AN ASSESSMENT OF NOISE POLLUTION IN SELECTED NEIGHBOURHOODS IN ENUGU METROPOLIS, NIGERIA

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Abstract

Noise is a neglected salient environmental pollutant in some neighborhoods in cities, increasing the risk to human safety and comfort. Noise meter instrument was used to collect data on sound levels in dBA in randomly selected high-density, medium-density and low-density neighbourhoods in Enugu metropolis, Nigeria on work days (Monday-Friday) during the morning hours (6:30-10 a.m.), after-noon hours (2.30-6 p.m.) and night hours (7-10 p.m.). T-test was used to make an inference. Results showed that the average sound level for two neighborhoods (Uwani and New Haven) is 62.8 (dBA), while that of Independence Layout and GRA is 50.3 (dBA). Comparing the results with WHO standards showed noise pollution in medium and high density areas, but not in low density areas.

Keywords: *Noise pollution, high-density neighborhoods, Enugu, Nigeria*

INTRODUCTION

Increasing economic activities has led to ever growing population in cities. These activities also generate noise that need to be measured and compared to WHO standards for noise pollution, which can be disturbing, irritating and can as well cause health related problems. Roberts (2018)

notes noise is one of the biggest pollutants and is linked to an increased risk of early death. Risk associated with noise has necessitated setting permissible limit to noise in different locations of the city, particularly residential neighborhoods, areas where majority of dwellers retire after the day's activities. Nonetheless, recent reports prove that there is rapid increase in sound level within residential neighborhoods either because of influx of population in commercial activities or increase in automobile use such as, electricity generating sets, indiscriminate use of public address system, poorly managed vehicular traffic, informal neighborhood markets, light industrial machines, religious worship centers, horns from motorists and trains, among others. Environmental noise pollution can affect hearing ability, nervous system, relaxation, sleep, comfort, ability to perform function, property value, per capital income, development, child development and sometimes death.

The World Health Organization (WHO) set the limit of noise pollution in residential neighborhood at 55 decibel. The United States Department for Housing and Urban Development (USA HUD) put its limit at 49 decibel. The limit for the European Union (EU) is 55 decibel. The United States Environmental Protection Authority (EPA) standard is 55 decibel. Nigerian extant laws lack the limit on noise pollution, and this makes control difficult. The relevant policies on noise pollution embedded in the National Environment Standards and Regulation Agency (Establishment) Act of 2007 are neither invoked nor applied, exposing humans to avoidable risk of safety and discomfort owing to noise pollution. The study aimed to determine the noise level in randomly selected residential neighborhoods of Enugu metropolis, and to compare them with the World Health (WHO) permissible limit (Oweri, 2019).

Residential neighborhood is an area where families reside, either permanently or for a considerable time. It is exclusively planned as a settlement area. The group includes children and youth, who are the future of tomorrow, women and men. It is an area where these youth and children are groomed. The societal behaviour is largely shaped or depends on the

environment they come from (Oweri, 2019).

LITERATURE REVIEW

An overview of noise pollution

People rather worry about pollution of water and ambient air than pay attention to noise pollution. Recently, however, scholars started investigating the significance of noise pollution to human health and the environment. Tens of millions of Americans suffer from health issues, such as, heart disease, disturbed sleep, increased blood pressure, hearing loss and more, because of noise exposure. Szkiller (2019) says that noise is an invisible pollutant that affect our breathing, brain wave and wellbeing. Most times, the noise may be instantaneous or continuous depending on the activity going on. Attempts to adapt to noise pollutants over a period of time often leads to health imbalance and discomfort in the environment.

The National Geographics (2019) asserts that noise pollution does not only affect humans, but also wildlife. Loud noise causes caterpillar's heart to beat faster and also influence blue birds to have fewer chicks. Noise pollution poses dangers to animals that use sound in achieving their routine tasks, such as navigating to attract mates, find food and escape from danger. This leads to loss of communication, resulting in starvation and possible death. Besides wildlife and humans, noise pollution also affects aquatic life. The increase in maritime activities like noise from ship, oil drilling, sonar facilities and seismic test has made aquatic environment noisy. Aquatic animals not limited to whales and dolphins rely mostly on echolocation for communication, mating, feeding among others. Noise in the aquatic environment stand the chances of jeopardizing the animals ability to echolocate effectively, causing its population reduction or extinction.

The ancient philosophers of Rome and Greek regarded noise as a serious distraction, one that challenged their ability to concentrate. Many health impact of noise is normally gradual, unnoticed and consistently

penetrating and damaging recipients' cells. Some neighborhood noise is instantaneous, such as train and motorist horn. Another is alarm bell from churches and mosques.

Harding et al (2013) reported that day-time noise exposure beyond WHO recommended limit influences the prevalence of unusual high blood pressure, heart disease, stroke, dementia (i.e. vascular dementia), Alzheimer's disease and related health problems among United Kingdom population. Exposure to noise pollution above the level recommended by WHO led to additional 542 cases of heart attack, 788 cases of stroke and 1169 cases of dementia. They used quality adjusted life year (QAIYs) to estimate the cost of these health impacts. The study concludes that these health impacts together have a cost.

Flamm et al (2012) worked on individual's noise exposures and observed that a substantial fraction of Unite States of America adults may be exposed to noise levels above the USA EPA 70 DBALEQ(24) limit. Neitzed et al (2012) sampled over 4,500 adults in New York City and opine that 9 of 10 individuals exceeded the recommended USA EPA limit.

Godwin (2018) submits that there is something about noise that make a person angry. Noise accelerates the grumpification process. It is a pollutant with well-established effects on multiple aspects of physical and mental health, from cardiovascular disease to depression. Noise exposure is associated with cognitive impairment and behavioral issues in children, in additions to sleep disturbance and hearing damage. European Environment Agency (EEA) link 10,000 premature deaths and 900,000 cases of hypertension yearly to noise in Europe.

Study Area

Geographical location

Enugu metropolis, the study area, is the capital of Enugu State, which was created in 1991 from the old Anambra State of the Southeast Nigeria. Enugu metropolis lies below Udi plateau which rises more than 1,000 feet (300m) (Encyclopedia Britannica, 2019). The area is mostly

covered by building structures with occasional wood and grass land as a result of development. The town is also known as coal city because of coal deposit in the area. Figure 11.4.1 is the map of Enugu Urban showing the study area.

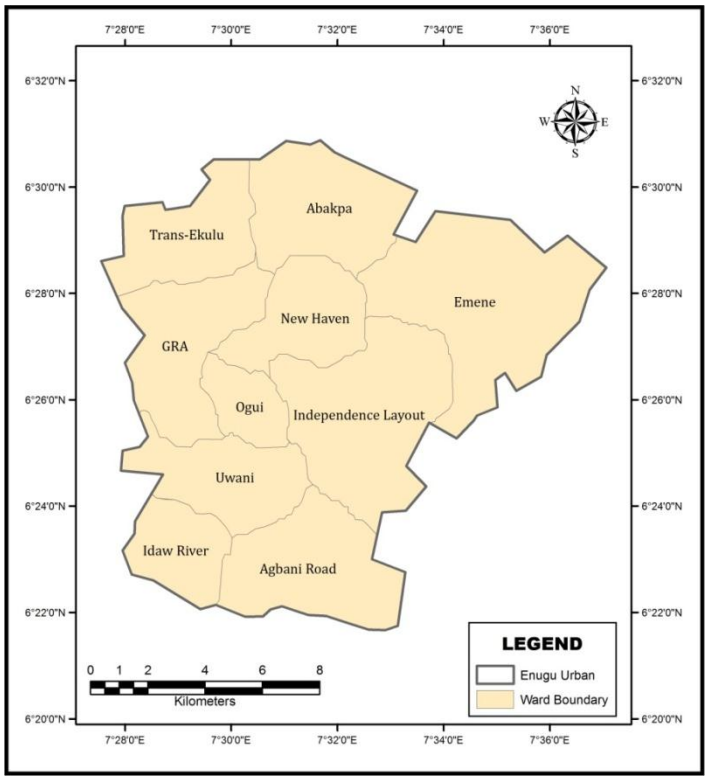

Figure 11.4.1: Map of Enugu Urban
Source: Ministry of Environment (2019)

Climate of the Area

The average whether condition of Enugu is the same as it is found

in other States in the Southeast Nigeria. It is characterised by two seasons, raining season and dry season. Rainy season starts in April and ends November. While the dry season takes over from November with its harmatan period in January, and ends in March. Though there are variations occasioned by climate change caused mostly by human unsustainable use of the natural resources.

The area has a temperature that is normally unstable but revolves round a room temperature of 27^{o}c in the two seasons. The hottest month of February has a temperature of about 87.16 of (30.64 ^{o}C), while the coolest month of November has temperature of about 60.54 of (15.80 ^{o}C)

Population

Enugu metropolis is estimated to have a total population of 222,664 approximately, going by 2006 population census. Table 11.4.1 is the population chart, from 1950-2035.

Road network

Road network in Enugu urban consists of major arterial, minor arterial and collector routes and streets. The major arterial road comes from Agbani Road, through Coal Camp, Okpara Avenue and down to Abakaliki Road, crossing Markurdi-Onitsha-Portharcourt by-pass to Abakaliki, Ebonyi State. Minor roads can be classified as roads from Zik Avenue, Kenyatta, Ogui New Layout, Presidential Road, New Haven junction and Ogui Road, while collector routes or feeder routes include streets in Uwani, Independence Layout, G.R.A, New Haven, Ogbete and Coal Camp road. Efobi and Anierobi (2014) observe that from the total road network in Enugu metropolis, 97.5km (68%) are of local character, while 20km (14%) are collector routes and 26.4 (18%) from the arterial road system consisting of 17.5km and 9km for minor and major arterial roads respectively.

All the major and minor roads in Enugu metropolis are of asphalt pavement, while some feeder or collect streets are paved and the rest unpaved. The paved roads have width that varies from 14.3 to 7.3 meters with laterite base course and black top that consists of prime coat, though

most of the local roads have no surface dressing at all (Enugu State Ministry of Transport 2012).

Table 11.4.1: Population of Enugu Metropolis

1950 – 60,000	1951–61,000	1952–62,000	1953–64,000	1954– 68,000
1955 – 72,000	1956–75,000	1957–80,000	1958–84,000	1959– 89,000
1960 – 93,000	1961 –98,000	1962–104,000	1963–110,000	1964–116,000
1965 – 112,000	1966–128,000	1967–136,000	1968–143,000	1969–151,000
1970 – 159,000	1971–166,000	1972–173,000	1973–180,000	1974– 187,000
1975 – 195,000	1976–204,000	1979–212,000	1978– 221,000	1979– 230,000
1980 – 240,000	1981–250,000	1982–104,000	1983–272,000	1984–283,000
1985 – 259,000	1986–308,000	1987–321,000	1988–334,000	1989– 378,000
1990 – 363,000	1991–372,000	1992–382,000	1993– 391,000	1994– 401,000
1995 – 412,000	1996–422,000	1997–433,000	1998–444,000	1999–455,000
2000 – 461,000	2001–479,000	2002–491,000	2003–503,000	2004– 516,000
2005 – 529,000	2006–543,000	2007–559,000	2008– 591,000	2009– 585,000
2010 – 600,000	2011- 615000	2012 -631,000	2013- 617,000	2014- 663,000
2015- 680,000	2016- 697,000	2017- 715,000	2018- 733,000	2019- 752,000
Enugu Urban	Area populatio	Projection		
2020- 773,000	2021- 797,000	2022- 820,000	2023- 847,000	2024- 876,000
2025- 907,000	2026- 940,000	2027- 974,000	2028- 1010,000	2029- 104,7000
2030- 108,5000	2031-1124000	2032 1164000	2033- 1204,000	2034- 1245,000
2035- 1286,000				

Source: Population Statistics (World Statistical Data) 2016.

There are two major means of transportation in this area, namely

public and private buses and cars. The volume of traffic is usually low before 7.30 a.m. From 7.30-10.30 a.m., it is usually very high because people leave for their various places of work, while students and children leave for school. At such periods, automobile noise is very high, causing discomfort and stress to both the road users and inhabitants of such neighborhood. The situation tends to reduce gradually from 10.30 a.m. to 12 noon.

By 2.30 p.m., the hours of school run, traffic starts to pick again and gets its peaks at about 4pm when people are retiring after the day's job. At such time, traffic with its attendant noise is heavy on roads like Zik Avenue, Agbani Road, Ogui, New Layout, New Haven, Independence Layout, Abakaliki Road among other.

Power supply

Electricity power distribution by the Enugu Electricity Distribution Company (EEDC) in Enugu metropolis is just like the company's normal disable system of power supply. Disable in the sense that their usual light-out lasts longer than 18 hours in every 24 hours. Awosope (2014) states that the current status of electricity generation in Nigeria with regard to its population is grossly inadequate. Not minding that he did not separate the various divisions along the chain of electricity supply in Nigeria. The challenge has been in existence since 1970s when the Udoji federal government award improved the economic life of the workers. According to Mohammed (2011), workers increased their electricity consumption by purchasing several sophiscated and automating machines that consumed quite a lot of energy. The power utility company, on the other hand, was not prepared for this increase in consumption. This challenge has consistently left a deficit in consumption and generated electricity problem ever since that period in the Nigeria electricity consumption history. This has led to consistence imbalance in the demand and supply of electricity. This existing situation in Enugu urban made the residents resort to using generating set in different capacity to power and light the area, an outcome that contributes to the increase in noise pollution in the area.

METHODOLOGY

Primary data were obtained by measuring the sound levels in selected locations in residential neighborhoods with noise meter and comparing them with World Health Organization (WHO) permissible limits. Sound measurement periods were early morning (6.30-10 a.m.), afternoon (2.30-6 p.m. and evening 7-10 p.m. for a period of five working days (Monday to Friday). Weekend (Saturday and Sunday) was excluded.

At 6.30 a.m., noise meter was taken to the field to measure sound level at five sample points. At each point, 30 minutes was spent, in collecting both the minimum and maximum sound level. The first 15 minutes was for the minimum and the second 15 minutes for the maximum sound level. Both are recorded in the field book. The procedure was repeated in the afternoon from 2.30 to 6 p.m. and in the night from 7-10 p.m. The process was adopted the second and the rest of the working days in the week. Weekend was not included because public servants, civil servants, students, their teachers and other workers are at home. The daily figures are recorded in a tabular form in such a way that the average noise can be calculated for each neighborhood.

Questionnaire instrument was used to generate data that determined the noise discomfort on the residents. T-test satirical tool was used in analyzing the data for inference.

DATA PRESENTATION, ANALYSIS AND DISCUSSION

Data presentation

Table 11.4.2: Uwani neighborhood per day dBA

1		Average Noise in Ibiam	60.3
2		Average Noise in Amokwe	58.9
3		Average Noise in Osadebe	61.4
4		Average Noise in Ohafia	61.11
5		Average Noise in Nise	64.8
Total		Average in the area	61.3

Source: Field work 2019

Table 11.4.2 presents the result of average noise per day in the sample points in Uwani neighborhood. The average noise in Ibiam Street which covers Anyaegbunam, Awolowo, Zik Avenue by Edinburgh round-about is 60.3 dBA. The average noise in Amokwe Street which covers Amaigbo Lane and Zik Avenue by Edozie junction is 58.9 dBA. The average noise in Osadebe which covers College Road, New Layout and Kenyatta junction is 61.4 dBA. The average noise in Ohafia which covers Awkunanaw Street, Bishop Okoye and Zik Avenue by Obioma bus stop is 61.1 dBA. The average noise around Nise bus stop by Agbani Road junction and Zik Avenue junction by Depot bus/stop is 64.8 dBA. The study also shows the overall average noise in Uwani neighborhood is 61.3 dBA. The figure is above the stipulated World Health Organization (WHO) noise level, allowed in residential areas.

The Department of Housing Urban Development (HUD) recommends 49 dBA as clearly acceptable, 65 dBA could be regarded as tolerable, but not 75 dBA, which is clearly unacceptable. But in Japan 50 (dB) is allowed in residential neighbourhood, while India, set it limit at 55 dBA. In Nigeria contest, there is no established noise limit allowed in residential areas. That is why Oyedepo (2012) affirms that there is no legal frame work by which noise can be abated in Nigeria.

Table 11.4.3: New Haven Neighborhood per day dBA

1	Average Noise in Uduma	64.8
2	Average Noise in Nnaji Park	65.3
3	Average Noise in Nanka	64.3
4	Average Noise in Marcus Garvey	63.4
5	Average in the Mbanefo	64.4
Total	Average in the area	64.4

Table 11.4.3 presents the result of average daily noise at sample points in new haven. From the table, the average noise in Uduma is 64.8 dBA. In Nanka, the average noise there is 64.3 dBA and Marcus Garvey Street is 63.4 dBA while that of Mbanefo Street is 64.4 dBA. The overall average noise level in the area is 64.4 dBA.

Table 11.4.4: GRA neighborhood per day dBA

1	Average Noise in Cattemach	54.5
2	Average Noise in Ekulu Avenue	64.6
3	Average Noise in Ota	46.2
4	Average Noise in Barr. Victor Uzo	59.3
5	Average in the Abakaliki Ave.	48.0
Total	Average in the area	54.4

Table 11.4.4 represents the average noise recorded in GRA. In Cattemach Street, the average noise is 54.5 dBA. In Ekulu Avenue, it is 64.6 dBA. In Ota Street, it is 46.2 dBA. In Barr. Victor Uzo Street, it is 59.3 dBA, and in Abakaliki Avenue, it is 48.0 dBA. The overall average noise in the area is 54.4 dBA.

Table 11.4.5: Independent Layout per day dBA

1	Average Noise in Ozubullu	48.7
2	Average Noise in Nwachukwu Anabogu Crescent	34.6
3	Average Noise in Oboro Street	41.6
4	Average Noise in ESBS	59.5
5	Average in the Isiuzo street	46.3
Total	Average in the area	46.1

Table 11.4.5 presents the average noise level in Independent Layout. Average noise in Ozubullu Street is 48.7 dBA, Nwachukwu Anabogu Crescent is 34.6 dBA, Oboro Street is 41.6 dBA, ESBS Junction is 59.5 dBA and Isiuzo Street is 46.3 dBA. The average noise level in the area per

day is 46.1 dBA.

Data analysis

T-test shows .001 level of significance less than the < P-value at 95% confidence level. The study rejects the hypothesis that there is no difference between sound level and WHO standard, and concludes that there was a difference between sound level in the neighborhoods and WHO standard for noise.

Discussion

There is noise pollution in two out of the four residential neighborhoods. Uwani (high-density area) has an average noise level of 61.3 dBA, which was majorly generated by traffic. The traffic noise was observed in the field to have started when dwellers in the residents started moving to their different destinations for work, school and business which gain momentum from 7 a.m. The same situation is applicable to New Haven, which represents a medium density area with 64.4 dBA.

Common to the two neighbourhoods was noise generation agent - population movement by means of buses and cars of different sizes. The noise continues to grow in intensity as long as vehicular movement and population surge increase. From the meter record, the noise level starts to reduce when the roads and junctions became free of peoples' congestion - an indication that vehicles and population are already in their destinations. Increase in noise situation lasted for three and half hours, when other noise factors like panel beating work, grinding machine, mobile and static loud speakers for adverts, market activities and light industrial machines, electricity generator set take over the environment.

In the afternoon, from 2.30 p.m., when schools dismiss, the population surge starts to build again leading to a commensurate increase in noise level to 64.4 dBA. This movement continued till 6 p.m. at the closure of major markets and other businesses in the city of Enugu. The noise level remains the same until 10 p.m. when majority of people went to bed. The study did not go further to measure midnight (12 midnight to 3

a.m.) sound level. However, observation showed that many residents put on their electricity generators all through the night. In this regard, there was an existence of turn-around noise in Uwani and New Haven, which can be described as circular noise.

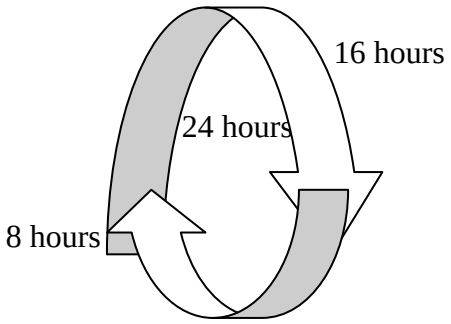

Figure 11.4.2: Noise pollution measurement in Uwani and New Haven

Figure 11.4.2 illustrates noise pollution measurement in Uwani and New Haven. Of the 24 hours in a day, noise pollution takes over 16 hours in the neighborhoods, leaving only 8 hours for sleep. This tells on the 7-hour minimum required time for sleep for regaining of strength. This helpless situation eats deep unnoticeably into the desired comfort and safety of the dwellers in both neighborhoods. Godwin (2018) reports that noise pollution kills thousands each year. Noise effects on humans include heart disease and type 2 diabetes. At least one million healthy life-years are lost every year in Western European countries because of environmental noise.

In Independence Layout and GRA neighborhoods (low-density areas) has an average noise level of 54.4 dBA; 54.4 dBA for GRA and 46.1 dBA for Independence Layout. Thus, the level of noise generated in these neighbourhoods is below WHO permissible limit of 55 dBA and within HUD allowed limit of 49 dBA. Thus, there is noise pollution in medium and high density area in Enugu Metropolis.

High impact sound usually influences an affected individual to

speak in a chaotic manner. Also, noise pollution or high impact sound is associated with various health problems.

RECOMMENDATIONS AND CONCLUSIONS

Recommendations

Noise pollution is an enemy and killer of man that lives among the population, but not easily identified. At least one million healthy life-year is lost every year in Western Europe because of noise pollution. In Nigeria and other developing countries, noise is not considered an agent of ill-health and death, an attitude that made Nigeria leadership not to adequately consider regulating high sound level. There is no legislation on sound level control threshold in Nigeria. Based on this, the study recommends that state and local governments should enshrine noise pollution abatement in their legislations or laws. In this law, a permissible limit of noise level required in residential, commercial and industrial areas should be stipulated. Just like World Health Organization (WHO) 55 dBA, Environmental Protection Agency (EPA) at 55 dBA, Department of Ubran and housing development (HUD) 49 dBA, among others. There should be legislation prohibiting the development of residential houses along major roads in the study areas.

It is also recommended that sound-proof doors be used to replace the current types of doors. Sound-proof walls made of clay or red earth should be used to build sound-proof fence along major roads.

Conclusion

This study has shown that there are noise pollution in Uwani and New Haven neighborhoods with a considerable growth in GRA and Independence Layout. Therefore, it is important and beneficial that children, youths, women and men, who are vulnerable, need protection from noise pollution.

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Appendix

Supplementary data to this article can be found online at the Website (shdevr.org) of an international multidisciplinary academic research journal, *Sustainable Human Development Review.*