices in the City of Patna. *Indian Journal of Environmental Protection.* 37(6) : 486-491.

Skoe, E. and Tufts, J. 2018. Evidence of noise-induced subclinical hearing loss using auditory brainstem responses and objective measures of noise exposure in humans. *Hear Res.* 361 : 80-91.

Swain, B.K., Goswami, S. and Das, M. 2014. Assessment of highway noise and predictive models along NH-316. *Asian Journal of Water Environment and Pollution.* 13(2) : 97-105.

Swain, B.K., Goswami, S. and Das, M. 2016. A preliminary study on assessment of noise levels in Indian offices: a case study. *Asian Journal of Water Environment and Pollution.* 11(4) : 39-44.

Swain, Bijay Kumar, Goswami, Shreerup, and Das, Madhumita 2014. A Preliminary Study on Assessment of Noise Levels in Indian Offices: A Case Study, 1 : 39-44.

Tiwari, A. V., Kadu, P. A. and Mishra, A. R.2013. Study of Noise Pollution Due To Railway and Vehicular Traffic at Level Crossing and Its Remedial Measures. *American Journal of Engineering Research.* 2(4) : 16-19.

Tripathi, S.R. and Tiwari, R.R. 2006. Self-reported hearing quality of traffic policemen: A questionnaire-based study. *Indian J Occup Environ Med.* 10 : 82-84.

Upreti, Brij M., Joshi, Mamta, Thakur, Shivani 2020. Assessment of Noise Pollution Level in Commercial and Residential Areas of Dehradun Bioscience Discovery. 11(3) : 142-145.

Valet, M., Gagneux, V., Blanchet, B., Favre, B. and Labiale, G. 1983. Long term sleep disturbance due to traffic noise. *J Sound Vib.* 90 : 173-191.

Vijay, R., Sharma, A., Chakrabarti, T. and Gupta, R. 2015. Assessment of honking impact on traffic noise in urban traffic environment of Nagpur, India. *J Environ Health Sci Eng.* 13 : 10. https://doi.org/10.1186/s40201-015-0164-4

Wani, K.A. and Jaiswal, Y.K. 2010. Assessment of noise pollution in Gwalior, M.P., India. *Adv Biores.* 1:54-60.

World Health Organization. Night noise guidelines for Europe. Geneva: WHO; 2009.

World Health Organization.Burden of disease from environmental noise. Geneva: WHO; 2011.

Yagnanarayana, K. and Ramalingeswara Rao, P. 1994. Noise monitoring at Ramagundam area. *Indian Journal for Environmental Protection*. 4(12) : 915-920.

Yogamoorthi, A. and Beena, 1996. Studies on Noise Pollution Level in Pondichery Town, South India. *Indian J. Environ. Health.* 15(2) : 155-158.

Ziauddin, A., Bahel, R.S. and Siddiqui, N.A. 2007. Noise pollution levels in the city of Deharadun. *Ecology, Environment and Conservation.* 13(4) : 891-893.