ASSESSMENT OF NOISE POLLUTION IN HIGH DENSITY AREA OF ILORIN METROPOLIS

FagbenroOluwakemiKehinde and AbdulrazaqAbdulroqeeb O.

Department of Civil Engineering, Faculty of Engineering and Technology, LadokeAkintola University of Technology, Ogbomoso, P.M.B. 4000, Nigeria.

**Corresponding author; Tel: + 234-7066669177, e-mail: okfagbenro@lautech.edu.ng*

ABSTRACT

Noise is an environmental pollutant that has continue to increase with an increase in population, Urbanization, and the general desire of man to acquire advanced technologies in transportation, construction, recreation and entertainment among others. In an attempt to provide solutions that will ameliorate pollution problem in urban centres of developing nations especially, the present study investigated the sources of noise pollution in very busy areas. Four very busy areas of Ilorin metropolis, Nigeria were randomly selected and used as case studies of a typical noise polluted city of a developing nation. Noise assessment quantities such as L_{Aeq}, L_{10}, L_{90}TNI, L_{NP} L_D L_N and L_{DN} were used to assess and establish the background noise, peak noise and dominant noise sources at these locations. Results of this study shows that the major source of noise pollution in Ilorin metropolis can be attributed to traffic, where the TNI ranged between 88 - 120 dB (A), and L_{NP} from 86 – 107 dB (A). Other intrusive sources of noise pollution at the studied locations could be attributed to the noise from business transactions, roadside media operators, individual electricity,hawkers advertising their wares and indiscriminate use of public address systems (PBS) for business promo and religious activities. Results show that the areas under study were noise polluted as they exceeded the standard provided by the world health organization (WHO).

Keywords:Environment, Health risk, Noise, Pollution, Sound.

1.0 INTRODUCTION

Environmental pollution abatement cannot be overemphasized, therefore, every effort should be made to reduce noise, where it is impossible to eradicate. Gradually, noise has become an important environmental pollutant and a threat to the natural quality of the atmosphere, (Essandoh and Armah 2011). Pollution can be described as an undesirable change in the physical, chemical or biological characteristics of the air, land and water, which will affect everything that is susceptible in the environment (Sharma and Singh 2017).

Noise is an unwanted sound, an inconvenience and often a nuisance. The least of its consequences being irritation or annoyance, and except an individual can be indifferent to it, effects will be felt. Often times, unwanted sound is dumped into the environment without regard to the adverse effects it may have, while the contribution of sound sources varies with the environment (Kang, et al. 2016). Industrialization, civilization and modernization are thought to be the initiator and catalyzers of environmental pollution (Singh 2015, Hu 2017). Crowded cities, the need for mobility, mechanized means of transportation, construction activities, new devices for recreation and entertainment are examples of sources of continuous noise pollution in the environment, which affects health and the quality of life (Morillas, et al. 2015, Rahmat and Hamid 2015).

Beginning with technological expansion of the industrial revolution, environmental noise has been gradually and steadily increasing, with more geographic areas being exposed to significant levels of noise. Previously, noise levels sufficient to induce certain degree of hearing impairment were confined to factories and occupational situations, but nowadays, noise levels approaching such intensity and duration are experienced in many urban and domestic environments (Palamuleni 2015).

Unlike other environmental issues, complains of noise pollution continues to increase with increase in pollution, yet it appears that insufficient effort is made to abate the problem. Growth in noise pollution is considered unsustainable as it involves direct and cumulative adverse health effects on the present and future generations, with socio-cultural, aesthetic and economic effects (Yilmaz and Ozer 2005, Ozer, et al. 2009). Its control is limited by insufficient knowledge of effects on humans, dose-response relationships and lack of defined criteria (Essandoh and Armah 2011). Also, there is an insufficient knowledge of noise pollution because noise is a subjective experience, which means that the sound considered as noise by a person may suit another individual. Also, because noise has a short

decay time, it may have disappeared before an individual is able to complain, or before any measure of discipline or enforcement of rule and regulations can be exercised. Finally, it is relatively difficult to associate a cause with effects, particularly of health.

Possible effects of noise pollution on human health are classified into four categories, namely: physical (e.g. temporary or permanent hearing impairment), physiological (e.g. high blood pressure and irregular heartbeats), psychological (e.g. insomnia, disorders, anxieties, irritability and stress) and performance at work (e.g. reduced productivity and lack of clarity and understanding) (Ouis 2001, Tijunelis, et al. 2005).

Noise has 3 inter-related elements, the source, i.e. the origin, or where it is generated, transmission path to reach the receiver, i.e. the atmosphere or media through which it is propagated which include also, any structural member or material that is not insulated against sound. The receiver includes living things, humans especially, (Modi, et al. 2013). So much has been discussed about noise and the possible effects on human especially (Olayinka and Abdullahi 2010, Oyedepo 2012). The possible effects of noise pollution has necessitated researches, so as to give more understanding of the problems of noise pollution and its control (Georgiadou, et al. 2004).

Not unlike other developing nations, noise pollution is wide spread in Nigeria. Studies have shown that noise level in metropolitan cities exceeds the limits specified by standards. Among others, Anomohanran, et al. (2008) in a related study on Abraka, Nigeria, found that the peak noise level at the road junction was 100 dB (A), 40 dB (A) higher than the Standard for commercial and residential areas. Another study on the determination of noise pollution level, conducted by Ighoroje, et al. (2004) on selected industrial areas in Benin city, Nigeria, showed that the pollution level was above 90 dB (A). Likewise, the study conducted on noise pollution in Markurdi, Nigeria by Ugwuanyi, et al. (2004), showed that the noise pollution level within the city ranged between 85 and 92 dB (A), also exceeding the allowable limit.

The situation of noise pollution in Ilorin metropolis is considered to be similar to that in many urban areas. Ilorin is a relatively large city, with a rapid population growth rate. Increasing from 423, 340 in 1980 to 902 131 in 2006 (NPC, 2006). The city has continued to expand in the last two (2) decades, with significant changes in industrial, urban, infrastructure and road network systems. Inspite of the efforts made to improve the roads, the city has continue to experience persistent road traffic congestion in the commercial centers and at multiple road junctions in the heart of the city (Oyedepo 2012). This study aims at proffering a sustainable solution to noise pollution in a typicallyvery busy area of Nigeria, using Ilorin metropolis as a case study. Its objectives are to determine the extent of environmental pollution from noise, and their sources, using the noise assessment quantities:L_{Aeq}, L_{10}, L_{90}TNI, L_{NP} L_D L_N and L_{DN} and to suggest, possible solutions that will ameliorate pollution problems.

2. MATERIALS AND METHODS.

In this study, four locations were considered for the measurement of outdoor sound levels. Two for the commercial (market) area (i.e. Ipata and Oja-Oba) and two for the road junctions/busy roads (i.e. Maraba and Challenge), as representatives of very busy areas of Ilorin metropolis, the Kwara state capital.

A portable precision grade sound level meter, ½-in Condenser microphone and ½-in Octave filter were used in this study. The instruments were first calibrated at the onset of experimentation and before measurements at new locations, for better accuracy. Measurements were taken at designated locations. The instrument was handheld with the microphone pointed in the direction of the noise but not less than 1m away from any reflective object. A-weighted instantaneous sound pressure level, L_{AI} was measured at 30 seconds interval over a period of 30 minutes. The procedure was carried out for morning (8.30 - 9.00am), afternoon (1.00 - 1.30pm) and evening (5.00 - 5.30pm). Readings obtained were used to calculate for commonly used noise assessment quantities given in Table 1.

Table 1: Noise Assessment Quantities

No. Identification	Noise Assessment Quantities
1	L_{Aeq}: A-weighted equivalent sound pressure level, dB (A)
2	$L_{10:}$ Noise level exceeded 10% of the time, dB (A)
3	$L_{90:}$ Noise level exceeded 90% of the time, dB (A)
4	TNI: Traffic noise index, dB (A)
5	$L_{NP:}$ Noise pollution level, dB (A)

6	$L_{D:}$ Day time noise level, dB (A)
7	$L_{N:}$ Night time noise level, dB (A)
8	$L_{DN:}$ Day-Night noise level, dB (A)

3. RESULTS AND DISCUSSIONS.

The average noise descriptors determined for the locations within the study area are presented in Table 1.

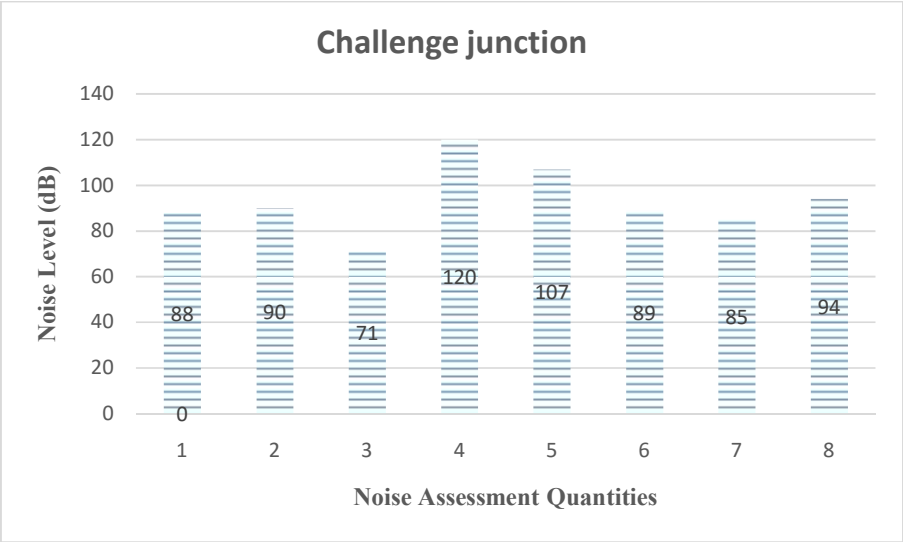

Figure 1: Noise assessment quantities measured at Challenge Junction

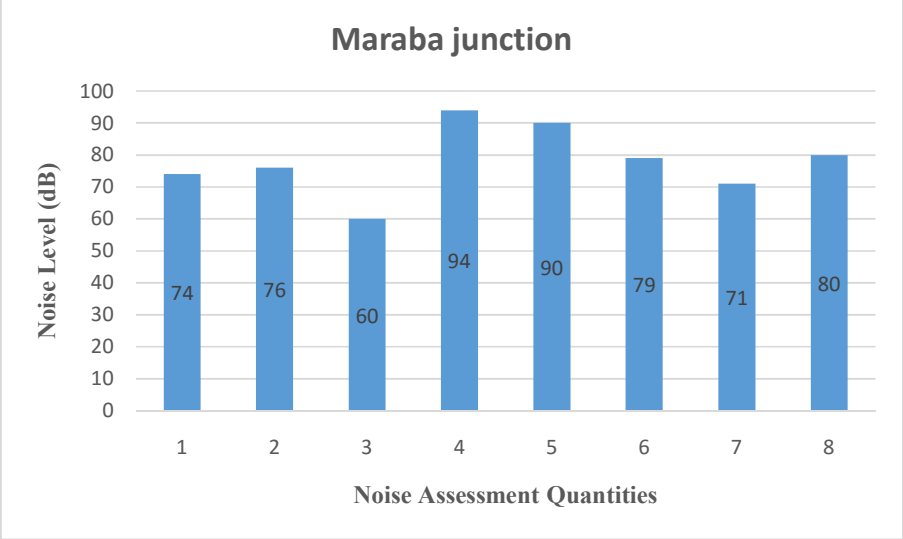

Figure 2: Noise assessment quantities measured at Maraba Junction

Having previously defined the parameters L_{Aeq}, L_{10}, L_{90}TNI, L_{NP} L_D L_N and L_{DN}, results show that at Challenge junction, all but one parameter (i.e. L_{90}) were highest of the studied locations (Figure 1). Values of all the noise measuring quantities at this location ranged between 85 and 120 dB (A). The background noise (L_{90}) was 71 dB (A).Although Maraba junction is a 4-way (roads) junction, while Challenge is a 3-way junction, the latter is much busier because it is the heart of commercial activities of the metropolis. There is also business activitiessuch as the market located at Challenge junction, which makes it very heavy on noise. Nevertheless, both junctions have very heavy traffic, especially on week days when residents are commuting to and from work, business, and

schools, among other activities. Noise level measurements at Maraba junction ranged between 60-94 dB(A) as shown in Figure 2.

In an attempt to guard against noise pollution problems, the World health organization, (WHO) has published guidelines for community noise indicating various sound levels, duration of exposure and corresponding critical health effects, as shown in Table 2. Likewise, many nations have come up with permissible noise standards to guide the citizenry. The US Federal Highway Administration, (FHWA) have also published an interim noise standards for various land uses as shown in Table 3.Results of the studies shows that noise levels at both Challenge and Maraba junctions are in violation of both the WHO guidelines for community noise (Table 2)and the FHWA standards for various land uses (Table 3).

Table 2: WHO guidelines for community noise (Dursun, et al. 2006)

Environment	Critical Health Effect	SoundLevel dB (A)	Time (h)
Outdoor living areas	Annoyance	50-55	16
Indoor dwellings	Speech Intelligibity	35	16
Bedrooms	Sleep disturbance	30	8
School classrooms	Disturbance of communication	35	During class
Industrial, commercial and traffic areas	Hearing impairment	70	24
Music through earphones	Hearing impairment	85	1
Ceremonies and entertainment	Hearing impairment	100	4

Table 3: FHWA Noise Standards (Dai, et al. 2015)

S/No	Land use	Noise level	Description of land use category
1	A	60dB (A) (Exterior limit)	For parks and open spaces
2	B	70dB (A) (Exterior limit)	Residential areas, Hotels, Schools, Hospitals, e.t.c.
3	C	75dB (A)	Developed areas
4	D	55dB (A) (Interior limit)	Residential area, Hotels Libraries

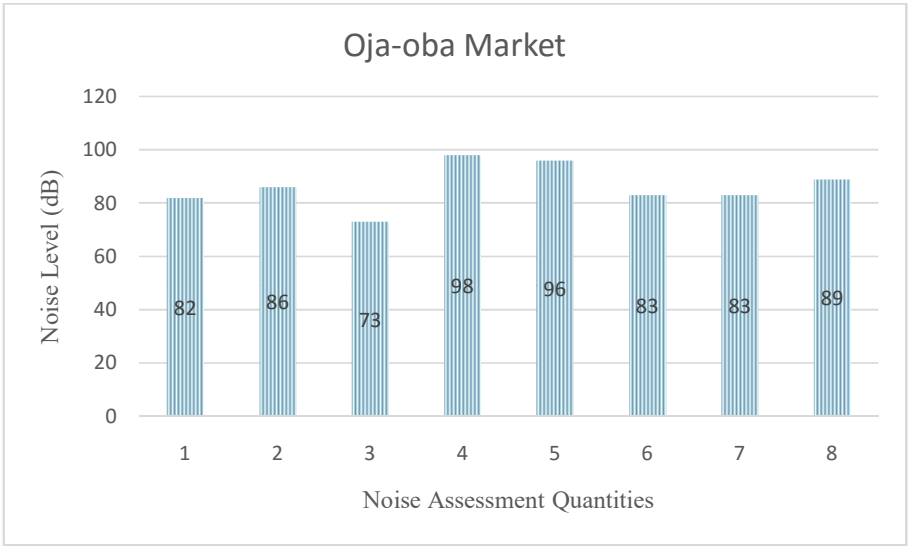

Figure 3: Noise assessment quantities measured at Oja-Oba Market

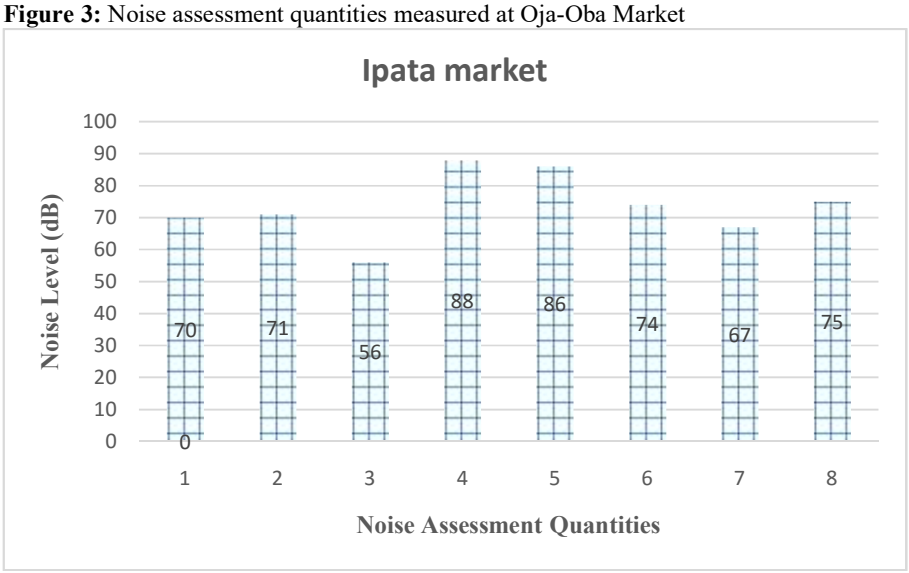

Figure 4: Noise assessment quantities measured at Ipata Market

Oja-Oba the largest market in the metropolis has the highest background noise L_{90} (73 dB A) as shown in Figure 3. This may be attributed to the size and degree of business activities it hosts. It also had the second highest values (i.e. after Challenge junction) for all other noise assessing quantities that were determined in the present study. The least values of parameters were recorded at the Ipatamarket, they ranged between 56-88 dB (A) as shown in Figure 4. This could be because it is not as busy as other locations. The market is smaller in size and business activities than the Oja-Oba. Ipata market is basically a wet market for the sale of meat primarily. Again the traffic noise index (TNI) and noise pollution (L_{NP}) especially, are in violation of the guidelines (Table 2) and standard (Table 3). Similar to the results of this study are the findings of Olayinka,(2013)that the major source of noise in Ilorin metropolis can be attributed to traffic noise while other intrusive sources of noise were from business activities.

The highest of the noise assessment quantities investigated is the traffic noise index, with a range of 88 - 120 dB (A) between the locations. These results shows that traffic contributes most to the noise pollution in the studied locations. Similar to these results are the findings of Oyedepo, (2012) who suggested noise mapping, technical, planning, behavioral, and educational solutions. In addition to the listed, the present study suggests the use of public transportation systems such as mass transits and shuttle buses to reduce the traffic movement along very busy routes. If and when there is provision of economical and affordable transportation, vehicle owners would be encouraged to park their vehicles in order to use the provision. Invariably, they would be saving on fuel and maintenance of personal vehicles. Others

indirectly connected to the use of public transportation include making tickets available for earlier purchase at the station offices and designated centres and provision of movement time schedule for monitoring of arrival and departures of mass transits and or buses. Provision of car parks at designated places, some distance away, for passengers who wish to park their vehicles to use the public transportation. Finally, to locate U-turns, bus-stops andcar parks away from the junction and market to decongest the already busy areas of heavy traffic.

4.0. CONCLUSION.

The areas studied were noise polluted, given by the noise levels measured by the noise assessment parameters of L_{Aeq}, L_{10}, L_{90}TNI, L_{NP} L_D L_N and $L_{DN.}$ Noise from traffic sourcescontributed most to the pollution. With regards to the WHO guidelines and FHWA standards, the possible effects of the level of noise pollution at the studied locations would range from annoyance to hearing impairment.

REFERENCES

Anomohanran, O., et al. (2008). "Investigation of environmental noise pollution level of Abraka in Delta State, Nigeria." Trends in applied sciences research**3**(4): 292-297.

Commission, N. P. (2006). "The Nigeria Population Census 2006." Accessed on**23**(2): 2011.

Essandoh, P. K. and F. A. Armah (2011). "Determination of Ambient Noise levels in the main commercial area of Cape Coast, Ghana." Research Journal of Environmental and Earth Sciences**3**(6): 637-644.

Dai, L., et al. (2015). "Traffic noise evaluation and analysis in residential areas of Regina." Journal of Environmental Informatics**5**(1): 17-25.

Dursun, S., et al. (2006). "Noise pollution and map of Konya city in Turkey." Journal of International Environmental Application & Science**1**(1): 63-72.

Georgiadou, E., et al. (2004). "Exploratory traffic noise measurements at five main streets of Thessaloniki, Greece." Global NestI International Journal**6**(1): 53-61.

Hu, A. (2017). Introduction: Entering the Green Industrial Revolution. China: Innovative Green Development, Springer**:** 1-13.

Ighoroje, A., et al. (2004). "Noise-induced hearing impairment as an occupational risk factor among Nigerian traders." Nigerian journal of physiological sciences**19**(1): 14-19.

Kang, J., et al. (2016). "Ten questions on the soundscapes of the built environment." Building and Environment**108**: 284-294.

Modi, M., et al. (2013). "A REVIEW ON THEORETICAL AIR POLLUTANTS DISPERSION MODELS." International Journal of Pharmaceutical, Chemical & Biological Sciences**3**(4).

Morillas, J. M. B., et al. (2015). "The temporal structure of pollution levels in developed cities." Science of The Total Environment**517**: 31-37.

Olayinka, O. S. (2013). "Effective noise control measures and sustainable development in Nigeria." World Journal of Environmental Engineering**1**(1): 5-15.

Olayinka, O. S. and S. A. Abdullahi (2010). "Comparative analysis of noise descriptors in some selected areas in Ilorin Metropolis, Nigeria." Noise Control Engineering Journal**58**(6): 646-657.

Ouis, D. (2001). "Annoyance from road traffic noise: a review." Journal of environmental psychology**21**(1): 101-120.

Oyedepo, S. O. (2012). "Environmental noise pollution in Ilorin metropolis, Nigeria." An International Quarterly Scientific Journal**11**(4): 553-567.

Ozer, S., et al. (2009). "Evaluation of noise pollution caused by vehicles in the city of Tokat, Turkey." Scientific Research and Essays**4**(11): 1205-1212.

Palamuleni, L. G. (2015). "A comparative land use-based analysis of noise pollution levels in selected urban centers of Nigeria." International journal of environmental research and public health**12**(10): 12225-12246.

Rahmat, A. and A. H. A. Hamid (2015). "Study of noise produced by construction activities in academic area." J Teknol**75**(5): 107-111.

Sharma, M. and V. Singh (2017). Unit-10 Man and Environment, IGNOU.

Singh, P. (2015). "DEVELOPMENT, GLOBALIZATION AND ENVIRONMENT: THE 21^ sup ST^ CENTURY DILEMMA." International Journal of Arts & Sciences**8**(3): 441.

Tijunelis, M. A., et al. (2005). "Noise in the ED." The American journal of emergency medicine**23**(3): 332-335.

Ugwuanyi, J., et al. (2004). "Assessment of environmental noise pollution in Markurdi Metropolis, Nigeria." Zuma Journal of Pure and Applied Sciences**6**(2): 134-138.

Yilmaz, H. and S. Ozer (2005). "Evaluation and analysis of environmental noise pollution in the city of Erzurum, Turkey." International Journal of Environment and Pollution**23**(4): 438-448.