

## Noise Pollution in Urban Areas: The Neglected Dimensions

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**Abstract:** This study which aim at review of noise pollution levels and its sources in Nigerian urban areas, reveals that noise pollution in Nigeria cities is found to be relatively high when compared to recommended levels by World Health Organization (WHO), Housing and Urban Development (HUD), Committee on Environmental and Occupational Health (CEOH) or Federal Highway Administration (FHWA). In Nigeria, there is no legal frame research upon which noise pollution can be abated. The study observes that Nigerian cities are environmentally noise polluted and the road traffic, industrial machineries and generators are the major sources of it. Noting that the noise levels lie much above the prescribed limits there is an imminent health risk to the exposed population. The complexity and magnitude of the problem of noise pollution call for effective and well-planned measures in the country, Nigeria. Government, industries and research institutions have so far given low priority to evolve strategies to prevent the epidemic of this invisible disease from spreading further. Some measures to combat the problem of noise pollution are outlines in this study so as to have sustainable urban development in Nigeria.

**Key words:** Noise, noise pollution, environment, urbanization, sustainable developement, Nigeria

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### INTRODUCTION

Modern life has given rise to a new form of pollution, noise. Crowded cities and towns, mechanized means of transport, new devices of recreation and entertainment are polluting the atmosphere with their continuous noise. Noise is no doubt a normal phenomenon of life and is derived to be one of the most effective alarm systems in man's physical environment. However, it is continuously disturbing human peace and tranquillity (Spence, 2003). Gradually, noise has become an important environmental pollutant and a threat to the quality of man's atmosphere. Noise in big cities is considered by the World Health Organization (WHO) to be the third most hazardous type of pollution, right after air and water pollution (WHO, 2005).

Noise pollution is an act in which displeasing human or machine created sound that disrupts the activity of balance of human or animal life is introduced to the environment. It can equally be described as an unwanted sound dumped into the environment without regard to the adverse effects it may have.

In contrast to many other environmental problems, noise pollution continues to grow and is accompanied by an increasing number of complaints from people exposed to the noise. The growth in noise pollution is unsustainable because it involves direct as well as cumulative, adverse health effects. It also adversely affects future generations and has sociocultural, aesthetic

and economic effects (Yilmaz and Ozer, 2005). The most important factors raising noise pollution in urban areas include interalia appliances, vehicular traffic, neighbourhood electrical appliances, TV and music systems, public address systems, railway and air traffic and generating sets. Even researchers fall prey to the noise generated by the household equipments used by us (Singh and Daver, 2004).

The need for studies regarding urban noise pollution and its consequences on the environment has motivated various researchers on the problem in several countries (Ugwuanyi *et al.*, 2005; Zeid *et al.*, 2000; Zheng *et al.*, 1996; Zannin *et al.*, 2003; Oyedepo and Saadu, 2009). Many researchers have reported that road traffic is the predominant and most generalized noise source in urban areas (Saadu *et al.*, 1998; Bisio, 1996; Nelson, 1998; Oyedepo and Saadu, 2008). Singh and Jain (1995) reported the measurements of noise levels in residential, industrial and commercial areas in the capital city of India, Delhi that commercial areas have the highest noise levels followed by industrial and residential areas. This is in contrary to the finding of Oyedepo and Saadu (2009) who carried out measurement of noise levels in busy roads/road junctions, residential, industrial, commercial and passenger loading parks areas in Ilorin city, Nigeria. The result shows that industrial areas have the highest noise levels followed by busy roads/road junctions, passengers loading parks and commercial areas. It has been generally accepted that noise pollution, particularly road traffic noise is severe in

rapidly expanding cities such as those of South-Eastern Nigeria (Onuu, 1992) where insufficient control is exercised and cities are poorly planned.

Existing evidence indicating that noise pollution may have negative impacts on human health has justified research in order to provide better understanding of noise pollution problems and control (Georgiadou *et al.*, 2004). Noise pollution has been stated as a serious health hazard with noise-related damage to humans ranging from annoyance to difficulty in falling asleep and high blood pressure (Ugwuanyi *et al.*, 2005; Saadu *et al.*, 1998; Jamrah *et al.*, 2006; Schwela and Zali, 1999).

In comparison with other pollutants the control of environmental noise has been hampered by insufficient knowledge of its effects on humans and of dose-response relationships as well as by a lack of sufficient data, especially in developing countries like Nigeria. The effects of noise in developing countries are just as widespread as those in developed countries and the long-term consequences for health are the same. Practical actions to limit and control the exposure to environmental noise are therefore essential. There is widespread and increasing excessive noise exposure everywhere especially in developing countries. In Africa, there are high noise exposure levels in the formal (manufacturing and mining) and informal occupational sector (small industries such as vehicle repairing, metal-working and milling) as well as the non-occupational sector (urban environmental and leisure). Awareness of hazard amongst employers, employees and the public is however very low. In most developing countries, occupational noise and urban, environmental noise (especially traffic noise) are increasing risk factors for hearing impairment. Many of these countries often lack both effective legislation against noise and programme to prevent noise-induced hearing loss. Where these exist, they are often poorly enforced and implemented. Most especially in Nigeria, noise is at high level.

Noise is a neglected form of pollution in the country but the form has a significant impact on human society, affecting the health of the population. Industry, shipments, car traffic are strong current and potential sources of pollution. Methods and apparatus for measuring noise are complex and must comply with standards that are applied to the measurement noise. Standards contain the necessary conditions for measuring instruments, methods of measuring noise for different activities or types of equipment, assessing the harmful effects of noise. The most important standards are those published by ISO (International Standards Organization) and IEC (International Electrotechnics Commission). ISO deals primarily in the measurement methods, experimental

conditions, measurement parameters and methods for evaluating the results while his prime objective is to design and construction of measuring instruments (Demian *et al.*, 2008).

The potential harmfulness of noise is not only depending on the level of this noise but also it depends on the duration. To measure the potential harm of a noise should measure both the level and duration of noise. Noise effects have various impacts on mental and physical health and disturbance in daily activities. It may affect sleep, conversation, leading to perception of annoyance and causes hearing loss, cardiovascular problems as well as affecting task performance (Piccolo *et al.*, 2005). This study focuses on noise pollution in Nigerian urban areas. The study reviews the noise pollution level and its effects in Nigerian cities and possible control measures to minimize its impact on the community.

## **URBANIZATION AND ENVIRONMENT**

Urbanization that is the growth of urban population has awfully accelerated during this century and has been faster in developing countries than in the advanced ones. The problems associated with the rapid change in human environment have intensified in the cities (Vijayalakshmi, 2003). It is here that the physical environment is becoming increasingly polluted the man-made environment of slums, restricted living space and noise are at their worst and the changes in the social environments have aggravated many problems (Mishra, 2000). Mankind is constantly flowing from rural settlements and every proposal for stopping this flow is completely unrealistic. Scientific and technological developments have given momentum to the growth of industries and hence, the pace of urbanization. Man has been living on the earth for about 40,000 years. He is surrounded by various forms of organisms forces and conditions both physical and biological, e.g., sunlight, land, air water and living beings which include all types of plants and animals. The total of these is called environment. For the first time in his entire cultural history, man has been confronted with the most horrible, tragic and unprecedented problems of environment pollution. Not very far back in the past, this very environment was pure, virgin and uncontaminated and basically quite hospitable for mankind. It is all due to thoughtless over-exploitation of the various natural resources by the own activities, perhaps due to the unending greed in the garb of development and the egoistic attitude towards Nature. The other three main reasons are population explosion rapid urbanisation and the throw-away concept of disposable items.

The word pollution has been derived from the Latin word pollutionem (meaning to defile or make dirty). Pollutant is a substance the presence of which causes pollution. The pollutants reach us through the air researchers breathe the water researchers drink the food researchers eat and the sound researchers hear. Morris K. Uddal (Vijayalakshmi, 2003) rightly said the more researchers exploit the more the options are reduced, until researchers have only one to fight for survival. Pollution can also be described as an undesirable change in the physical, chemical or biological characteristics of the air, land and water that will harmfully affect human life or that of desirable species, living conditions, etc. (Kudesia, 2000). There are seven main types of pollutions in the environment:

- Air pollution
- Water pollution
- Land pollution
- Industrial pollution
- Sewage pollution
- Noise pollution
- Radiation pollution

Noise pollution did not create much public concern due to ignorance about the treacherous effect of noise on both workers in industry in particular and the public in the community in general. It is therefore, imperative to assess the environment in which the noise is being heard by using suitable bases of judgement and awareness to determine whether or not a definite nuisance exists.

Noise pollution is a type of energy pollution in which distracting sounds which are clearly audible and which may result in disturbing any natural process or causes human harm. Consequently, noise is unwanted sound. What is pleasant to some ears may be extremely unpleasant to others depending upon a number of psychological factors (Hamza, 2008).

Noise pollution is one of the environmental hazards affecting human as well as climate. In most urban areas of the third or developing countries of the world there are lots of noise pollutants which includes noise from exhaust cars, industrial as well as home generating plants. In the advanced countries however, scientific experimentations like launching and re-launching of rockets, bombs and satellites sounds constitutes a major climate pollutant.

Human being, animals, plants and even inert objects like buildings and bridges have been victim of the increasing noise pollution caused in the world. Noise has become a very significant stress factor in the environment to the level that the term noise pollution has been used to signify the hazard of sound which consequences in the

modern day development is immeasurable (Aslam *et al.*, 2008). Though not physically visible, noise has been a major catalyst to climate change and practical sources of human health catastrophes globally.

It can rightly be said that noise is an unwanted pollutant introduced directly or indirectly into the environment usually at range of 80-85 dB level and at which sound becomes so painful and of deleterious effects as harm to living resources, hazard to human health and sea amenities (Alawode *et al.*, 2008). A major distinction between sound and noise is that sound is regarded as noise when it becomes a source of inconvenience to another (Mohammed, 2008). It has been revealed that noise is a technology generated problem and that the overall noise doubles every 10 years keeping pace with the social and industrial progress. This geometric progression-wise growth of noise could be mind-boggling in view of the ever increasing pace of technological growth in urban areas (Vijayalakshmi, 2003).

#### **NOISE POLLUTION IN NIGERIAN CITIES**

The urban environment has always been an area of high population concentration in Nigeria mainly because people tend to believe that the only hope of improving their standard of living is to live in an urban environment (Onokerhoraye, 1988). The country has therefore, witnessed a progressive trend in its urbanization process over the years. The boom in Nigeria's economy due to the huge revenue earnings from oil export during the seventies stimulated rapid growth of many urban centers in the country. As a result, existing road networks could not cope with the increased number of vehicles plying city and inter-city roads. This contributed immensely towards worsening environmental noise pollution in the cities (Saadu *et al.*, 1998). It therefore, became necessary to measure traffic noise and conducts a social survey in urban centers in order to evolve a scientific basis for regulating environmental noise.

Environmental noise pollution in Nigerian urban centers has been found to increase with an increase in population, commercial activities and road traffic volume (Oyedepo and Saadu, 2008). In Nigeria, the problem of noise pollution is wide spread. Several studies report that noise level in metropolitan cities exceeds specified standard limits. A study by Ugwuanyi *et al.* (2005) conducted in Makurdi, Nigeria found that the noise pollution level in the city was about 3-10 dB above the recommended upper limit of 82 dB(A). Onuu and Menkiti (1993) also found that the peak noise level ranges between 86-106 dB(A) in Aba and Uyo, Nigeria. This noise level is higher than the recommended level of

60 dB (A) for commercial and residential areas. The traffic noise levels observed by Saadu (1988) for the night time intra-city LA<sub>Eq</sub> noise levels range from 48-69 dB while the day-night levels ranged from 68-80 dB for both highway noise and intra-city traffic noise. These traffic noise levels observed constitute a threat to sleep activities and other health function of the city dwellers in the traffic areas. Day and night time noise pollution studies were carried out by Anomohanran and Osemeikhian (2006) in some major towns in Delta State, Nigeria. The results of the studies show that the average day time noise level for Warri exceeded the WHO permissible limit of 90 dB. All other locations have an average noise level lower than WHO limit but within the range of 75-85 dB. The peak noise level for the day time exceeded the WHO permissible limit for all the towns except at Abraka with a peak of 76.2 dB. A comparative study of noise pollution levels in some selected areas in Ilorin metropolis, Nigeria was carried out (Oyedepo and Saadu, 2009). This study was conducted to compare the noise pollution levels at busy roads/road junctions, passengers loading parks, commercial, industrial and residential areas in Ilorin metropolis. A total of 47-locations were selected within the metropolis. The results of the study show that industrial areas have the highest noise pollution levels (110.2 dB(A)) followed by busy roads/road junctions (91.5 dB (A)), passengers loading parks (87.8 dB (A)) and commercial areas (84.4 dB (A)). According to the researchers the noise pollution levels in Ilorin metropolis exceeded the recommended level by WHO at 34 of 47 measuring points. It was concluded that the city is environmentally noise polluted and industrial machineries and road traffic are the major sources of it. Ighoroje *et al.* (2004) investigated the level of noise pollution in selected industrial locations in Benin city, Nigeria. The average ambient noise level in Sawmills, Electro-acoustic market and food processing industrial areas was determined to be above 90 dB (A). This noise level is well above the healthy noise level of 60 dB (A). Ambient noise levels were measured both indoors and outdoors in eight tanning industries in Kano, Nigeria by Sonibare *et al.* (2004). The average noise level measured ranged between 70.1-95.2 dB. The result of this study shows that in the production floor, workers were exposed to marginally high noise level. Onuu studied the sound levels and spectra of industrial noise of nine industrial layouts in Calabar, Cross Rivers State of Nigeria and found the octave band pressure levels to be well above 85 dB (A) which is the starting point where damage risk is thought to be imminent. From the survey, they also found that the deafening level produced by the machinery noise was as high as 115 dB (A). High noise levels in industry may

reduce productivity and the efficiency of workers. Additionally, a lot of industrial accidents are caused by excessive noise. Furthermore, industrial noise in plants, depending on the spectral distribution and amplitude may annoy, interfere with speech and hearing, accelerate presbycusis or cause irreversible hearing damage. It also has pathological danger. Omubo-Pepple *et al.* (2010) investigated the effect of noise-induced hearing loss within Port Harcourt metropolis, Nigeria at two locations and concluded that the noise pollution within Port Harcourt International Airport has adverse effect on the environment and recommended that if certain protective measures were not taken that it will result to induced hearing loss and other psychological and pathological effects. Oyedepo and Saadu (2010a, b) carried out a study on assessment of noise level in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria. In this study, five selected processing and manufacturing industries were evaluated and compared the noise emitted by individual industrial machinery. Event L<sub>A,Eq</sub> and L<sub>N</sub> cycles were study to identify the noisy machines. Findings show that hammer mill machine from mineral-bearing rock-crushing mills produced the highest average noise (98.4dB(A)). The percentages of machines that emits noise above Federal Environmental Protection Agency and Occupational Safety and Health Administration recommendations (90 dB (A)) are from the soft drink bottling industry (83.3%) the beer brewing and bottling industry (42.9%) the tobacco making industry (71.4%) the mattress making industry (11.1%) and minerals-bearing rock-crushing mills (87.5%). An overview of industrial employees' exposure to noise in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria was carried out by Oyedepo and Saadu (2008). In this study, the average noise exposure level (L<sub>A,Eq</sub>) in minerals-bearing rock-crushing mills, soft drinks bottling, beer brewing and bottling and tobacco making industries was found to be above 85 dB (A). The noise level in these industries is well above the healthy noise level of 60 dB (A) recommended by World Health Organization (WHO). The researchers concluded that the workforce in the industries included in this study are at high risk of developing Noise Induced Hearing Loss (NIHL) and other associated ailments due to excessive occupational exposure to noise.

It is sad to know from the investigations by Saadu *et al.* (1998), Onuu and Menkiti (1993) and Ugwuanyi *et al.* (2005) unpublished research of Saadu (1988) that Nigerians are noisy people. In Nigeria, there is no legal frame research upon which noise pollution can be abated. The hazardous nature of industrial noise in Nigeria laid credence to the formulation of permissible

Table 1: Noise exposure limits for Nigeria (FEPA)

Duration per day (h)	Possible exposure limits (dB (A))
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Oyedepo and Saadu (2010a)

levels/standards by the Federal Environmental Protection Agency (FEPA) to which an employee may be subjected to FEPA (1991). The FEPA guideline is shown in Table 1. However, this guideline has been violated in the processing and manufacturing industries in Nigeria due to inefficiency of the statutory body in enforcing and implementing the regulatory laws to limit a high level of occupational noise and the unawareness of the workers about the ill effects of high levels of noise. In short, the Nigerian Government and her citizenry appear not to be conscious of the present and future impacts of noise induced health hazards in their environment. Unless and until measures are taken to control the level of noise the ongoing urbanization and industrialization may complicate the problem so much that it becomes incurable.

**COMPARISON OF NOISE POLLUTION CONTROL IN NIGERIA WITH OTHER COUNTRIES**

Noise pollution is not a unique problem for developing countries like Nigeria. In China, until the third century B.C., instead of hanging men for dangerous crimes, noise was used for their torturing. Similarly in India, not until of late when most of the people do not consider noise as pollutant and takes it as part of life routine, noise was before considered gravious just like any other serious crime (Nagi *et al.*, 1999).

The worrisome effects of noise are dangerous enough that the noise problem can be considered a crime by certain countries. Many researches have revealed that >130 million people in Europe suffer from exposure to noise levels above 65 dB (A) (CEC, 2000). Bond (1996) reports that 16% of people in Europe are expose to 40 dB (A) or more of traffic noise in their bed rooms at night compare it with WHO’s average estimates of 30-35 dB (A) for undistrupted sleep.

WHO has proposed the time base guideline for LAeq for 16 h daytime and 8 h night-time. The environmental noise level of 70 dB (A) LAeq, 24 h was recommended by WHO for industrial, commercial, shopping and traffic areas, indoors and outdoors areas to prevent impairments (Birgitta *et al.*, 1999).

Table 2: FHWA noise standards

Land use	Noise level L <sub>10</sub>	Description of land use category
A	60 dBA (Exterior limit)	For parks and open spaces
B	70 dBA (Exterior limit)	Residential area, hotels, schools libraries, hospitals, etc.
C	75 dBA	Developed areas
D	55 dBA (Interior limit)	Residential area, hotels and libraries

Parbat and Nagarnaik (2007)

Several initiatives have been taken by various countries to check noise levels. For example, the USA has taken initiatives to create sites where human-caused noise pollution will not be tolerated (Gerard, 1998). Laws in the Netherlands do not permit the building of houses in areas where 24 h average noise levels exceed 50 dB. In Great Britain, the Noise Act empowers local authorities to confiscate noisy equipment and fine people who create excess noise at night. In Nigeria as far back as 1990 while forming the Federal Environment Protection Agency (FEPA) the Federal government entrusted it with the responsibility of formulating laws to regulate and control the levels and impact of noise in the country. However, the impact of FEPA has not been felt. Despite the fact that much has been written about the health effects of noise, it seems that much of the information about the noise is not appreciated by the medical community and even less so by the general public. Most of the countries, keeping in view the alarming increase in environmental noise pollution have come up with permissible noise standards. The US Federal Highway Administration (FHWA) in April 1972 published interim noise standards for various land use as shown in Table 2.

The US Department of Housing and Urban Development (HUD) (Brueel and Kjaer, 1998) recommends the following noise levels for residential areas, measured outdoors: LAeq = 49dBA clearly acceptable:

- 49 < LAeq ≤ 62 dBA (or LDN ≤ 65dBA) normally acceptable
- 62 < LAeq ≤ 76 dBA (or 65 < LDN ≤ 75dBA) normally unacceptable
- LAeq > 76 dBA (or 75 dBA < LDN) clearly unacceptable

Considering the criteria from HUD, only 9 locations representing 21.43% out of the 42 locations surveyed by Oyedepo and Saadu (2010b) in Ilorin metropolis, Nigeria can be classified as normally acceptable while 14 locations representing 33.33% can be classified as clearly unacceptable. The result of this study also shows that noise levels (L<sub>10</sub>) in all the passenger loading parks surveyed (ranges from 72-86 dBA) are higher than the recommended values by FHWA (60 dBA). In other locations such as developed areas and residential areas

Table 3: Noise level standard in some countries

Countries	Industrial		Commercial		Residential		Silent zones	
	Day	Night	Day	Night	Day	Night	Day	Night
Australia (dB)	55	55	55	45	45	35	45	35
India (dB)	75	70	65	55	55	45	50	40
Japan (dB)	60	50	60	50	50	40	45	35
US, EPA (dB)	70	60	60	50	55	45	45	35
WHO (dB)	65	65	55	55	55	45	45	35

Chauhan *et al.* (2010)

the measured noise values ( $L_{10}$ ) can be classified as normally acceptable. Out of 12 developed areas (commercial centers) surveyed only 5 locations are having noise level >75 dBA, out of 6 high density residential areas, only 2 locations recorded noise levels >70 dBA and out of 6 low density residential areas, only 1 location is having noise levels >55 dBA.

Based on the National Guidelines for Environmental Noise Control by Federal-Provincial Advisory Committee on Environmental and Occupational Health, a generally acceptable road traffic noise level  $L_D$  for residential areas should be <55 dBA and for night, LN should not be >50 dBA. An area with environmental noise level <55 dBA is usually considered as a comfortable environment with little or no annoyance so that no negative physical and mental influence will be caused to essential activities such as working leisure and sleeping (Dai *et al.*, 2005; Parbat and Nagarnaik, 2007). Among all the locations surveyed in Ilorin metropolis, Nigeria by Oyedepo and Saadu (2010b), only two locations in the residential areas are acceptable in terms of the noise levels per recommendations of CEOH and WHO. If the standard of HUD is considered, only six dwelling areas are under normally acceptable situation and the noise levels of the other areas are still not acceptable. From the study, it was established that the locations that fall under commercial centers, road junctions/major roads, passenger loading parks and high density residential areas in Nigerian urban areas do not satisfy the recommended noise limit requirements according to these standards. Table 2 shows the noise level standard in some countries for some strategic locations for day time and night time. The noise levels in Nigerian cities exceeded the noise level standard set by the countries in Table 3. This was confirmed from the researchers of Oyedepo and Saadu (2010b) and Saadu *et al.* (1998).

### SOURCES AND EFFECTS OF NOISE POLLUTION IN NIGERIAN CITIES

**Sources of noise pollution in nigerian cities:** Noise is a major factor of environmental pollution; on the 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. As the day rises the noise level in the different parts of the city increases in and around research places and homes. The peak noise levels are reached in the twilight hours as traffic reaches a peak. In Nigeria, the problem caused by noise pollution is more aggravated in view of the fact that there is hardly any celebration, festival, marriage or religious function where there is no use of loud speakers at a very high pitch continuously for a long time. In offices also there is noise pollution due to clicking of typewriters, bells, ringing telephones, clattering office machines and conversations. On the road, noise pollution exists due to growing automobiles, screeching tyres, squealing brakes, screaming sirens, blaring, televisions and radios and blasting horns. Another major factor contributing to the noise pollution in Nigeria is that in many of the cities the industrial and commercial units are either not very far from the residential areas or they are sometimes set up in the residential areas. The use of electric generating set in most houses in urban areas in Nigeria has contributed a lot to noise pollution in the residential areas. This is as a result of inability to generate sufficient electric power for the populace in the cities by the power generating authority (PHCN).

Noise disrupts the tranquility of the environment and can affect climate and human health negatively. Amongst the common sources of noise pollution that contributed directly to climate change in Nigeria are given.

**Electricity generating plants:** Electric energy occupies the top grade in energy hierarchy as it finds innumerable uses in homes, industry, agriculture and defense and of course in some nations, transportation. Nigeria's electricity power situation is very poor because of erratic power supply. As a result, there is an upsurge in the use of electricity generating plant with its attendant noise pollution on the environment and human health. Most workplaces and homes use generating plants 24 h in alternative to power supply (Awosope, 2003). The noise from generated plants in Nigeria couples with its accompany smoke emission to the sky which has greatly contributed to the breaking of the ozone layer in the sky (Oyebolu, 1992). Nigeria is facing a very serious erratic electricity supply all governmental efforts to meet the need of the populace in this premises proved abortive. The industries and most people whom the sources of livelihood depend on electricity find generating plant as an inevitability to meet their needs. Even at home, office generators become the main source of getting power to meet their socio-economic advancement. Hence, this increases noise pollution in the environment.

**Vehicular traffic noise engine and pressure horns:**

Increase in vehicular traffic is also a source of noise pollution around the globe, especially in most urban cities around the world. The situation is getting seriously alarming with increase in traffic density on city roads. The emissions of smoke from cars are of great concern to the changes we are currently experiencing in the climate of this country.

**Construction/industrial noise:** To meet the demands of the basic necessity of living the construction of buildings, highways and city streets causes a lot of noise. Pneumatic hammers, air compressors, bulldozers, loaders, dump trucks and pavement breakers are the major sources of noise pollution in construction sites all emitted one classes of smoke or another which are all contributing to the current changes in climate in the country.

**Industrial/machinery noise:** Motors and compressors used in the industries create a lot of noise which adds to the detrimental state of noise pollution in Nigeria. Plumbing, boilers, generators, air conditioners and fans create a lot of noise in the buildings and add to the prevailing noise pollution.

**Other sources of noise pollution:** Other sources of noise pollution that are not contributing directly to climate change but that are indirectly contributing and that are having some negative effect on human health are:

**Noise from religious worship institutions:** Nigeria is a multi religious society and is therefore prone to religious activities. These activities manifest in congregational worship in various forms. These congregational worships are held in mosques, churches and other nonconventional areas like residential and workplaces in the daytime and even throughout the night. Noise of significant levels is generated from these congregational worships with the use of heavy public address systems and intensity of the voices of the worshippers oozing from inside. However, despite the thunderous nature of the noise and the adverse effect on human health the government has shied away from adding the issue. For example, a bill to control noise emission from religious places in Kwara State was met with strong opposition and eventually the idea was dropped.

**Household noise:** Household equipments such as vacuum cleaners, mixers and some kitchen appliances are noisemakers of the house. Though, they do not cause too much of problem, their effect of noise emitted on human health cannot be neglected. Furthermore, noise can be

generated from neighbourhood noise consisting of neighbouring apartments and noise within one's own apartment.

**Honking noise:** The people while honking do not realize the difficulties they caused to others and themselves. There can be lose of hearing, stress level may go high and even mental instability. Honking unnecessarily while driving or stationed in a place has become a trend these days and one can hear it very well at the traffic signals. Goods are now advertised and sold in vehicle using loud speaker even in promoting goods and services, Banks, GSM providers, local herb seller, transporters to invite intending traveller are very prominent in Nigeria. Omubo-Pepple *et al.* (2010) carried out a study in Port Harcourt city, Nigeria to establish the main source of noise pollution in the city. The results of the study are shown in Table 4 and 5.

Table 4 shows that a very large proportion of the respondents in each age group are affected by noise emanating from generators. Similar results are obtained with noise from road traffic and loudspeakers. Relatively small proportions (53% across various age groups) of respondents acknowledge the effects of noise generated from neighbourhoods. And almost equal proportion of respondents (54%) across different age groups agree that noise generated from religious activities affect them. From Table 5, it is observed that women are more affected by noise pollution from religious activities and social activities while in the other sources like the road traffic, air traffic and generators, there is no remarkable difference in percentage of male and female population.

Otutu investigated sources of noise pollution within Campus 2 of Delta State University, Abraka, Nigeria.

Table 4: Sources of noise in terms of age groups

Sources of noise	Age groups (years) (%)				Total
	Up to 18	19-35	36-50	51 and above	
Religious activities	61	51	54	55	54
Social activities	53	58	71	83	60
Loud speakers	81	74	88	84	82
Road traffic	67	63	72	78	75
Neighborhood	44	49	45	57	53
Air traffic	32	37	33	30	29
Generators	84	80	86	88	85

Omubo-Pepple *et al.* (2010)

Table 5: Sources of noise in terms of male and female respondents

Sources of noise	Male (%)	Female (%)
Religious activities	57	61
Social activities	53	58
Loud speakers	83	74
Road traffic	72	71
Neighborhood	47	47
Air traffic	33	31
Generators	86	86

Omubo-pepple *et al.* (2010)

This study revealed that the major source of noise within the campus emanated from the indiscriminate use of power plants to generate electricity and this is due to the constant power failures by the Power Holding Company of Nigeria PLC (PHCN). Results from an eight-city noise survey carried out by Saadu *et al.* (1998) in some major urban centers in Nigeria show that road traffic is a major source of environmental noise pollution in Nigeria. Many of the respondents of the study also felt that it was one of the major sources of annoyance.

Ana *et al.* (2009) carried out study on assessment of noise and associated health impacts at selected secondary schools in Ibadan, Nigeria. >60% of respondents reported that vehicular traffic was major source of noise and >70% complained being disturbed by noise. Three schools reported tiredness and one school lack of concentration as the most prevalent noise-related health problems. It was concluded in the study that Secondary school occupants in Ibadan, Nigeria were potentially affected by exposure to noise from mobile line sources. Table 6 shows how participants at study schools identified sources of environmental noise pollution.

**Effects of noise pollution:** The basic hearing mechanism of the ear cochlea is the communication of sounds to brain by the small hair cells. Intense sounds damage these cells, sometimes beyond recovery due to prolonged exposure to sounds (Borg and Counter, 1989). Exposure to excessive noise during pregnancy may result in high-frequency hearing loss in new-borns, prematurity, intrauterine growth retardation, cochleae damage and disruption to the normal growth and development of premature infants (CEH, 1997). Noise pollution can play havoc with the nervous system affecting the physical and psychological behavior of the individuals. It may cause nausea, vomiting, pain, hypertension, high blood pressure, cardiovascular problems, sleep disturbance, restlessness, depression, fatigue, allergy, mental stress and annoyance (Rehm, 1983).

There exists a connection between noise exposure and increased levels of catecholamines and magnesium metabolism (Suter, 1991). These findings suggest a possible mechanism for cardiovascular effects in that a chronic magnesium imbalance can lead to increased intra

cellular levels of calcium which in turn, can cause vasoconstriction and increase the sensitization for catecholamines.

**Auditory effect:** The human ear is a very sensitive instrument. If the hearing mechanisms are damaged in any way either by excessive noise levels or by diseases which affect the brain the auditory nerve or the auditory ossicles then hearing will be impaired. Intense noise levels for example are encountered in many industries and they can cause temporary or progressively permanent loss of hearing.

**Physiological effect:** Noise is likely to harm the physiological and psychological well-being of people. Physiological changes include:

**Effect main observations:**

- Cardiovascular response changes in heart beat rate and blood-pressure
- Metabolism increased metabolic rate increased pulse rate
- Respiration increased respiratory rate pulse frequency
- Eye pupil dilation. There is significant increase in pupil size above 55 dB

**Non-auditory effects:** In addition to its auditory effects, (temporary and permanent threshold shifts and noise induced deafness, etc.) noise can also produce many non-auditory effects. The exposure to noise:

- May interfere with verbal communication
- Cause annoyance and distraction
- Reduce working efficiency and research output
- Cause fatigue

**Sleep interference:** The WHO (World Health Organization) Task Group on Environmental Health Criteria for Noise has recommended a noise level of 35 (A) to preserve the restorative process of sleep.

**Speech interference:** Speech reception is the most important and also the most complex use of the auditory

Table 6: Identified sources of environmental noise at four selected secondary schools in Ibadan, Nigeria

Name of schools	Identified sources of noise in the school environment, No. of respondents (percentage) by school					
	Vehicles	Market	Factories	Religious houses	Others	Total by school
Ikolaba Grammar School (IGS)	47 (94%)	0 (0.0%)	0 (0.0%)	0 (0%)	3 (6%)	50 (100%)
Oba Akinbiyi High School (OAHS)	39 (78%)	3 (6.0%)	3 (6.0%)	5 (10%)	0 (0%)	50 (100%)
Anglican Commercial Grammar School (ACGS)	9 (18%)	6 (12.0%)	0 (0.0%)	31 (62%)	4 (8%)	50 (100%)
Bashorum Ojoo High School (BOHS)	33 (66%)	16 (32.0%)	0 (0.0%)	0 (0%)	1 (2%)	50 (100%)
Total across school	128 (64%)	25 (12.5%)	3 (1.5%)	36 (18%)	8 (4%)	200 (100%)

Ana *et al.* (2009)



Table 7: A global comparison of noise nuisance results

City	Percentage of people annoyed					
	Road traffic	Trains	Industrial/ construction equipment	Conversation	Children playing	Animals pets
Benin City (Nig)	20	0	15	23	13	0
Onitsha (Nig)	25	0	13	10	10	0
Port Harcourt (Nig)	27	12	15	24	12	3
Ilorin (Nig)	17	11	11	11	12	3
Lagos (Nig)	17	5	10	31	22	0
Ibadan (Nig)	25	5	12	28	28	0
Kano (Nig)	11	16	7	16	19	1
Kaduna (Nig)	16	6	14	26	31	1
London (UK)	56	5	7	19	8	3
Chicago (USA)	36	7	3	33	18	10
Minneapolis (USA)	29	3	6	32	13	13
Athens (Greece)	62	6	5	-	-	-
Patras (Greece)	69	1	8	-	-	-
West Philadelphia (USA)	42	6	5	-	-	-

Saadu *et al.* (1998)

system. Noise can either mask the speech to make it inaudible or by making only some frequencies leaving it audible but of reduced intelligibility. Saadu *et al.* (1998) carried out a study to assess people's reaction to noise in eight of Nigeria's largest cities. In the study, questionnaires were distributed to workers in offices, traders in commercial centers and adult pedestrians on streets. Most of the respondents to the questionnaire distributed said they were generally annoyed by the environmental noise in their domains. However, many ranked traffic noise as the second greatest source of annoyance after radios and loud speakers. The results of the opinion survey in this study were compared with those outside Nigeria in Table 7. From this table with the exception of a few cities, road traffic stood out as the greatest source of annoyance in all the cities followed by conversation.

In an attempt to establish the effects of noise pollution on city dwellers, Omubo-Pepple *et al.* (2010) reported the problem of noise pollution within the Port Harcourt metropolis, Nigeria. From the study, it was found that noise interferes with many aspects across the age groups. A majority of the respondents exposed to noise report occurrence of sleep disturbance, annoyance and hearing problems (Table 8). Generally, the growing age group bears more effect of noise pollution. The study also shows that the perception of the effect of noise on male and female varies. A good percentage of the male population feels the adverse effect of noise pollution more than their female counterparts (Table 9). The reasons for these differences may be because females are more tolerating, patient and accommodating and also because more men are exposed to industrial noise than women. From the investigation, it was found that people within

Table 8: Effect of noise on different age groups

Effects of noise	Age groups (years) (%)				Total
	Up to 18	19-35	36-50	51 and above	
Effect on hearing	68	54	80	94	75
Annoyance	75	79	86	74	77
Mental stress	26	39	43	31	32
Sleep disturbance	67	90	97	93	87
Speech interference	98	95	96	83	93
Lack of concentration	41	53	57	55	49
Cardiovascular disturbances	24	37	33	31	30

Omubo-Pepple *et al.* (2010)

Table 9: Effect of noise in terms of male and female respondents

Effects of noise	Male (%)	Female (%)
Effect on hearing	73	61
Annoyance	91	83
Mental stress	31	26
Sleep disturbance	95	80
Speech interference	92	75
Lack of concentration	87	84
Cardiovascular disturbances	26	22

Omubo-Pepple *et al.* (2010)

Table 10: Reactions to noise by different age groups

Reactions	Age groups (years) (%)				Total
	Up to 18	19-35	36-50	51 and above	
Quarrel with people	31	11	19	17	20
Complain to the police	8	6	5	2	19
Request to stop or reduce	71	60	65	73	64
Ignore	78	81	69	88	75
Retaliate	73	55	49	41	42

Omubo-Pepple *et al.* (2010)

the ages of 19-35 do not border on quarrelling, complaining to the police or even requesting the source of noise to be reduced or stopped. Small proportions seek redress through legal means while those up to 18 years quarrel and retaliation seems popular among them (Table 10).

## **EFFECTIVE NOISE CONTROL AND SUSTAINABLE URBAN DEVELOPMENT IN NIGERIA**

The need to strike a good balance between human's activities and their impact on the physical environment has remained a topical issue among scholars and administrators alike. The term sustainable development has become a global cliché to describe man's attempt to control and reverse the negative consequences of his domination of the earth. World Commission on Environment and Development in 1987 provided the most commonly used definition of Sustainable Development as the development that meet the needs of the present without compromising the ability of the future generation to meet their own needs. Lele (1991) also defined it as a way of maintaining and enhancing the quality of human life by protecting the health of the biosphere and husbanding the key resources of the air, water, land and minerals.

Sustainability therefore is very complicated and primarily concerns environmental issues. Research into sustainability is mainly to assess the environmental impact of human activities and to search options which could have least negative impact on natural environment. Therefore, the study of urban environment involves both the sustainability of natural and human environments, created by industrial activities and technological advancement. The sustainability of the natural environment includes less depletion of natural resources, pollution and consumption of energy. The sustainability of human environment aims to achieve a stable and comfortable indoor and outdoor environment by providing adequate functional spaces and services.

Since, there is no single strategy for environmental sustainability the strategy to be used, depend on the objectives and level of sustainability under consideration. This study addresses the problems of environmental noise pollution in Nigerian urban areas with the implications of implementing its control measures on the sustainability of the urban areas. The Nigerian experience as far as the sustainable development of its cities is concerned is quite appalling. The challenges to sustainable built-up environment in Nigeria cities and urban areas are embodied in urbanization. Among the common negative consequences resulting from urbanization is environmental noise pollution. The urban environmental noise pollution simply entails all what make the urban centre not to be conducive for living and also makes the environment to be unhealthy for living. This is a source of worry going by the problems and challenges presently faced in ensuring that urban areas of Nigeria become functional, livable and aesthetically pleasing.

Urbanization has been the primary reason commonly advanced by scholars for the present deplorable state of many cities in the country (Ademiluyi and Dina, 2011).

A sustainable city could be defined as a city in which the population enjoys a high quality of life and which takes care not to transfer socioeconomic and environmental or health problems to other placed or future generations (Girardet, 1992). Sustainable development seeks to deliver basic environmental, social and economic services to all residents of the community without threatening the viability of the natural, built and social systems upon which the delivery of these services depends. The main characteristics of sustainable development as stated in the European Union's Fifth Environmental Action Programme (Kadiri, 2006) are:

- To maintain the overall quality of life
- To maintain continuing access to natural and built resources
- To avoid lasting environmental damage

In spite of the extensive generation of noise in urban areas of Nigeria, surprisingly little research and documentation exist on the nature and extent of noise generation activities, their accompanying impacts and the implication for urban communities and their residents. In order to achieve sustainable urban development in Nigeria, there is need to combat the main sources of noise pollution in Nigerian urban areas both at Local Government level and Federal Government level. A number of action plans can be taken to abate the environmental and industrial noise pollution in Nigeria. These include: technical, planning, behavioural and educational solutions. For industrial noise pollution, firstly, noise should be reduced from the source through proper and regular maintenance, replacement of worn out parts, replacing old machines with new ones and provision of damper at the base of machines. Secondly, minimizing noise intensity transmitted along its transmission path by covering outer surfaces of machine rooms with sound absorbent materials, Green belt design and use of noise protective measures. In environmental noise pollution since, transport infra-structures can be recognized as major sources of noise, technical actions on the transport systems can produce interesting results. Possible technical controls include:

- Changes in road profiles
- Low noise pavements (porous or porous elastic) type
- Effective repairs to the silencers and vehicle suspensions so as to reduce exhaust and rolling stock noise

- Reduction limitations or restrictions on traffic (types of vehicles, speed, hours of access, etc.)
- Building of acoustic barriers along the sides of heavily travelled highways running through residential areas

Transportation and land planning (private versus public transportation, bus lanes, parking areas, shuttle buses and pedestrian areas) are important components of plan. Since, noise also results from the citizen's behavior (driver, music player, hawker, etc.) information and education campaigns usually produce good results in the long term. Information on different actions and on the results should be well disseminated and should correspond to general aims and action plans. There is need to establish environmental noise impact criteria levels for various land use purposes. These criteria levels would enable impacts to be determined. The authorities should pass laws to check excesses of the sources of high noise levels. Other professionals such as town planners, architects and environmental engineers as well should have the problems of environmental noise pollution in mind when citing new roads, shopping centers, schools, hospitals and both commercial and residential houses in general. The most valuable step to decrease noise pollution in big cities in Nigeria is the preparation of noise maps. Noise maps are very powerful tools for communicating results of assessment of environmental noise to the general public and for the government (local and national) to devise noise correction measures. The noise map itself with the values of noise descriptors, provides baseline data for town planners, engineers and other professionals and researchers for the planning and execution of their projects. Most of the cities in Nigeria have not presented noise pollution maps. It is suggested that noise maps should be developed for every big city in Nigeria to serve as a noise control measure.

### CONCLUSION

Due to the ignorance of Nigerians on the fact that there exist a close nexus between noise pollution and sustainable city, little or no attention is paid to the control of noise pollution in Nigeria. The execution and implementation of the law as regards environmental pollution is never implemented to the letter. It is observed that the persistence of this problem could endanger the future stability of human health and could aggravate the human health catastrophe in the fast growing cities in Nigeria. The sources of noise pollution identifies in the paper also exposed the common channels of

environmental pollution through noise and its effects on the public in Nigeria which is most significantly similar throughout the world. The challenges posed by noise pollution on human health and the environment have not yet received full attention which it deserves. Though, generally statutory and policy provisions regulating noise on pollution in Nigeria as well as the world over have lofty aims and are quite salutary however, there is need for proper implementation.

Conclusively therefore, aggressive implementation of the existing laws, policies and guidelines on environmental pollution will go a long way in addressing the problem of noise pollution and brings about sustainable urban development in Nigeria.

### RECOMMENDATIONS

**Bill for combating noise pollution:** Considering the adverse effects of noise pollution on human health and environment, it is significance to evolve proper approaches to address the issue of noise and protection of human and environmental health in Nigeria. This study recommends that the National Assembly passed a bill making it mandatory for all states and local government of the federation to enact similar law to combat noise pollution aggressively in Nigeria.

**Putting in place a regulating agency:** The realization of the importance of sustainable environment is necessary. This is achievable if specific laws are put in place to determine level of acceptable noise and regulate noise pollution in Nigeria. Putting in place a regulatory agency will assist in the measurement, control and enforcement of the laws to achieve a desired goal.

**Encouragement of scientific as well as natural protection:** There is the need to take advantage of the opportunities presented to man by technological advancement in the area of measurement and control of noise through the use of gargets like insulator and sound proofing to doors, walls, ceilings using ear protection and planting vegetation and screen out noise pollution and zoning urban area to maintain a separation between residential area and zones of excessive noise.

**Review of environmental policies in Nigeria:** There is the need for review or strategic assessments of government policies, plans and programmes for noise pollution and environmental health. Strict punishment is recommended for any breach of environmental laws in Nigeria.

**Public awareness campaign on danger in noise pollution and its nexus with sustainable city:** There is the need for

public enlightenment, education and sensitization on the hazard, danger and human health catastrophe associated with noise pollution and also on the nexus between noise pollution and sustainable city. This is of paramount significance because many are still ignorant of the fact that there exist any nexus between noise pollution and the sustainable city with the resultant effect researchers are witnessing in the world today.

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