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A Review of Noise Management Practice in Nigeria

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Abstract

Technological advancement, modern systems of transportation, and an expanding human population have brought in their wake a disturbing situation of exposure to environmental noise. This paper was therefore written to create awareness about the expository effects and impacts of environmental noise pollution on the human population. The target population of interest was the Nigerian population. The key findings were linked and related to existing regulations in Nigeria and other countries to enable effective intervention strategies to reduce the harmful impact of noise pollution. Noise pollution was identified as contributing to the poor health of citizens and as a barrier to development and growth at the national level. By focusing on adverse effects and risk factors, the paper highlighted methods to promote the best interests of the vulnerable population. The paper also acknowledged the issue of industrial and environmental noise pollution from the perspective of its contribution to the economic growth and development of the country. Noise pollution was, therefore, required to be measured and controlled with the help of effective strategic laws. It would help reduce the negative effects on the economy and the vulnerable Nigerian population. This paper will be useful in anticipating future reforms that can reduce the considerable noise pollution and its negative impact on the population.

Keywords

noise pollution; noise management; decibel; legislation; noise level; NESREA

1. Introduction

The words "sound" and "noise" are often interpreted as interchangeable terms in the dictionary. According to industry standards, noise pollution is mainly observed by individuals working near sources that produce sounds that are intolerable to the ear [1]. Sound, on the other hand, can be considered a fluctuation that may be perceived by the human ear and can be interpreted at different frequencies by different individuals. A sound can often be pleasant to hear; however, noise is never good for the ear. It is mainly due to the higher frequency or intensity of the waves at which a certain sound is produced that it becomes rather unpleasant to the ears while having various negative impacts on individuals. Noise can also be deemed an objectionable sound that is not pleasant to the human ear and can also have adverse effects on physical and mental health [2]. While an individual is working within an environment that is prone to emitting such noises, eliminating these sounds may not be possible. Environmental noise pollution can be observed as industry-based noise pollution or can also be stipulated as per individual categorization or perception. Noises are generally produced at a higher decibel, which can be uncomfortable, irritating, annoying, and unwelcome for the ears [3]. Some of the environmental noises can also be based on the occupation of an individual working in the surroundings and emitting higher decibels. According to scientific specifications, any exposure to noise for more

than 8 hours of the period can be deemed a potential source of environmental noise pollution. So, in a nutshell, the noise emitted from all sources within proximity of an individual can be deemed environmental pollution. Apart from industries, noise pollution can also be due to transportation noise, noise from the neighborhood, or any other unwanted resource deemed to be liable to cause distress [4]. The topic might not seem complicated; however, it can be rather threatening to human health, safety, and communication. It aims to preserve natural resources and promote their abundance for future use and utility promotion [5]. One of the major contributors to noise pollution is a spurt in economic growth. Another factor contributing to environmental noise pollution is an increase in the number of motor vehicles on the road. This has contributed to overall growth, development, and industrial advances, which are inadvertently hurting the possibility of attaining development. There is also a dire need to acknowledge this issue and take the necessary action within the bounds of laws and regulations. This is also required to reduce the overall negative impact on the people of Nigeria [5]. There has been a scarcity of evident and reliable research studies that can help explain the effect of industrial and environmental noise pollution on citizens in general. This paper will help in focusing on the key terminology involved in the subject matter and the overall impact of environmental noise pollution on an individual. The paper will also shed light on the underlying laws and regulations in Nigeria and compare them with those of other countries to gain insight into possible ramifications. The paper will also emphasise the value of promoting a sound balance between cutting back on potential resources that generate considerable noise pollution and contributing to positive economic development in Nigeria. The paper will discuss the various issues in different sections, beginning with the meaning of noise pollution and the rate of noise pollution in Nigeria. The second section will discuss the sources of noise pollution (industrial machines, wind turbines, and construction sites). The third section will discuss the effects of noise pollution, which will be followed by section four, where the current methods for the management of noise pollution will be discussed. The fifth section will provide an overview of the rules and regulations that have been taken into implementable form and will help in the control of noise pollution. The last section will discuss the recommendations and conclusion.

1.1 Methods

In this review paper, a systematic approach was employed to filter and select relevant studies and literature. The process of data filtration involved several steps. First, a comprehensive search was conducted to identify relevant sources, including academic databases, research articles, conference proceedings, and reputable online sources. Inclusion and exclusion criteria were established to maintain consistency and relevance, with a focus on including studies that specifically addressed noise management practices in Nigeria and provided valuable insights or findings. The selected sources then underwent a rigorous evaluation process to assess their quality, reliability, and relevance. Peer-reviewed articles, reputable research studies, and publications from recognised experts in the field were prioritised. Pertinent information from the selected sources was extracted and synthesised to form a coherent narrative, incorporating key findings, important concepts, and relevant data. The entire process of data filtration was reviewed and iterated upon, taking into account feedback from experts and colleagues, to ensure the selection of the most valuable and up-to-date information for this review paper on noise management practices in Nigeria.

1.2 Understanding the concept of noise pollution

The concept of noise pollution is not new to anyone and is one of the leading causes of various health-related issues. Noise can take any form and be present within the close vicinity of an individual. Increased noise projections can also result in increased levels of stress, high blood pressure, and even significant hearing loss [6]. Noise pollution can also be deemed an invisible danger, the repercussions of which cannot be seen but are present. The overall definition of noise pollution is listening to unwanted and disturbing sounds that can interfere with an individual's healthy way of life. The level and intensity of sound are generally measured in decibels. Various sounds can be heard within an environment and can have a damaging impact on the individual hearing them. Environmental pollution can be heard at as low as 20–30 decibels and can range up to 120–140 decibels [7]. However, any sound that is over and above the decibel range of 85 can be damaging to the health of an individual, leading to potential harm. The issue of noise pollution in general and environmental pollution, in particular, can impact the well-being of an individual daily. This is also considered the most common cause of noise-induced hearing loss [8]. The issue of noise pollution also impacts all age groups of vulnerable populations and can also cause memory and attention deficits. Some of these damages have also been found to be permanent, which again contributes to the overall burden.

1.3 Basic terminologies associated with noise measurement

Noise is usually described and designated as having a certain "sound level." This is also recognized on an international level in terms of performance standards. Audible sound pressures can vary from a range of 107 Pa to 200 Pa. Decibel is another key term that is associated with sound [9]. It enables a more accurate algorithmically corrected prediction of sound levels, which helps explain the manageable range of sound and a sound level pleasant to the ears. Noise levels in the environment, such as those produced by industry, construction, and road traffic, are commonly expressed in decibels (dB(A). Octave is the division of frequency ranges into possible bands of upper frequency [10]. This is also used to limit the audible frequency of sound necessary for promoting a safe ambient atmosphere. Some other key

terminologies explaining the levels of sounds and noises include measurement of background noise level, measurement of time interval, reference time interval, rating level, residual noise level, specific noise source, and specific noise source. Various terms are also used for quantifying the level of noise and sound produced in the environment [11]. These terms include an explanation of inaudible sounds, barely audible sounds, and just audible, audible, and dominant sounds. The dominant sounds are the ones that contribute largely to significant noise pollution. The operation of noise pollution can also be caused by constant sounds, intermittent sounds, and infrequent sounds. Sound also comes with levels of vibration, and thus, a few common terms designate these levels of vibration. Some of these terms include acceleration, geophone, maximum instantaneous charge, peak particle velocity, and scaled distance.

2. Sources of Noise Pollution

One of the most common sources of noise pollution is the environment. This is also commonly known as "sound pollution." The pollution is mainly caused by the propagation of noise, which varies in range. However, all of these sounds can contribute largely to the smooth facilitation of activities in human life. It can also be more damaging than normally anticipated, and thus the source must be identified and modified with effective preventive strategies. The most commonly observed sources of environmental pollution can be noted to come from machines, transport, and propagation systems. Here is a detailed discussion of such sources.

2.1 Noise from road transportation

Road transportation can include buses, bikes, cars, trucks, and many others. Apart from the sound generated by the high-paced movement of these vehicles, noise pollution is also generated by the constant barking of horns. A normal car horn can generate a sound pressure level of 95–120 decibels [12]. This can be deemed to be significantly higher than the normal anticipated range suitable to be heard by the human ear. This can be suggestive of the impact of the noise pollution generated from road transportation and its impact on the vulnerable population impacted by the same.

2.2 Noise from Railways

Railway noise is generally considered to be the most environmentally friendly means of transportation Szwarc et al. [13] compared the impacts of road noise and railway noise on the environment and found that the latter has a lesser effect on it. Despite the fact that railways are one of the lesser-known hazards contributing to noise pollution, they cannot be avoided. Noise from railroads can also have a greater impact on those who work in close proximity to these machines. The passing of a train can also generate low-frequency, inaudible ground vibrations, which can magnify the sound produced by this movement [14]. It can thus cause evident harm to the ears and raise mental health concerns.

2.3 Aircraft Noise

Knobloch et al. [15] argued that the invention of flight was one of man’s greatest accomplishments and has helped connect the world together. Nevertheless, the increasing influx of passengers, requiring a larger number of aircraft and a total of more daily flights, has led to increased annoyance resulting from aircraft noise. Gély and Márki [16] compared the level of annoyance generated from the various sources of noise within our immediate environment, such as noise from manufacturing industries, noise from automobiles, railway noise, and aircraft noise, and found that aircraft noise was perceived to produce the greatest annoyance of them all, for the same equivalent noise levels. The noise produced by aircraft can reach 140 decibels or higher. This can be considered to be above the acceptable level of decibels normal for human hearing. A greater amount of noise is generated at the time of takeoff and landing, and thus, it can impact the ground staff who assist in these activities. There are major health consequences that can occur due to elevated sound levels. Noise is also one of the most common problems associated with aviation. It can cause health issues such as sleep disturbance, anxiety and stress, annoyance, and even cardiovascular impairments [17-21]. Moreover, Benz et al. [22] opined from their research that a continuous stress state could result from steady exposure to aircraft noise. Kors and Collin [23] are of the opinion that for the aviation industry to continue to grow, control measures for aircraft noise reduction must be introduced.

2.4 Noise from waterways

Noises produced by waterways can affect marine flora and fauna. This is mostly caused by the generation of anthropogenic noises, which can cause impairments in physical and behavioral displays [24]. These noises can indirectly impact population groups due to echolocation caused by the navigation of waterways. It can also make communication a bit difficult and add to the overall stress.

2.5 Noise from industrial machines

There are three most damaging sources of noise pollution that can arise from industry settings. Three of these sources have been noted as machinery, construction, and vehicles. Many industries require raw work to be done that cannot be executed without the use of drills, saws, progressive-use lathes, and so on. This is the reason why many industry

setups make it compulsory for people working on-site to use protective listening gear. This is considered to prevent hearing damage, which can be caused by subjection to constant high-pitched sounds within proximity.

2.6 Noise from wind turbines

Wind turbines produce some of the higher broadband noises, which are mainly generated through high-intensity revolving rotator blades. This causes potential turbulence due to the passing of air at a higher pressure and thus generates a "whooshing sound," which can be damaging to the ears [25]. If the turbines get old, they also produce a constant, low-paced, high-intensity tonal sound that is sustained at a steady pitch but can contribute largely to environmental noise pollution.

2.7 Noise from construction sites

Construction site noise is usually loud, and noise coming from such sites is usually noted to be at 90 decibels or above [26]. The noise pollution from a construction site usually comes from equipment such as bulldozers, compressors, pneumatic hammers, loaders, trucks, and even cranes used for lifting. The noise is also sustained at a constant level as work on these sites has to be carried out relentlessly. These higher levels and intensities of noise decibels not only affect those living nearby, but they can also affect those working on these sites, resulting in permanent or long-term hearing effects and damages. It also impacts the sleep pattern, which can be distressing for an individual's mental health.

2.8 Entertainment Noise

These noises come from pubs and clubs that have huge gatherings of individuals. However, although these activities help promote a culture of positive social engagement and interaction, they can often turn into nuisances. Noise from clubs or open-air concerts can impair the normal functioning of the interactive environment and, thus, affect the people coming under its influence [5]. Environmental noises coming from music can interfere with the neighbours' lives and also disturb their sleep patterns. This can also result in evident signs of distress and poor mental and physical health. It can also compromise the ability to perform activities smoothly.

2.9 Noise from military activities

Military operations include actions taken on the ground, on the water, and in the air. Most of these activities create a loud, intense sound that can also have significant damaging effects. Military activities such as explosions can also result in noise-induced hearing loss [27]. It can also impact the level of performance and combat skills of an individual. Apart from this issue, military personnel and training cadets are exposed to the risk of surprisingly high levels of noise, which can also lead to tinnitus and ringing in the ears. This has also been noted as the second-most commonly observed disability due to participation in military operations.

2.10 Other public noise sources, such as firecrackers

Public noise pollution includes all types of man-made noise pollution. This can come from vehicles, the use of machines, obstructions in the functioning of a normal environment, and burning crackers. Cracker burning can produce both noise and air pollution [28]. This can be noted in sounds that are louder and can generate huge bangs and thunderous sounds. Cracker-busting not only damages the environment but can also make conditions of living for animals inhumane, and thus, it should be avoided at all costs unless it is very necessary and vital to be conducted.

3. Effects of environmental noise pollution

The issue of noise pollution has become a nuance for a lot of people, which creates a constraint on daily living. It has impacted a million people on a daily basis and also compromises their quality of life significantly. Exposure to loud decibels of noise has been shown to have a major detrimental impact on people [1]. This is closely associated with issues such as high blood pressure, increased levels of stress and anxiety, heart diseases, and even hearing loss in severe cases. The problem has been shown to impact all age groups of people across the nation [29]. Children, however, are more vulnerable to the risk of hearing loss due to poor development of the ear anatomy. Subjection to loud decibels at an early age can be rather damaging for these young individuals. Furthermore, a comprehensive review of the literature carried out by Farooqi et al. [30] identified the effects of environmental noise to include increased heart rate, nausea, headache, insomnia, triggered hearing loss, high blood pressure, heart attack, impaired reproduction ability, exhaustion, decreased value of property, and dizziness.

3.1 Hearing loss

This is one of the major issues related to noise pollution. The hearing loss caused by the impact of noise pollution can be temporary or permanent in nature. Aside from age, it is also affected by the extent and intensity of the exposure [31]. Loud noises have a direct impact on the inner ear, commonly known as the cochlea. Loud noises and sounds can cause irreparable damage to the cells and membranes of the cochlea. These cells die over the exposure period due to this. The most critical part is that the impact of the loud noise persists even after the exposure has been cut off. This can result in permanent damage to the auditory neural system, which can leave the person hearing impaired [3]. In most cases, this gets detected in later stages, making it rather difficult to get the issue treated.

3.2 Sleep disturbances

Studies have shown that environmental pollution can be the root cause of fragmented sleep patterns [32]. This can be less refreshing for the person, which eventually hinders a good mood. Some noises may not be of a higher level, causing you to awaken from a deep sleep. However, these noises can still have multiple subconscious effects on sleep stages and sleep cycles. The sleep cycle varies from a lighter stage of sleep, which comes with low waves, to a deeper sleep pattern. Environmental noises have been shown to increase the speed of rapid eye movements, which can further cause potential disturbances in sleep patterns [2]. This disturbance in sleep patterns, especially during the night, is associated with the extra production of hormones such as adrenaline and cortisol. This release of hormones can result in elevated heart rate and blood pressure, and even irregularities in heart rate and rhythm. Short-term impacts of noise pollution on sleep patterns can be reflected in poor physical and mental functionality. Due to disturbances in sleep patterns, one will experience sleeplessness, which will also result in irritability [33]. On a long-term basis, poor sleep quality can be shown to cause cardiovascular diseases, diabetes, and even stroke in a few rare scenarios. In totality, poor sleep caused by noise pollution can significantly increase the overall risk of health and decrease the quality of life.

3.3 Speech interference

The issue of noise is present in all walks of life and impacts our daily functionality. Due to noise, there can be severe confusion while communicating with one another. Interrupted communication can also result in poor outcomes as it directly impacts social interaction [34]. Noise can interfere with communication, which is not only restricted to industrial places but is also far-reaching to other settings such as offices, schools, open spaces for mining and construction, and many other places as well. This can severely compromise your quality of safety and interaction. It can also have a direct influence on your productivity and learning capabilities [34]. It is necessary to have a good comprehension of what the other person is saying to enable good communication with them. However, excessive noise pollution can hamper this effective communication method. This can also compromise your social participation and functionality. Having a compromised social interaction status can also compromise speech intelligibility [35]. This can hamper various signs and signals of communication, which might lag in acknowledgment. Environmental pollution creates a lot of warning sounds, which can make it difficult to robustly comprehend speech. This can also lead to miscommunication and poor outcomes in social interactions, creating a sense of distrust and uncertainty.

3.4 Annoyance

Annoyance can be defined as a sense of displeasure. This is associated with the poor impact of a condition or a situation on an individual or a group of people. Compared to other forms of environmental pollution, noise pollution has been observed to have a significant impact and relate to a sense of annoyance in the behavioral displays of individuals [36]. Due to this factor, the person is also more likely to experience a negative impact on various body functions, such as cardiovascular health, metabolic diseases, and even poor impact on cognitive functioning.

3.5 Other effects of noise pollution

Noise pollution has also been closely related to the cause of tinnitus, which is defined as an abnormal sensation in the ears. Tinnitus is also marked by sound in the absence of an external sound source. This is usually caused by excessive exposure to noise. Most patients exposed to chronic noise have been reported to suffer from tinnitus [37]. This condition also gives rise to other secondary concerns such as anxiety, psychological distress, depression, communication issues, tension, irritability, and increased frustration [17]. The condition can also impact the well-being of the person and the quality of life by restricting social participation and interaction. The ear is connected to the brain, which assists in the coordination of the stimulus-response and creating the required action. All sound signals are sent to the brain for interpretation, and thus, a clear and precise message must be relayed to fetch specific details [38]. Noise pollution sends an excessive number of sound signals to the brain at once. This type of overriding sound can dull the brain's response time and also lower the rate of response significantly. Gradually, with due course, cognitive functioning is bound to be reduced, which is required for sound reasoning and decision-making. Industrial noises, which are typically higher in decibels and are constantly fed into the environment, can have the most detrimental effect on an individual.

4. Key Environmental Noise Concerns in Nigeria and Management Methods

The existing literature highlights several key noise concerns in the context of Nigeria, including transportation-related noise in urban areas, industrial noise pollution, and the impact of cultural elements on noise levels [39]. Construction noise [40], as well as transportation noise, particularly from road traffic, has been found to adversely affect residents' health and well-being, leading to increased stress levels, sleep disturbances, and reduced quality of life. Industrial activities generate significant noise, posing health risks for nearby communities [41]. Cultural practices such as traditional festivals and social gatherings contribute to noise pollution, necessitating a balance between preserving cultural traditions and mitigating excessive noise [42]. Vulnerable groups such as children, the elderly, and individuals with pre-existing health conditions are particularly susceptible to the negative effects of noise pollution. We will now discuss the various methods of environmental noise management used in Nigeria, which encompass targeted interventions and policies aimed at creating a more sustainable and harmonious soundscape for all.

4.1 Land-use planning and design

The major reason for noise zoning and land use planning is to prevent people from being exposed to levels of noise that are incompatible with their well-being and health. According to Rajé et al. [43], land-use planning and management are critical in order to ensure that only a small number of people living near airports are subjected to aircraft noise. This is done by introducing specific land-use zoning around airports that is compatible with land usage within the airport area. Land-use planning helps in zooming out the location and the type, which allows for assessing the level of decibels allowed in the specific region. It can also be used to design noise-sensitive areas through strategic mapping [44]. This is also done by allocating a significant distance between new noise-emitting sources and more sensitive regions. This is one of the most underutilized methods but, it is rather effective as it assists in planning before the incorporation of the developmental plan in the specific region.

4.2 Building insulation

Building insulation can be done with the help of soundproofing the building's surroundings. A choice of materials can be installed in the walls, such as cellulose, foam, or even fibreglass. This can be an effective strategy for significantly reducing outside noises and, as a result, the disturbance and annoyance caused by environmental pollution [45].

4.3 Noise barriers

It also depends on the noise barrier material and the surface of the treatment. The amount of original noise energy reflected or scattered back to the resources. Some of the left-over portions are absorbed by the material, and thus, the overall sound that is reflected is distracted from the top edge. A noise barrier can be effective in reducing noise levels by 5 to 10 decibels [46]. This material can be used to insulate windows or buildings to cut back on noise levels.

4.4 Use of silent electric cars

Silent electric cars can have acoustic technology, which can help issue a warning sign for producing noise. This can also be controlled by a sensor, which can artificially lower the decibel level of the pollution these cars cause to the environment.

4.5 Quiet Road Surfaces

The noise abatement potential of quiet road surfaces is generally lower than that of noise screens or facade insulation. This is also a good way to cut down on decibel levels and possible noise pollution in the environment.

4.6 Efficient Building Design

Architectural design can also be done to reduce the possibility of noise pollution. This can be done by using specific sound-proofing materials or by designing the building in a manner that helps cut down on unwanted noises and sounds and eventually controls the decibels.

4.7 Efficient Soundscape Design

The soundscape is the new measurement framework that aims to more accurately reflect the listener's experience of the sounds that they hear in context. Soundscape management aims to treat noise as a resource rather than a waste to improve the acoustic environment in which we live [47]. So, this can be a good way to control noise pollution in the environment, especially in industrial settings and close-by neighbourhoods.

Existing noise regulations and standards, such as ISO 12913 Soundscape, provide valuable insights and guidance for noise management practices in Nigeria. ISO 12913 focuses on the concept of soundscape, which emphasises not only the decibel levels but also the overall acoustic environment, including its quality, character, and perception by

individuals [48]. By drawing from ISO 12913 and similar standards, Nigeria can incorporate elements of soundscape assessment and management into its noise regulations. This approach encourages a more holistic approach to noise management, taking into account not only the quantitative aspects of noise but also the subjective experience and perception of sound. It can help inform the development of comprehensive noise management strategies that prioritise the creation of pleasant and sustainable acoustic environments in various settings, including urban areas, residential neighbourhoods, and public spaces.

4.8 Efficient Traffic Management

Traffic management can help identify the various noises and sources contributing to higher decibels in the environment. With this information, traffic can be sent to places where there aren't as many people. This will assist in noting the sounds and reducing their audible levels, which are pleasant to the ears, thereby contributing to controlling the possible negative impact of environmental noise pollution.

5. Legislation as an important tool for noise management

The use of legislation can include the application of laws and regulations that can help prohibit the use of higher decibels, which can be damaging to the ear. These regulations can also help in seeking federal actions and penalties against authorities and bodies that are contributing largely to increased levels of environmental noise pollution [49]. It is also a constructive approach to creating provisions for ensuring the practice of regulated levels of decibels within the scope of legislative practices. In organized societies, laws are meant to regulate human behavior. According to Ijaiya and Joseph [50], the purpose of promulgating environmental laws is to curb the menace and threat to the environment posed by human activities in the search for economic gains and development. Apart from international treaties and conventions, each country makes its own laws in the form of acts of parliament, edicts, or decrees. Legislation plays an important role in environmental noise management as it provides a framework for deciding whether a noise level is acceptable or not. It is the government's responsibility to ensure the measurement of noise abatement from various sources. The national environment protection agency must ensure that noise levels and intensities do not exceed the designated limit and that environmental quality is sustained as per specified quality standards. The National Environmental Standards and Regulations Enforcement Agency (NESREA) is the agency responsible for the implementation of environmental laws in Nigeria, including laws governing exposure to environmental noise [51].

5.1 Overview of the existing noise management approaches in Nigeria

The existing noise management approaches in Nigeria encompass a range of strategies and initiatives aimed at mitigating the adverse effects of noise pollution. The country has recognised the importance of addressing noise issues and has implemented various measures at different levels. At the national level, Nigeria has established the National Environmental Standards and Regulations Enforcement Agency (NESREA), which is responsible for developing and enforcing environmental standards, including those related to noise. NESREA has enacted regulations that set permissible noise levels for different types of activities and industries. Additionally, state and local governments have also introduced their own noise control measures and guidelines, often tailored to address specific regional or local concerns. These approaches typically involve a combination of noise zoning, noise level limits, and licensing requirements for noisy activities, with enforcement carried out by environmental agencies and law enforcement bodies. However, despite these efforts, challenges related to enforcement and awareness persist, requiring further attention and improvement in noise management practices in Nigeria [52].

In order to stop noise pollution, NESREA has set a decibel limit that is acceptable on both an international and a national level. The standard approval level of noise within residential areas has been set at 55 decibels during the day and 45 decibels during the night. In industrial regions, this level must not exceed 90 decibels during the day [53]. The higher range is primarily determined by the industry setup. Clubhouses and entertainment outlets have been instructed to operate in an enclosed and soundproof environment. A noise permit is also required for places where there are possible chances of higher decibels being emitted into the environment and eventually leading to significant environmental noise pollution [53].

5.2 Noise regulations in various countries

Due to the evident risk of harm, many countries have developed effective legislative regulations to control the dose of noise to which people are generally exposed. Most developing countries are subjected to the issue of noise pollution due to exposure to high-decibel sounds generated by industrial setups. This includes countries like Pakistan, India, and China, which are located on the Asian continent, and many others [54]. The exposure limit for these developing countries has been set at 85–90 dB for 8 hours maximum per day. However, in the noise regulations for the 22 countries that make up America (Latin America, Canada, and the United States), the limit has been set at 85 dB [55]. This has been noted as the permissible exposure limit, which has been deemed appropriate by the International Organization for Standardization (ISO) and the European Economic Community (EEC). The majority of American countries do not have established occupational noise levels in decibels [56]. In developing nations, the frequency

levels also play a vital role in deciding the optimal level of decibel suitable for hearing as compared to the intensity generated from these environmental sounds. Major sources of environmental noise pollution have been noted as traffic, industrial setups, and recreational centres, which are located within the close vicinity of residential complexes. Therefore, the legislative regulations are also closely associated with further reducing the acceptable decibel ranges within these locations.

5.3 Exposure limits given by international bodies

The World Health Organization (WHO) recommends that noise exposure levels should not exceed 70 dB over 24 hours and 85 dB over 1 hour to avoid hearing impairment [57]. The Environmental Protection Agency (EPA) report identified 70 decibels (dB) over 24 hours (75 dB over 8 hours) as the average exposure limit to environmental noise [58]. This agency has also identified the outdoor noise levels as being 55 dB and the indoor levels as 45 dB as being the highest. The Occupational Safety and Health Administration (OSHA) has mandated that workers limit their exposure to 90 decibels (dB) or less in order to avoid hearing damage and other psychological distress [59].

5.4 Challenges associated with the enforcement of noise regulations in Nigeria

The enforcement of noise regulations in Nigeria encounters various challenges that must be addressed for effective implementation. One of the significant challenges is the lack of awareness and understanding among the general population regarding the importance of noise regulation and its impact on health and well-being. Many individuals in Nigeria remain uninformed about the potential risks associated with prolonged exposure to high levels of noise, which undermines their compliance with noise control measures [60]. This lack of awareness highlights the need for comprehensive education campaigns to inform the public about the adverse effects of noise pollution and the benefits of adhering to noise regulations.

Inadequate infrastructure and resources pose another challenge to the enforcement of noise regulations. The limited availability of noise monitoring equipment, particularly in rural areas, hinders the accurate measurement and assessment of noise levels. Additionally, the scarcity of trained personnel and the lack of designated agencies or departments responsible for noise regulation enforcement further impede effective implementation. Addressing this challenge requires investment in appropriate equipment, the establishment of dedicated enforcement bodies, and the training of personnel to effectively monitor and enforce noise regulations [61].

The diverse and multicultural nature of Nigerian society presents unique challenges in enforcing noise regulations. Different cultural practices, traditions, and social norms may impact noise levels and perceptions. Balancing the preservation of cultural heritage and individual freedoms with the need to protect public health and well-being requires careful consideration and stakeholder engagement. It is essential to foster dialogue and collaboration with community leaders, religious institutions, and cultural organisations to develop noise control strategies that are sensitive to local customs and traditions [62].

Lack of compliance and resistance from stakeholders, including industries and businesses, is another significant challenge faced in noise regulation enforcement. Some industries may be hesitant to invest in noise reduction measures due to concerns about increased costs and potential disruptions to their operations. Businesses operating in densely populated areas may find it challenging to meet noise restrictions while balancing customer demands and operational requirements. Effective enforcement strategies should involve stakeholder consultations, providing incentives for compliance, and promoting voluntary adoption of noise control measures [63].

Inconsistencies and gaps in legislation pose additional challenges. The existing legal framework may lack clarity or specificity regarding noise regulations, making it difficult to prove violations and enforce penalties. It is crucial to review and update the legislative framework to provide clear guidelines for noise control, establish robust mechanisms for monitoring and enforcement, and streamline the legal processes to ensure timely resolution of disputes [64].

Insufficient financial resources allocated to noise regulation enforcement is another challenge that needs to be addressed. Inadequate funding often results in a lack of personnel, equipment, and infrastructure necessary for effective enforcement. Adequate budgetary provisions must be made to ensure that noise control agencies have the necessary resources to carry out their monitoring, enforcement, and public awareness activities [65].

Overcoming these challenges requires a multi-faceted approach. It involves strengthening public awareness and education campaigns, investing in infrastructure and resources, fostering stakeholder collaboration, reviewing and updating legislation, and allocating sufficient financial resources. Additionally, partnerships with international organisations and sharing best practices with other countries can provide valuable insights and support in addressing noise regulation enforcement challenges. By addressing these challenges, Nigeria can create a more conducive environment for the effective enforcement of noise regulations, leading to improved public health, enhanced quality of life, and sustainable development.

Conclusions and recommendations

The issue of industrial and environmental pollution has become a major public health issue globally. However, the noise component has not been widely studied in Nigeria. Apart from highlighting the issue, reflection and emphasis were also laid on the current legislative regulations progressing towards controlling and managing noise pollution across Nigeria. The best method that was identified to manage the problem of noise pollution was to implement the rules and regulations that would allow the management of noise pollution. The National Environmental Standards and Regulations Enforcement Agency was identified as the primary agency responsible for the implementation of environmental laws in Nigeria and, as such, has a vital role to play in effecting change. The paper discussed the key role of the regulatory bodies to ensure damage control and establish effective preventive strategies for narrowing down the industries and institutions responsible as the largest contributors to noise pollution in Nigeria. To control the noise in Nigeria, a variety of initiatives must be taken that will allow the noise to be released in a range of ways: through changes in the infrastructure of the buildings and roads, using cars that are electrical, and so on. The paper attempted to define the problem and raise awareness about the solution. With the help of the paper, a whole view of the situation of noise pollution was taken up. One of the positive aspects gives a broader idea of the "noise" topic in Nigeria.

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