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A Comprehensive Review of Noise Pollution and its Impact on the Urban Environment

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Abstract

Noise pollution is a significant danger to urban life, affecting living and non-living things. It is becoming a more pervasive and unrecognized kind of environmental degradation, and after air and water pollution, it ranks as the third riskiest form of pollution. It is characterized as any sound pressure level of more than 55 dB, and prolonged exposure is bad for human health. Humans are mostly responsible for modifying the acoustic backdrop of the planet, and to reduce noise by 3 to 6 dB (A), noise barriers can be used. The primary cause of noise pollution, particularly in cities, is the rise in the number of automobiles, excessive honking, and traffic congestion. Traffic noise is a result of vehicle movement on roadways, and numerous elements affect how loudly vehicles emit noise. Additionally, other kinds of noise pollution, such as industrial noise pollution and neighborhood noise pollution, can also have harmful effects on human health. The steps to reduce noise pollution include maintaining vehicles and roads, planting trees, using silencers for generators, controlling traffic movements, raising public awareness, and so on. This review paper provides a comprehensive overview of noise pollution and its effects on the urban environment. By understanding the sources, impacts, and potential mitigation strategies, policymakers, urban planners, and the public can take informed actions to reduce noise pollution and create more livable cities.

Keywords: Noise Pollution, Urban Environment, Traffic Noise, Noise Effects, Noise Mitigation, dB (decibel)

Introduction

One of the biggest components of environmental pollution in contemporary cities is noise. It may be characterized as an unwelcome and undesirable sound that is now a significant danger to urban life. Noise is similar to a physical kind of pollution that does not directly impact the air, water, or soil, which are the three elements that support life. However, the receiver, for instance, is more immediately affected by its effects on humans [1]. Thereby, it was claimed that, after air and water pollution, among various forms of pollution, noise pollution ranked as the third most hazardous type [2]. In addition, Mumbai also ranks third among the noisiest cities in the world [3]. Noise pollution, which is caused by the incorporation of undesired noise into our regular routines, poses a significant challenge to urban life. No one can avoid noise since it is an inescapable, upsetting, and, depending on who is listening, bothersome sound that permeates all of existence [4]. Even in developed countries, noise pollution is increasingly prevalent, yet

often overlooked, as a form of environmental deterioration. Additionally, as noise is an obtrusive sound, exposed living and non-living things may experience some psychological and bodily stress as a result [5].

Noise pollution is one of the issues that might damage human peace and health. Currently, noise pollution is widely recognized as one of the primary concerns in urban regions since it may have many dangerous consequences on the environment and can be quite expensive for society [6]. Also, the main negative consequences on healthcare include irritation, sleep disturbances, difficulties with communication, and other negative outcomes [7]. Additionally, rather than responding to changes in sound pressure in an absolute way, the human hearing system does so in a relative one. Because of this, the decibel (dB), a logarithmic scale, is used to quantify sound pressure level. The threshold of hearing is equal to 0 dB and is the lowest sound that the human ear can perceive. The threshold of pain, on the other hand, refers to the sound pressure level that would hurt the ear, and it equals 120 dB [8]. This review delves into the subject of noise, examining noise pollution along with its various types, the underlying causes, the consequences it imposes, and the techniques employed to quantify and assess its presence in the environment.

2. Noise

The Latin word *nausea* is where the English term noise comes from. The phrase "wrong sound in the wrong place at the wrong time" can be used to characterize noise. Sounds that are necessary for happiness in daily life include spoken sounds from children playing, music, and the natural sounds found in parklands, gardens, and parks [9]. Unwanted sound, pollution, and health risk are all characteristics of noise. It affects emerging countries as well as developed ones, as environmental issues are not just something that wealthy nations should worry about [10]. With their manufactured noises of various pitches and amplitudes, humans are mostly to blame for modifying the acoustic backdrop of the planet [11]. Also, humans are physiologically and psychologically affected by the phenomena of noise. It is a serious environmental issue in several urban areas [12]. Based on their design and height, the utilization of noise barriers can effectively reduce noise levels by approximately 3 to 6 dB (A). Only highways and other bypass routes where there is no requirement for pedestrian crossings are permitted for using roadside noise obstacles [13].

3. Noise Pollution

Noise pollution is defined as any sound pressure level of more than 55 dB, and prolonged noise exposure is bad for human health [14]. However, currently, noise pollution has escalated to become the third most perilous form of environmental pollution, behind only air pollution and water pollution, according to the WHO [12]. Also, noise pollution is becoming more prevalent every day, in addition to rising levels of air and water pollution. According to the WHO, the most common and irreversible occupational danger in the world is noise-induced hearing loss, which affects an estimated 120 million individuals globally and causes incapacitating hearing problems [15]. Thus, the lives of those exposed to noise pollution are severely impacted, and noise pollution plays a crucial role in affecting human health [16]. Therefore, research to improve comprehension of noise pollution issues and control is warranted given the data that suggests noise pollution may have adverse impacts on human health [17].

One of the primary causes of noise pollution, particularly in cities, is the increase in the number of automobiles, excessive honking, and traffic congestion [14]. With the quick rise in industry, urbanization, transportation infrastructure, and population expansion, along with a rise in the number of vehicles on the road, noise pollution has over the years reached a disconcerting level [18]. Nevertheless, vehicles are responsible for around two-thirds of the noise pollution in urban areas. People who live near existing urban roads have decreased quality of life and lower property values as a result of traffic noise [19]. Due to the poor efficiency and inadequacy of the public transportation systems in many urban areas, the number of customized cars has increased dramatically and the continual use of roadways by diverse traffic creates situations in which traffic flows irregularly and is directly to blame for traffic congestion, which results in noise pollution [20]. Also, the traffic should be diverted to limit loudness, and horns and audio systems in cars should be used sparingly or not at all [9]. Additionally, it is the main cause of environmental irritation [11].

4. Types of Noise and Noise Pollution

Sound pollution can happen for two primary causes in particular. They are as follows:

- i. **Man-Made Noise Pollution** - This category includes a variety of noise disturbances brought on by man-made noise, such as traffic, fighting, loud music, construction, and numerous other home noises.
- ii. **Environmental noise pollution** refers to noise that is produced as a result of environmental problems such as earthquakes, thunderstorms, volcanic eruptions, animal howling, etc. [21].

This paper explores various types of noise pollution that have detrimental effects on both human health and the urban environment.

4.1. Transportation or Traffic Noise Pollution

Traffic noise is a result of vehicle movement on roadways. Numerous elements, including vehicle density, road types and surfaces, vehicle speed, gradients, intersections, the proportion of lorries on the road, the temperature, and building deflection, affect how loudly vehicles emit noise [22]. Factors influencing road traffic noise encompass variables such as traffic volume, vehicle velocity, the presence of large vehicles, road gradient, and the type of road surface. [6]. However, according to the calculations, a 50% decrease in overall traffic volume or a 50% decrease in the volume of high vehicular traffic would result in a 3 dB(A) drop in noise levels [23]. Additionally, a pertinent issue in the context of human health is the growing traffic noise pollution in urban settings [24]. Also, air pollution and noise pollution from traffic are sources that have been linked to adverse health impacts [25].

4.2. Industrial and Construction-related Noise Pollution

Industrial noise is produced by a variety of technological processes, including the operation of various internal combustion engines as well as other machinery found on industrial sites. These processes generate noise due to friction created between the various machine component compounds and the raw materials and/or finished goods. This friction results in vibrations that travel through the environment and are heard as noise by humans [26]. Furthermore, there is evidence of an increase in the prevalence of occupational noise in the workplace, which is an issue in every part of the world [27].

Based on its frequency range and loudness, in-plant industrial noise may irritate, interfere with communication and hearing, or result in permanent hearing impairment [28].

Building projects, particularly those involving concrete and earthwork, can contribute significantly to noise pollution. Individuals respond to noise pollution in diverse ways; however, when noise levels surpass a threshold, various adverse reactions and negative consequences can be observed, and individuals usually start to suffer the consequences. Furthermore, several studies have demonstrated that noise from buildings is a substantial source of annoyance for individuals [29]. So, at least one of, the noise source, noise propagation paths, or noise receivers can be changed to alter the amount of industrial noise [26].

4.3. Environment-Related Noise Pollution

On the whole, world, including in industrialized and developing nations, the noise generated by traffic is a notable contributor to environmental pollution [30]. As a result of the worldwide push for non-carbon energy generation, there has been an increase in interest in the adverse health impacts linked to various environmental noise makers, notably wind turbines, which are becoming a more noticeable presence on the landscape and coastal seascapes. Previous studies predominantly emphasized the effects of wind turbine noise on irritation, but a new socio-acoustic survey that included self-reported sleep disruption due to wind turbine noise has been published [31]. Environmental noise pollution, despite being a stressor with potential impacts on well-being, remains a significant concern [32]. It is now commonly acknowledged that ambient noise is a problem for the environment and in the modern world, there are public health issues that need to be addressed [33].

5. Sources of Noise

Noise can originate from a multitude of diverse sources, including traffic, loudspeakers, crowds of people, etc. [34]. As a result, the main noise sources are businesses, cars, planes, and building and demolition projects [6]. Amongst all other sources, traffic noise emerges as a major contributor to the overall noise levels in metropolitan areas. The primary contributors to traffic noise in metropolitan cities include the sounding of horns, heavy traffic, and a sudden increase in traffic flow [35]. However, when the gap widens between the source and receiver, the impression of the noise decreases [36]. The following are additional sources of noise:

1. Toys and Play Stations: toys sirens and squeaky toys, musical toys, such as electric guitars, drums, and horns, and toy phones for children.
2. Office, mechanical furniture, kitchen, and educational equipment
3. Entertainment: Live performances, TV, stadium, radio, loudspeakers, music players, theaters, and personal audio equipment including Bluetooth devices and earbuds
4. Communications tools, including cell phones, poor wiring techniques in a network, converter in the product's power supply, the noise of Wi-Fi, etc.
5. Vehicular transportation: privately owned powered wheels for commuting, public transportation vehicles including buses, trains, airplanes, and cargo transportation vehicles like trucks, goods trains, and cargo aircraft.
6. Mechanical apparatus, including mixing devices, grinders, cooling systems, hammers, fans, mowers, and air coolers.

7. Big machines: Drills, land movers, equipment, and automobiles used in building and maintaining residences, buildings housing offices, schools, colleges, and industries, among other things.

8. Urbanization or deforestation: These factors contribute to noise inadvertently. A formerly tranquil area becomes noisier as a result of deforestation, which also causes a rise in the building of homes, businesses, industries, roads, and other structures [37].

6. Effects of Noise Pollution

Depending on its length and level, noise has four different types of effects on human health and comfort. They are:

(i) Physiological consequences, such as elevated blood pressure and irregular heartbeats.

(ii) Physical impacts, such as hearing impairment.

(iii) Psychological consequences include difficulty falling asleep, staying up late, irritation, anger, and stress.

(iv) Consequences for how well people function at work including decreased productivity and hearing impairment [38].

The incidence of noise pollution is rising and having a negative influence on people's health, including sleep disorders, hearing loss, decreased productivity, sexual impotence, and cardiovascular, pulmonary, and neurological injuries as well as a shorter life span [39]. In accordance with WHO recommendations, noise pollution has distinct negative health impacts, such as interference with intended activities, annoyance, psychophysiological, mental-health, and performance effects on residential behavior, interference with speech communication, interference with rest and sleep, and hearing impairment caused by noise [40]. Also, environmental noise is the unwelcome sound that urbanization and industrialization processes create and that has a negative impact on human health, including hypertension, hearing loss, and sleep difficulties [41].

Generating annoyance, stress, and hearing loss, noise pollution in cities also contribute to coronary heart disease. However, regular noise exposure is linked to sleeping problems and mental health issues [42]. Additionally, exposure to noise pollution during pregnancy can have an indirect impact on the well-being of the child [43]. Thus, according to the poll, 94% of respondents experienced headaches, 76% slept poorly, 74% had hypertension, 74% had physiological stress, 64% had high blood pressure, and 60% had vertigo brought on by noise [44].

Although, it is damaging to schoolchildren's learning and academic success. For the teachers and students, poor acoustics and excessive noise might result in a variety of issues. The acoustical metrics and circumstances of classrooms play a significant role in how well kids learn [45]. The research has found that the most frequent impacts of noise pollution include irritation, sleep disturbance, problems with the heart and blood circulation, quality of life, cognitive functions, and hearing loss [46]. Several effects of noise pollution will be discussed in this paper.

6.1. Noise-Induced Hearing Impairment or Hearing loss

A rise in the threshold of hearing is the standard definition of hearing impairment. Threshold audiometry is used to evaluate it. The disadvantage brought on by a loss of hearing that is severe enough to reduce an individual's productivity in everyday tasks is known as a hearing handicap. The standard way to define it is in terms of being able to

recognize normal conversation over background noise [40]. There is a consensus that, regardless of exposure time, it is safe for ears to be exposed to sound pressure levels under 70 dB. For comparison, the amount of heavy truck traffic on a major route is about equivalent to 85 dB. Another widely held belief is that prolonged exposure to noise levels exceeding 85 dB may be hazardous [47]. Aside from that, farming is listed as one of the professions with the highest hearing loss possibility, largely because of the lack of usage of hearing protection gear [48].

There are two basic categories of hearing loss: conductive and sensorineural hearing loss. Conductive hearing loss affecting the outer or middle ear has an impact on various structures, including the pinna, ear canal, eardrum, and the space beneath the eardrum. Conduction Although there are several potential reasons for hearing loss, cerumen impaction, middle ear infections including otitis media, and tympanic membrane perforations are the most common. Conductive hearing loss is frequently transient or treatable with more complex surgical procedures or drugs, as is the case with middle ear infections (otitis media). Sensorineural hearing loss can impact the auditory nerve, which connects the inner ear to its origin in the brain, either through sensory or neurological factors [49].

6.2. Sleep Disturbances

In terms of a faster pace of transitions in sleep phases and a greater number of awakenings, noise exposure disrupts sleep in direct proportion to the quantity of noise encountered. With further exposure to music during the night and over several nights, habituation sets in [50]. However, one of the main effects of ambient noise is thought to be sleep disruption. According to estimates, noise coming from outside accounts for between 80 and 90 percent of reported occurrences of sleep disruption in loud environments [40]. Thus, even while sleeping, humans are capable of perceiving, analyzing, and responding to ambient noises.

The highest volume of sound as low as 33 dB have been shown to rouse people from sleep by causing autonomic systems, motor, and arousals of the brain (such as tachycardia and body motions) [51]. In addition to having an impact on the sleep process itself, noise during sleep causes changes in respiration, heart rate, blood pressure, pulse amplitude, vasoconstriction, cardiac arrhythmias, and body motion. [47]. Despite the fact that blood pressure usually falls during sleep, those who are suffering sleep fragmentation due to noise find it difficult to reach their lowest point for any length of time since blood pressure increases with noise temporarily and heart rate rises with noise intensity [52].

6.3. Noise Annoyances

Noise annoyances are a worldwide occurrence. A sensation of irritation connected to any agent or circumstance that a person or group knows or believes will negatively impact them is what is meant by the notion of annoyance [40]. Furthermore, among a population exposed to ambient noise, irritation is a prevailing social response to noise pollution. The discomfort arising from noise can stem from its interference with daily activities, thoughts, feelings, sleep, or relaxation. Unpleasant emotions such as anger, dissatisfaction, fatigue, and stress-related symptoms may accompany this noise-induced discomfort [51].

However, irritation, which can sometimes involve dread and mild rage because of the perception that one is being injured in an avoidable way, is the most common and

extensively reported subjective reaction to noise [50]. Because of this, the most common reaction to ambient noise is irritation, which is a combination of discomfort, rage, and feelings of intrusion [53]. On the other side, almost 25% of people in Europe report that their quality of life has declined as a result of irritation [54]. However, studies of local people have regularly revealed a clear correlation between the average degree of irritation or the percentage of extremely irritated individuals and noise levels [55].

7. Measurement of Noise Pollution

Decibels (dB) is the abbreviation for the unit of measurement for sound that Alexander Graham Bell introduced originally. Typically, 1 Decibel (dB) is the maximum sound intensity that a human ear can detect. Also, we define noise pollution as anything that is louder than 30 dB. The sound intensity is also a health risk and can result in permanent harm if it exceeds 130 dB [21]. Most often, the decibel scale with a logarithmic decibel (dB(A)) scale is used to indicate sound pressure level [56]. A noise level meter, which consists of a microphone, an amplifier, and a timer, can measure sound in the air. Different frequencies of noise can be measured by sound level meters (often at A- and C-weighted levels) [57]. Scientists and audio engineers have developed smartphone applications that serve as sound measurement tools, akin to standalone sound level meters and dosimeters. The effectiveness of 192 sound measuring applications for Apple and Android smartphones was the subject of research released in 2014 by the National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC) [57].

In addition, Sound levels below 80 dB are considered safe for the human ear, more than 80 dB results in momentary hearing loss and, if not treated right away, irreparable harm, and higher noise levels above 160 dB lead to permanent impairment, induce eardrum rupture and inner ear damage, which results in complete deafness. It also affects the developing embryo in pregnant women, raises blood pressure, causes stomach ulcers, palpitations, nervous disorders, irritability, and rage, and by damaging the inner ear and rupturing eardrums, noise levels exceeding 200 dB pose a serious risk of complete deafness. Additionally, it affects the embryo of pregnant women and raises blood pressure, causing stomach ulcers, palpitations, psychological disorders, and rage [58].

8. Noise Level in Different Countries

In a case study on two busy, commercial roads in Karachi, the average equivalent sound pressure levels were computed to be Leq 88.07dB at the Old Radio Station Building on M. A. Jinnah Road and 86.09dB at the Aisha Bharani College on Shah Rah-e-Faisal, both of which are significantly higher than the SEQS-acceptable limit (Sindh Environmental Quality Standards) [10]. According to research done in the Bangladeshi city of Dhaka, the major road's lowest and highest noise levels were recorded at 78.1 decibels and 119.7 decibels, respectively, during peak hours and 57.4 decibels and 89.3 decibels, during off-peak hours [34]. At the Fakir Mohan University in Balasore, Orissa, additional research was done to assess the amount of traffic noise pollution at five different locations along the route from the Vyasa Vihar Campus to the Gyan Vigyan Vihar Campus. The contributions of various vehicle types to ambient noise were determined to range from 70.4 to 94.2, 79.0 to 96.1, 77.8 to 110.2, 70.8 to 90.3, 71.0 to 87.5, 71.1 to 84.4, 72.5 to 86.9, and 74.0 to 85.4 dB (A), respectively, for cargo-carrying trucks, tractors, dumpers, town buses, motorbikes, and bolero/trucker, pick up, and tempo vehicles [59].

The research was done on investigating road traffic noise pollution in Rourkela, India. The noise level was measured at 12 different squares throughout the city at various times

(7 a.m. to 10 a.m., 11 a.m. to 2 p.m., 3- 6 p.m., 7- 10 p.m., 10 p.m. to 12 midnight, and 4- 6 a.m.), with daytime noise levels ranging from 68.5 to 120.3 [60]. Another study was conducted in the Pakistani city of Faisalabad's Rail Bazaar, Jhang Bazaar, and Chenab Chowk. It was found that the average value for each time of day – "Morning," "Noon," and "Evening" – was found to be 92 dB(A), 102 dB(A), and 97 dB(A) [61]. A study was carried out in Karachi, Pakistan, and six distinct study sites were chosen from busy regions across the city.

The average traffic noise level measured in this study was 95 dB (A), which is significantly higher than the internationally recommended standards. Karachi has a variety of sources for traffic noise, including auto-rickshaws, motorbikes, buses, minibusses, trucks, water tankers, pickups, and wagons, but the auto-rickshaw is the loudest of them all [62]. A case study was carried out in Tehran, the capital of Iran, and the results show that the maximum equal sound level (Leq), assessed in the Fajr Hospital, was equal to 59.9 dB. The minimum equal sound level (Leq), measured in the Basij Highway, plays a crucial role in the district as a linking route, was recorded from Basij Highway, a crucial linking route in the area, and measured at 84.2 dB(A) [63].

9. Mitigation and Control of Noise Pollution

There are a number of steps that can be taken to reduce noise pollution, including maintaining vehicles and roads properly, planting trees, covering electricity generators with silencers, having traffic movements maintained or effectively controlled by traffic police, and raising public awareness of noise pollution [5]. As well as vigorously enforcing traffic laws, to tackle noise pollution, it is recommended that the government installs quieter approach horns and effective silencers in automobiles [4].

Additionally, controlling the noise sources can be done by building a structure that rejects airborne transmission of sound, dampening vibrating metal structures, or replacing them with materials like wood. Additionally, noise from traffic can be decreased through the usage of appropriate fuel, great tires, and better roads, as well as through discouraging the use of stress horns, and auditorium noise may be decreased through noise-canceling materials, such as acoustical tiles, fiberglass carpet, etc. [39]. Thus, a select area (such as educational facilities or quiet zones) should be designated as no-horn zones [18].

10. Conclusion

In conclusion, this review paper has shed light on the significant impact of noise pollution on the urban environment. Nowadays, noise is the world's third most hazardous pollution and the reviewed literature consistently highlights the adverse consequences of excessive noise on human well-being, ranging from sleep disturbances and increased stress levels to hearing impairments and cardiovascular problems. In general, noise pollution is divided into two categories, environmental noise pollution, and man-made noise pollution. In urban areas, the main source of noise is traffic which is produced by vehicles, usage of horns, and traffic congestion.

While noise pollution remains a persistent challenge in urban environments, it is essential to recognize the potential for mitigation and management strategies. Urban planning and design, planting trees, maintenance of roads, and public awareness can be useful to prevent the exposure of noise, to save our precious life and the environment. By implementing effective noise control measures and promoting sustainable practices, we can create healthier, more harmonious urban spaces where individuals can thrive, and

the natural environment can flourish. In summary, this review paper highlights the urgency of handling noise pollution as a public health and environmental concern.

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