



ISSN: 0975-833X

REVIEW ARTICLE

“NOISE POLLUTION”: AN OVERVIEW

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ARTICLE INFO

Article History:

Received 19th February, 2014
Received in revised form
05th March, 2014
Accepted 18th April, 2014
Published online 20th May, 2014

Key words:

Noise,
World health organization,
Stress,
Government.

ABSTRACT

Noise acts as an environmental stressor, activating the body's remunerative mechanisms to stress. The impacts on humans of noises above the acceptable range have been studied extensively. Other problems related to noise include compromised learning, stress, high blood pressure, sleep loss, disorder and lost productivity, and a general reduction in the quality of life and opportunities for composure. The World Health Organization strives to warn, raise awareness of and promote actions against noise pollution. Public education appears to be the best method as suggested by the respondents. However, government and NGOs can play a significant role in the noise pollution. The aim of the present review is to highlight the sources, effect along with noise law awareness.

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INTRODUCTION

Noise is derived from the Latin word “nausea” implying ‘unwanted sound’ or ‘sound that is loud, unpleasant or unexpected’ (Mangalekar *et al.*, 2012). Noise in large cities is considered by the World Health Organization to be the third most hazardous type of pollution, right after air and water pollution (Khilman, 2004). The noise originates from human activities, especially the urbanization and the development of transport and industry. Therefore the urban population is much more affected by noise pollution, however, small town/villages along side roads or industries are also victim of this problem. Noise is increasing everywhere, yet unnoticed form of pollution even in developed countries (Narendra Singh and Davar, 2004). Noise pollution is distinguished from other pollution categories due to its source and diffusion characteristics (Hunashal *et al.*, 2012) though noise pollution is a slow and subtle killer, yet very little efforts have been made to ameliorate the same problem. Noise is any unwanted or harmful outdoor sound created that is detrimental (Bhagwat and Meshram, 2013) along with other types of pollution has become a hazard to quality of life. The noise pollution is not a unique problem for developing countries like India only. The worrisome effects of noise are dangerous enough that noise problem is considered next to crime by certain countries (Kapoor and Singh, 1995). Of late, it has been recognised as a pollutant (Negi *et al.*, 1999). Noise is a disturbance to the

human environment that is rising at such a high rate that it will become a major threat to the quality of human lives. In the past thirty years, noise in all areas, especially in urban areas, has been increasing rapidly. There are numerous effects on the human environment due to the increase in noise pollution. Slowly, insensibly, we seem to accept noise and the physiological and psychological deterioration that accompanies it as a necessary part of our lives. Although we attempt to set standards for some of the most major sources of noise, we often are unable to monitor them. Community awareness of environmental noise has increased and there is a higher expectation for state and local government to reduce noise levels (Tania and Odagiu, 2007). Noise pollution and its consequent influence over the environment and life quality of human beings may be considered a “hot topic” in scientific research.

Sources of Noise Pollution

Noise is a major factor of environmental pollution; on one hand, industrialization, scientific and technological developments have contributed a great deal to the progress of society, on the other, these are main causes of environmental pollution including noise pollution. The noise level in the different parts of the city increases in and around work places and homes as the day rises. The peak noise levels are reached in the twilight hours as traffic reaches a peak (Vijayalakshmi 2003). Among all of the sources responsible for noise pollution, such as traffic noise, industrial noise, construction activities, and community noise, traffic related sources are

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from great environmental concern and increasing level of nuisance in urban areas with high traffic concentration. Noise is a well-known source of pollution in urban and work environments (Zannin and Sant'Ana, 2011). The conception of sounds in day-to-day life is of major importance for human wellbeing. Proportion of people exposed to noise is greatly increasing. This has direct and indirect affect to the people that can lead to the health hazard (Padhy and Padhi, 2008). Noise is an emerging problem in the world today, as it causes adverse effects on the human lives and there is a need to access the review of various studies and its sources. Mainly there are two types of noise pollution i.e., natural and man-made sources of noise pollution which are discussed as follows:

Natural sources of Noise pollution

Bugs

Insects can be very noisy and therefore a natural form of noise pollution for example; crickets chirping on summer nights to the enormous swarms of Cicada that live around the world, which shows that bugs can create a lot of noise.

Weather

Weather can be one of the most distressing noise pollutants, changing constantly around us. The High winds and storms can block out all other noise and cause fear in those experiencing the storm, even if there is no threat.

Birds

Birds are naturally noisy creatures, singing and chirping everywhere all the time, except during times of the year when they migrate to cooler or warmer climates. Birds can create quite stressful situations for nearby dwellers due to excessive noise.

Man-Made Sources of Noise pollution

It is broadly divided into two parts: Industrial and Non-Industrial Noise.

Industrial Noise

Noise produced by industries is called Industrial Noise. In general it is produced, at every stage in industry by various aspects like welding, hammering, drilling, blowing, running machinery, motors, sheet metal work, lathe machine work, operation of cranes, grinding, turning, riveting, fabricating, forging, compressing, vaccumising, breaking, moulding, steaming, boiling, cooling, heating, venting, painting, pumping, packing, transporting etc. Significantly, it affects the working people as well as surrounding people and creates very serious large-scale noise problems. The noise levels in coal washeries, coal preparation plants, open cast and underground mining centres were very high when compared to accepted limits for occupational noise exposure. Even the residual noise level when there is minimal activity was 80 to 82dB. The results of the noise emitted by machines were analysed to predict an overall noise climate (Sharma *et al.*, 1997).

Non Industrial Noise

TRAFFIC NOISE

Traffic is a significant part of urban environment contributing about 55% to the total urban noise (Pandya *et al.*, 2002; Sinha *et al.*, 2003). Traffic noise was found to be interfering daily activities such as resting, reading, communication etc (Pathak, 2007).

Road noise

Road traffic is the most widespread source of noise in all countries and the most prevalent cause of annoyance and interference. It is directly proportional to the volume of vehicles. Increasing of population is increasing of vehicles and hence increasing of Noise pollution. The major sources of noise in automobiles are exhaust, intake, engine and fan, and tires at high speed. The noise output of all components increases with speed. The Road traffic noise not only depends on volume of vehicles and also depends on several factors; some of them are Road conditions, Traffic clearance, Condition of vehicles, Speed of the vehicle and the people living near roadside (highway) are mainly exposed. For example the study conducted around the main roads inside the urban perimeter of Curitiba, simultaneous measurements were done regarding noise levels, vehicle flow and traffic composition and thus some mathematical models have been developed in order to estimate those sound pressure levels. It was confirmed that people living or working in these areas are exposed to noise levels beyond the legislated norms (Calixto *et al.*, 2003) and the two models for predicting in-city road-traffic noise pollution of Mashhad were obtained by Rahmani *et al.*, (2010).

Rail Traffic Noise

Railway transportation has made significant contributions to the expanding economy the environment-friendly development of the system having become one of the major challenges. Noise from the trains includes: Diesel exhaust, Engine and air intake, Cooling fans, Wheel-rail interaction, Electric generator and electric traction motor and miscellaneous noise generated in freight and passenger cars etc. Other intermittent noises includes car impact sounds when trains are braking and accelerating and the sounds of sirens or horns that produces 10 to 20 dB (A) higher than from other sources. The primary sources of railway noise to residential communities include the whistling noise of locomotives, the noise of diesel locomotives and wheel/rail noise (Xiaoan, 2006). Pronello, (2003) analysed the interactions between vehicles, infrastructure and environment for rail traffic and identifies variables having a significant influence on sound levels, defined a standard procedure for measuring noise, and developed a database for setting up and calibrating train noise models. Rail noise prediction models enabled consideration of different scenarios for the optimal management of noise prevention and mitigation (Nassiri *et al.*, 2007).

School Noise

Studies on the detrimental impact of chronic external noise upon the academic performance of school children were

normally based on sampled school sites, and the results were often limited to a specific range of areas and determine the noise exposure of secondary schools. It has been shown that the environmental noise levels of secondary schools in Greater London have almost no significant relationships with those academic achievement indicators. The average difference is calculated as 2 dB (A) (Xie *et al.*, 2011).

Aircraft Noise

Noise from commercial aircraft is only a problem around airports as this is where aircraft converge at low altitude and high engine power. The invention of supersonic aircrafts has added more noise for the plight of persons who live near aerodromes. It has been observed that supersonic jet planes are one of the biggest irritants in today's noisy world. Ignaccolo, (2000) initially analysed the environmental compatibility of Catania-Fontanarossa airport and then generalized the methodology. This makes it possible to formalize the relationship between the four principal factors determining aircraft noise nuisance: level of noise, composition, number of operations per day and selected surface. It allows the construction of abacuses showing the trend of each of the four factors, as the others vary. The increasing trend of charging for aircraft noise nuisance to encourage the sustainable development of the air transport industry has resulted in a need to evaluate the real social costs of such externalities for the formulation of effective charge mechanisms.

Hospital Noise

Christensen (2004) undertook a study to assess what knowledge nursing staff from a General Intensive Care Unit held with regard to noise exposure. The effects noise exposure has on individuals for example decreased wound healing; sleep deprivation and cardiovascular stimulation must be of concern especially in terms of patient care but more so for nursing staff especially the effects noise levels can have on cognitive task performance.

Residential Noise

Residential noise is a leading cause of neighborhood dissatisfaction but is difficult to quantify for it varies in intensity and spectra over time. Residential noise is modeled as an ambient background punctuated by transient events (Zimmerman and Robson, 1999).

Community Noise

Community noise is one of the major sources for affecting a large number of people living within the community. It occurs due to various activities of community during religious festivals, fairs, marriages, or public functions. Most of the problems, which occur in public, originate from these main sources: Amplified sound i.e. loud speakers, public gatherings and festivals; Indecency behaviour of people; Rash driving with various kinds of horns / music with unnecessary use in vehicles (CPCB, 2006).

URBAN AREA NOISE

Urban noise is a disturbance to the human environment that is increasing at a high rate, primarily due to population growth,

urbanization and technological development (WHO, 1999). The study reports community noise levels measured during day time in a fast developing semi-urban area of Nepal. Since levels lie much above the prescribed limits there is an imminent health risk to the exposed population and the study suggests control measures to be instituted on a priority (Murthy *et al.*, 2007). The noise status of growing urban centres of the country are very much required to develop acoustic design and planning guidelines for various land use classification. An attempt in this direction has been made by measuring noise equivalent levels for cities like Delhi, Jamshedpur, Dehradun and Nagpur. It has been observed that maximum percentage of areas in Delhi and Jamshedpur fall under moderately severe to very severe noisy conditions as compared to Dehradun and Nagpur on the noise rating scale (Pandhya, 1999). Similar study is conducted in Aurangabad city due to the expanding industrialization; the problem of noise pollution has become a concern for urban dwellers and government authority too. The study deals with the assessment of traffic noise levels in Aurangabad city. The measured noise level values exceed the prescribed noise level (Bhosale *et al.*, 2010).

RURAL AREA NOISE

People were preoccupied with such pollution problems as dirty streets, dirty air and water, and noise, for they aspire to live in a clean, healthy environment. To achieve this, they pressurise the government, and take certain individual and collective actions themselves, although direct political action is rare (Hopkins and Mehanna, (2003).

NOISE RELATED STUDIES ON ANIMALS

Environmental noise caused by human activities may hamper acoustic communication in animals. Field studies in urban environments suggest that birds may alter their communicative behaviour in response to noise, but there is little experimental evidence for a detrimental effect of urban noise on perception, investigated the masking effects of urban noise on signal detection using operant tests with great tits in the laboratory, compared masking effects induced by urban noise, woodland noise and a typical dawn chorus, including a variety of singing birds. The signals to be detected were composed of artificial sinusoids and noise bands mimicking signal features of natural great tit song elements. Signals with the sound energy concentrated within a narrow frequency range were on average easier to detect than signals spread over a wide frequency range and perceptual results provide insight into how birds may counteract negative masking effects by singing song elements with specific features (Pohl *et al.*, 2009). The modern human societies generate new patterns of noise that may affect acoustic communication in many animal species. Traffic noise triggered a decrease of the males' calling activity, with males being more affected when noise amplitude increased. Additionally, the males' social situation (calling in chorus versus alone) exerted a strong influence on sensitiveness to noise. Understanding species' ability to adapt their communicative systems to cope with human-made noise constitutes an important contribution to wildlife conservation (Lengagne, 2008).

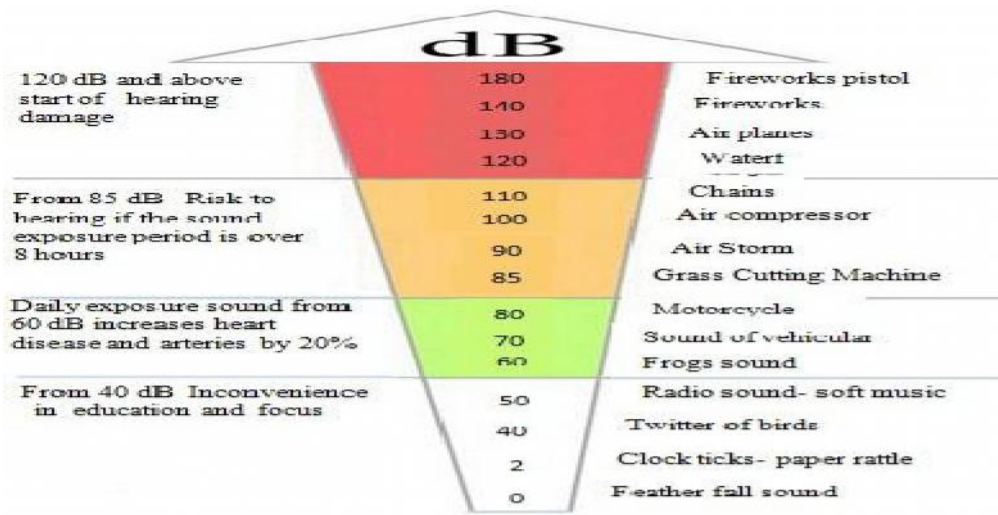


Fig.1. Noise pollution sources and influence due to its levels in (dB) (Wael 2008)

Table 1. Physiological and Psychological effects of noise pollution

Effect	Comment
Annoyance	Even relatively low levels of noise can cause annoyance and frustration.
Speech interference	Noise can interfere with speech.
Sleep interference	Noise can wake people from sleep and keep them awake.
Decreased work performance	Noise pollution can make people nervous.
Hearing loss	Prolonged exposure to noise levels above 85 dB (A) can damage inner ear cells and lead to hearing loss.
Physiological changes	Noise can change a man's physiological state by speeding up pulse and respiratory rates.

(USEPA, 1981; USDOT, 1995; Dora, 1999)

In general, Figure 1. schematically illustrates the magnitude of noise pollution, sources, and its influence on human beings.

HARMFUL EFFECTS OF NOISE POLLUTION

The harmful effects of noise on human health and development have been underestimated for a relatively long time. This may be due to the fact that noise endangers human health in an indirect manner, as opposed to other harmful substances in the workplace or environment. The exposures during traffic participation may be associated with adverse health effects. Traffic participation involves relatively short but high exposures. Potentially relevant exposures include ultrafine particles, fine particles (PM2.5) and noise (Boogaard *et al.*, 2009). However, in contrast to other environmental problems, noise pollution continues to increase, with increasing development (Berglund *et al.*, 2000). Physiological and psychological effects of noise pollution on human health are shown in Table 1.

Exposure to continuous noise of 85–90 dBA, particularly over a lifetime in industrial settings, can lead to a progressive loss of hearing, with an increase in the threshold of hearing sensitivity. Hearing impairments due to noise are a direct consequence of the effects of sound energy on the inner ear. However, the levels of environmental noise, as opposed to industrial noise, are much lower and effects on non-auditory health cannot be explained as a consequence of sound energy (Stephen A Stansfeld and Mark P Matheson, 2003). Evidently, noise pollution has assumed alarming proportions affecting adversely the efficiency of various populations, mental health and general quality of life (Davar, 2004).

NOISE RELATED LAWS IN INDIA

In India, Control of noise has been covered in three major legislations:-

- 1) Factories Act, 1948
- 2) Motor Vehicles Act, 1988
- 3) Environment Protection Act, 1986 (Environment Protection Rules 1986 and Noise Pollution (Regulation and Control) Rules 2000)

The Central Pollution Control Board constituted a Committee on Noise Pollution Control. The Committee recommended Ambient standards in respect of noise for different categories of areas i.e. residential, commercial, industrial and silence zones which were later notified in Environment(Protection) Rules,1986 are shown in Table 2.

Table 2. National Ambient noise level standards

S.No.	Zone	Standards dB (A)	
		Day time	Night time
1	Industrial	75	70
2	Commercial	65	55
3	Residential	55	45
4	Silence	50	40

(Environment (Protection) Act, 1986 as amended in 2002)

*The limit in dB denotes the time-weighted average of the level of sound in decibels on Scale A which is relatable to human hearing.

Note:

- 1) Day time is reckoned in between 6 am to 9 pm.
- 2) Night time is reckoned in between 9 pm to 6 am.
- 3) Silence zone is defined as areas up to 100 m around such premises as hospitals, educational institutions and courts. These are to be declared by the Competent Authority. Use of vehicular horns, loudspeakers, bursting crackers shall be banned in these zones.
- 4) Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standard shall apply. Noise standards for automobiles, domestic appliances and construction equipments have been notified in Part 'E', Schedule-VI of Environment (Protection) Rules, 1986, as amended on 19th May, 1993, are shown in Tables 3. & 4.

The WHO guideline values in Table 5. are organized according to specific environments. When multiple adverse health effects are identified for a given environment, the guideline values are set at the level of the lowest adverse health effect (the critical health effect). An adverse health effect of noise refers to any temporary or long-term deterioration in physical, psychological or social functioning that is associated with noise exposure. The guideline values represent the sound pressure levels that affect the most exposed receiver in the listed environment.

Noise Mitigation

The study conducted by Rowe (2011) concentrated on how green roofs impact on air pollution, carbon dioxide emissions, carbon sequestration, longevity of roofing membranes that result in fewer roofing materials in landfills, water quality of

Table 3. Noise limit in dB (A) of Vehicles

Category of Vehicle	Noise limit in dB(A)
(a) Motorcycle, scooters and three wheelers	75-80
(b) Passenger Cars	75
(c) Passenger or commercial vehicles upto 4 MT	77
(d) Passenger or commercial vehicles above 4 MT and up to 12 MT	80
(e) Passenger or commercial vehicles exceeding 12 MT	82

(Noise standards for domestic appliances have been notified in Part 'E', Schedule-VI of Environment (Protection) Rules, 1986)

Table 4. Noise limits in dB (A) of Domestic Appliances/ Construction Equipments

Category of Domestic Appliances/Construction Equipments	Noise limits in dB(A)
(a) Window air conditioners of 1 tonne to 1.5 tonne	68
(b) Air Coolers	60
(c) Refrigerators	46
(d) Compactors (rollers), Front loaders, Concrete mixers, Cranes (movable), Vibrators and Saws	78

(Noise standards for domestic appliances have been notified in Part 'E', Schedule-VI of Environment (protection) rules, 1986).

Table 5. Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	LAeq (dB)	Time base (hours)	LAmax, fast [dB]
Outdoor living area	Serious annoyance, daytime and evening. Moderate annoyance, daytime and evening.	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance, daytime and evening. Sleep disturbance, night-time.	35 30	16 8	- 45
Outside bedrooms	Sleep disturbance, window open (outdoor values).	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	During class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School, playground outdoor	Annoyance (external source)	55	During play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings.	30 30	8 16	40
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from fireworks and firearms	Hearing impairment (adults) Hearing impairment (children)	- -	- -	140 #2 120 #2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

(www.who.int/docstore/peh/noise/comnoise.pref.htm)

#1: as low as possible; #2: peak sound pressure (not LAmax, fast), measured 100 mm from the ear; #3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low; #4: under headphones, adapted to free-field values

storm water runoff and noise pollution. Suggestions for future directions for research include plant selection, development of improved growing substrates, urban rooftop agriculture, water quality of runoff, supplemental irrigation, the use of grey water, air pollution, carbon sequestration, effects on human health, combining green roofs with complementary related technologies, and economics and policy issues.

Conclusion

In modern life no one can escape from noise. Noise pollution is very dangerous. Many health problems can be caused by noise pollution, as this review explores the sources, effects, reactions and suggestions for controlling the excessive noise. Strategies to prevent damage from sound exposure should include the use of individual hearing protection devices, education programs beginning with school-age children, consumer guidance, increased product noise labelling, and hearing conservation programs for occupational worker. Environmental noise management is a part of environmental impact studies and of guidelines for urban development in various countries. The World Health Organization strives to warn, raise awareness of and promote actions against noise pollution. Public education appears to be the best method as suggested by the respondents. However, government and NGOs can play a significant role of management in the noise pollution.

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