



Neighbourhood Spatial Pattern and Noise Disturbance in Benin City, Nigeria

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Noise has an environmental challenge is increasing due to urbanization, industrialization and modernization. While residential noise pollution could have adverse effect on health and social wellbeing, little attention has been directed towards investigating the implications of spatial pattern of neighbourhood facilities on noise pollution in Nigeria. This study assessed how noise disturbance is related to spatial pattern within two neighbourhoods in Benin City, Nigeria. Structured questionnaires were used to elicit information from residents on demographics and neighbourhood characteristics while residential land-mix was observed through street mapping. Sixty-six participants were randomly selected from Government Reserved Area (GRA) and Ogbé quarters of Benin City. Result showed that the neighbourhood facilities which host commercial, transportation and industrial activities were the closest to the dwelling units while natural vegetation was the farthest. Also there was spatial variation in distribution of neighbourhood features especially the commercial and recreational areas which affects the noise exposure level. The study concludes that it is necessary to mitigate noise within residential neighbourhoods through proper land use and zoning strategies.

Keywords: Residential areas; neighbourhood; noise pollution; land use.

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1. INTRODUCTION

Noise pollution has been well-recognized as one of the major challenge affecting quality of life in urban areas worldwide. With the rapid development of urban areas, the noise pollution has become increasingly serious [1]. A large body of studies show that noise causes non-auditory stress effects such as changes in the physiological systems (such as elevated blood pressure), various cognitive deficits (such as poor sustained attention, memory/concentration problems), sleep disturbances, changes of social behaviour, psychosocial stress-related symptoms, and emotional/motivational effects (such as annoyance, learned helplessness) [2,3,4,5].

To meet a long-term sustainable and healthy living in urban residential environment, it is essential to strive for lower sound levels at the residencies by ensuring “noise-free” places or more quiet neighbourhoods. In this regard, most developed nations have taken actions to control noise effects as evident in the various anti-noise laws, regulations and noise policies [5,6]. Conversely, such action has received lesser attention in the developing countries, especially in Nigeria. While issues such as solid and liquid wastes disposal, flood prevention and fire hazards have received their fair share of attention in literature comparatively, noise as an environmental concern has not been highly addressed [7].

Nigeria is currently undergoing an unprecedented urbanization and pollution growth which is expected to increase noise level in urban environment. However, there are poor strategic actions towards noise abatement in neighbourhoods in Nigeria. Although, the Federal Environmental Protection Agency (FEPA) in Nigeria provided daily noise exposure limits for various urban zones [8]. Yet, the citizenry seems not conscious of these guidelines, and perhaps are also ignorant of the health hazards associated with noise within residential environments. More importantly, systematic studies aimed at characterizing residential facilities and highlighting noise effects on the residents’ remains very scarce in Nigeria [9,7].

This study focuses on evaluating the implications of neighborhood’s spatial configuration on noise pollution in residential neighbourhood in Benin City, Edo State, Nigeria. Benin City was chosen as the study area since the city is one of the

mega cities in Nigeria. More so, the noise situation in Benin metropolis is similar to what is obtainable in many urban areas in Nigeria. The city is relatively large with rapid increase in population rate and has expanded continuously in all directions in the past two decades. Many significant changes in terms of urbanization, industrialization, expansion of road-network, and infrastructure have been experienced. Owing to rising population growth and expansion of economic activities in Nigeria, residential areas have been subjected to increasing road traffic and diverse noise-prone activities. Till date, research towards understanding the implication neighbourhood spatial patterns on noise disturbance remains scarce in Nigeria. Therefore, this study assessed the situation in two neighbourhoods in Benin City. This is with the view to increasing understanding on noise-prone facilities which are important in neighbourhood planning and provide strategic outline for better planning.

2. EMPIRICAL STUDIES OVERVIEW

The distribution of noise pollution in urban areas is related to various parameters which make up the urban fabric, such as density, open spaces, the shape and physical position of buildings, traffic situation, and population distribution etc. [10,1]. Research evidence on noise pollution in urban areas affirms that relationship exist between land use, pattern of activities and noise disturbance. For instance, Mehdi et al. [11] examined the spatial patterns in relation to traffic noise in Karachi City, Pakistan, and found that noise level during mornings and evenings were higher due to commuting pattern of Karachi residents. Banihani and Jadaan [12] in Amman, Jordan conducted a social survey to evaluate the perceived noise impacts of road traffic noise on residents. The results of the survey revealed that road traffic noise was a major concern for the communities living in the vicinity of streets.

Abolade and Adebeyejo [13] explore the contributions of urban informal enterprises to noise pollution in Ibadan, Nigeria. The varying level of noise was observed in fifty-two (52) locations across the selected four LGAs in Ibadan. It was found that the noise levels which ranges between 73.63 dB and 77.95 dB breach the sleep disturbance limits of 45 dB as set by WHO and the World Bank’s limit of 55 dB. Another study by Oloruntoba et al. [14] investigated the sources and noise levels, and possible impacts in selected residential

neighbourhoods of Ibadan metropolis, Nigeria. The outcome showed that noise levels, sources and the period the noise level reaches its peak vary with population density. Across the three residential neighbourhood considered, mean noise values of 53.10 ± 2.80 dB was observed for low density (LD), 68.45 ± 2.10 dB for medium density (MD), and 68.36 ± 1.92 dB for high density (HD), in essence, the medium density areas had the highest mean value. Only 16 (23.2%) locations in the three residential neighbourhood groups had noise values that were within WHO 16-hour Daily Noise Level criteria of 55 dB, recommended limit for residential areas.

Specifically, studies [1,11,15] observed that relationship exists between land use and noise pollution. Non-traffic parameters, such as land use type and pattern as well as physical distance from a given source, plays an important role in assessing noise level [16,5,17]. Gunnarsson and O' hrstro'm [5] examine whether perceived availability to nearby green areas affects various aspects of well-being in two noise-condition groups. The results show that "better" availability to nearby green areas is important for their well-being and daily behaviour by reducing long-term noise annoyances and prevalence of stress-related psychosocial symptoms, and by increasing the use of spaces outdoors.

Efforts toward noise abatement are currently being directed at finding solution in urban land use. Abbaspour et al. [1] study addressed the fact that sound level is not the only parameter to indicate the extent of noise pollution and that the situation of urban land uses, distribution of population centers and types of passages can profoundly suggest the possibility of noise disturbance although not with a similar proportion. Abbaspour et al. [10] used Analytical Hierarchy Process (AHP) to define noise prone areas based on different factors in relation to land use within Tehran Metropolitan City. The portion of each criterion in noise pollution intensity was determined using AHP, thereafter, the map layers were overlaid based upon the relative importance of the criteria to get the final map on which the noise prone areas are specified. Aguilera et al. [18] developed land use regression models for noise predictions for European cities. Suárez and Barros [19] conducted noise mapping across Santiago, a city of nearly six million inhabitants. In essence, these findings suggest that noise disturbances are somewhat related the pattern of land use or proximity of neighbourhood facilities to dwelling

units. A series of reports on residential noise prediction of national scope have been published, but limited in detailed information and its application on city planning and the land use condition. Hence, this study analyzes the impact of land use on noise level within residential environment in Benin City, Nigeria.

3. RESEARCH METHOD

3.1 The Study Area

Benin City is located at latitude $06^{\circ}19'E$ to $6^{\circ}21'E$ and longitude $5^{\circ}34'E$ to $5^{\circ}44'E$ with an average elevation of 77.8 m above sea-level. Benin City is a pre-colonial city, the capital of defunct Bendel State and the present day Edo State. The city is located in the humid tropical rainforest belt of Nigeria with a population of 762,717 according to the 1991 national population census with a projected population of 1.3 million by 2010 at 2.9% growth rate. The population of Benin was 1,495,800 by 2015, which is about 0.821% of Nigeria's population. It is expected that the population would reach 1,617,579 by 2017 at 3.99% annual growth rate [20]. The rainy season starts in March/April and ends in October/November.

Apart from demographic growth, Benin City has witnessed, rapid territorial expansion mainly due to rapid rural-urban migration. The desire to own private properties, have made private property developers to erect structures in different parts of the city and often without strict adherence to town planning regulations. This study is focused on evaluating of noise pollution in residential neighbourhood in Benin City, Edo State, Nigeria. This study includes only two that were selected purposively. The choice of these locations was premised on differences in neighbourhood characteristics and activities. Two urban neighbourhoods that have been selected for the purpose of the research are: a) Government Residential Area, Benin City (GRA) and b) OGBE Residential Quarters (ORQ), Benin City.

Government Residential Area, Benin City (GRA) represents a planned urban neighbourhood in the Benin, Edo State. It is one of the 12 land pooling development schemes introduced and developed to date by the government through the initiatives of Edo state Development Committee (EDC). GRA quarters is situated at the central area of Benin City district and lies just within the northern segment of Ring Road in Benin adjoining facilities such as Government house,

Hotel, Benin Club and Forces headquarters. The residents of the GRA are composed of mixed ethnic groups.

Ogbe Residential Quarters has been chosen in this study as a representative case of an unplanned development of new neighbourhoods in the Benin. It is a residential neighbourhood located in an inner city core area of Benin City with a development history of more than 30 years. Some of the adjoining facilities include the Ogbe stadium, Oba's Palace, shopping centers,

office amongst others. The relatively longer period of development history was one of the main reasons for its choice. The growth of the Ogbe has been spontaneous, resulting in the haphazard growth and urban sprawl. Consequently, public spaces are virtually non-existent in the Ogbe, except for on the streets. There is no presence of physical elements or structures of public interest, except for a number of smaller complexes. The demographic profile of the residents indicates a mixed ethnic composition.

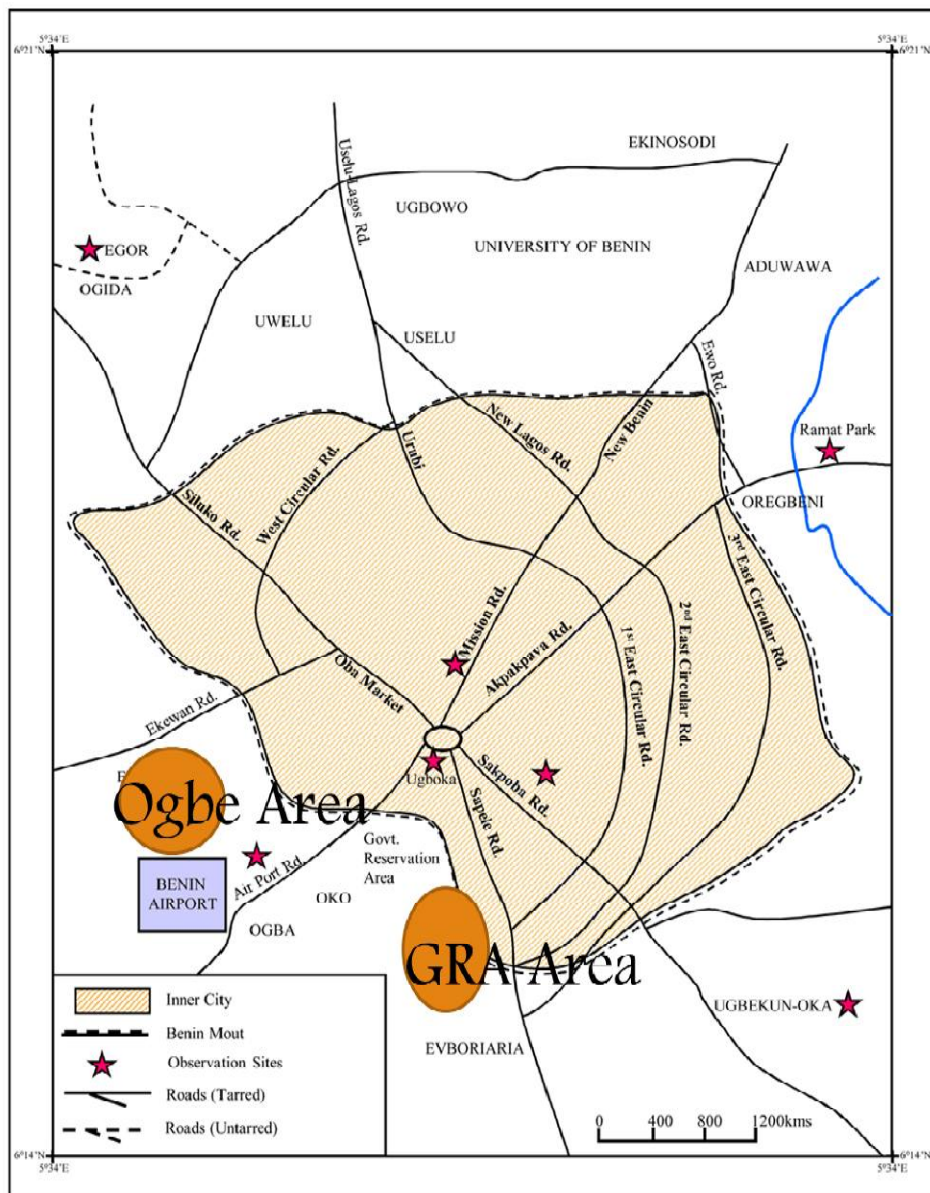


Fig. 1. Map of Benin City showing the major Neighbourhoods (Source: [21])

3.2 The Research Design

A cross-sectional survey was used which involved questionnaire administration while the population for the study consisted of the male and female inhabitants with ages from 18 years upwards. Sixty-six (66) participants were randomly selected from Government Reserved Area (GRA) and Ogbe quarters of Benin City. The neighbourhood characteristics and perceptions of the respondents on the proximity of noise-prone facilities were collected using structured questionnaires while street mapping (walk-through approach) was used in determining the land-use pattern. Data collected were analyzed using Statistical Package for Social Sciences (SPSS) version 20 at 5% level of significance.

Mann Whitney U Test was used to compare the overall means in the spatial distribution of neighbourhood facilities in the two locations, It is specified as:

$$U = n_1n_2 + \frac{n_1(n_1+1)}{2} - R_1 \quad (1)$$

$$E(U) = \mu_U = \frac{n_1n_2}{2} \quad (2)$$

$$Var(U) = \sigma_U^2 = \frac{n_1n_2(n_1 + n_2 + 1)}{12} \quad (3)$$

$$Z = \frac{U - \mu_U}{\sigma_U} \quad (4)$$

where n_1 = sample size for GRA; n_2 = the sample for OGBE; R_1 = the sum of the ranks of the GRA sample, σ_U^2 = the variance of the Mann-Whitney U, and μ_U = the mean of the Mann Whitney U.

In addition, a Sound Level Meter was used to measure the noise in Six (6) selected locations in the 2 residential neighbourhoods. The measurement was taken three-time period in a day across the selected sampling points. The measurements were made at street level based on access to the neighbourhood (outer street, Median Street and the inner street). The instrument was held comfortably in hand with the microphone pointed at the suspected noise source at a distance not less than 1 m away from

any reflecting object. The result is presented in Fig. 2.

4. RESULTS AND DISCUSSION

4.1 The Characteristics of the Respondents

The characteristics of the respondents as indicated in Table 1 showed that majority of the participants were male (59.1%) whereas about 40.9% were female. Over a quarter of the respondents (49.2%) were between ages 21-30 years, about 21.5% were between 31-40 years, 18.5% were between 41-50 years, 9.2% were between 51-60 years while only 1.5% was above 60 years of age. This result suggests that most of the respondents were within their active and productive ages.

Also half of the respondents (50.0%) were single, while about 48.5% were married. As for the educational status of the respondents, majority were literate as over half (59.1%) had tertiary education, while very few (7.6%) of them had no formal education. Furthermore, the occupational status of the respondents varied with a greater proportion (47.1%) in the private sector, about 26.2% owned their business whereas 1.5% was in the public employments.

The result on the average income of the respondents shows that 26.6% of respondents earned less than 18,000 naira monthly, about a quarter (37.5%) earned between 18,000 and 50,000 naira monthly, with only a few in earned above 200,000 naira. The duration of tenure was also examined, the result shows that about 27.3% of respondents have stayed less than 5 years in the neighbourhoods, and about 7.6% of them stayed above 20 years. The social-economic characteristics of the participants show that their response can provide information needed on the noise pollution level and the periods of noise experience in the neighbourhoods.

4.2 Intensity of Noise Level

Fig. 2 shows all reading obtained which indicates a general increase in noise meter reading on Friday and a significant reduction in the readings on Sunday. The chart also shows that most reading exceeded the EPA standard of 55 dBA for residential neighbourhoods. The Maximum value obtained was 88.3 for Ogbe 1 whereas the Minimum value was 50.3 for GRA 2.

Table 1. Percentage distribution of respondents by socioeconomic characteristics

Variables	Categories	GRA	OGBE	Total
Gender	Male	33.3	25.8	59.1
	Female	19.7	21.2	40.9
Age	21-30	27.7	21.5	49.2
	31-40	10.8	10.8	21.5
	41-50	9.2	9.2	18.5
	51-60	3.1	6.2	9.2
	Above 60	1.5	0.0	1.5
Martial	Single	30.3	19.7	50.0
	Married	21.2	27.3	48.5
	Others	1.5	0.0	1.5
Education	No education	0.0	7.6	7.6
	Primary school	1.5	0.0	1.5
	Secondary school	19.7	12.1	31.8
	Tertiary school	31.8	27.3	59.1
Occupation	Trader	1.5	12.3	13.8
	Civil servants	7.7	3.1	10.8
	Private sector	30.8	16.9	47.7
	Own Business	10.8	15.4	26.2
	Others	1.5	0.0	1.5
	Income	< 18,000	23.4	3.1
	18- 50,000	14.1	23.4	37.5
	51- 100,000	4.7	21.9	26.6
	101-200,000	7.8	0.0	7.8
	Above 200,000	1.5	0.0	1.5
Duration of Stay	1-5 years	25.8	1.5	27.3
	6-10 years	12.1	13.6	25.8
	11-15 years	4.5	21.2	25.8
	16-20 years	6.1	7.6	13.6
	Above 20	4.5	3.0	7.6

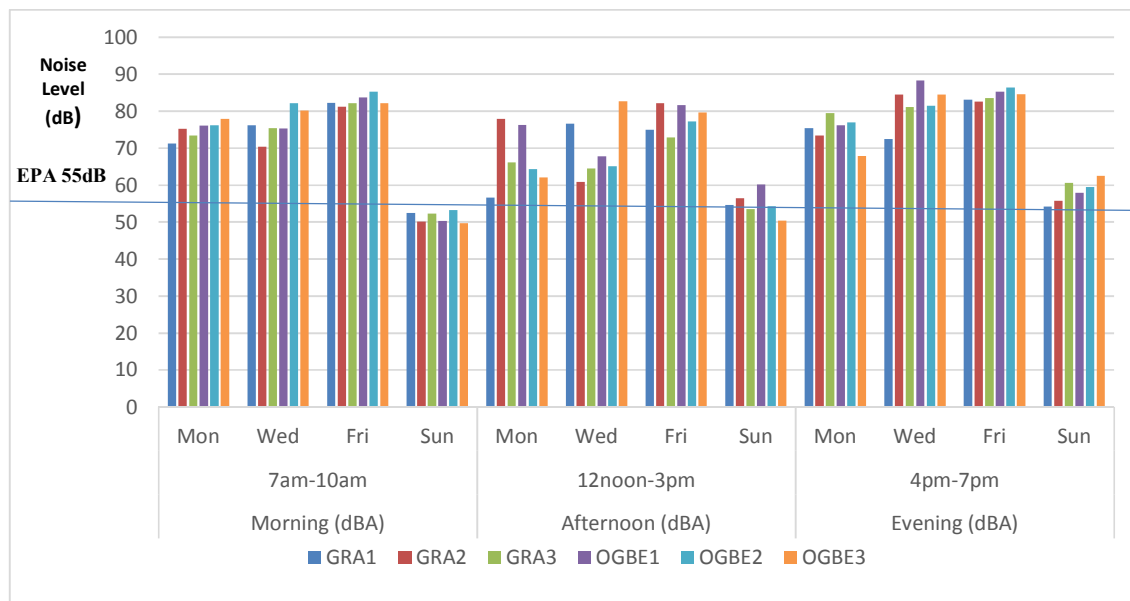


Fig. 2. Noise levels for one week across the two locations

4.3 Spatial Pattern of Neighbourhood Facilities

The spatial configuration of the neighbourhoods was measured by determining the proximity of dwelling units to other neighbourhood facilities. The mean rank values result (Table 2) indicates that across the two locations, the recreational area (38.8) were the closest to residential units within GRA, however, this situation was difference in OGBE where recreational areas (26.6) were farther away from the dwelling areas. Evidently, this suggests that the GRA was planned to accommodate recreational facilities. Also, commercial facilities (e.g. shops and markets) were closer to the residential unit in OGBE but farther from GRA (26.8). This indicates that more commercial activities were prevalent in OGBE residential quarters. In general, the results suggest that facilities which host the commercial activities were the closest to dwelling units. In essence, to control the noise exposure level, certain infrastructural factors such as economic enterprise, transportation, and industrial expansion must be well configured.

Furthermore, the results indicate that natural vegetation which supposed to be the buffer zones are the farthest from the dwelling units in GRA (25.2) and OGBE (28.9). Vegetation being the least in proximity to residential areas among

other features suggests more urban expansion is giving away green spaces in the neighbourhoods. This can have an adverse effect on dwellers as green vegetation can serve as a veritable noise barrier [5]. Policy direction as to strategies to enhance vegetation growth is essential in controlling noise.

4.4 Difference in Spatial Pattern of Neighbourhood Facilities

To determine if significant variation exist in the spatial distribution of the neighbourhood facilities in the two locations, a Mann-Whitney Test was conducted. This test was conducted because the data size is not largely distributed and thus not suitable for a t-test. Table 3 shows the Mann-Whitney Test for the independent samples with the significance level set at 95%. The results reveal that significant differences in the proximity of dwelling units to the commercial and recreational areas at 1% level across the two locations. However, there were no significant differences in the proximity of the neighbourhoods to other land use. Nearness of market to residential areas suggests increase in economic activities in most urban neighbourhood. Significance of market proximity further corroborates the finding of Ogunseye et al. [22] as areas prone to market activities is associated with higher noise level.

Table 2. Comparison of proximity of dwelling units to neighbourhood facilities

	Location	Mean rank	Sum of ranks
Religious building	GRA	33.03	1156.00
	OGBE	34.03	1055.00
School	GRA	30.60	1040.50
	OGBE	35.63	1104.50
Commercial area	GRA	26.81	911.50
	OGBE	39.79	1233.50
Transport station stations	GRA	31.67	1045.00
	OGBE	33.39	1035.00
Animal area	GRA	31.69	1014.00
	OGBE	32.32	1002.00
Industrial area	GRA	31.74	1047.50
	OGBE	33.31	1032.50
Event centre	GRA	34.53	1139.50
	OGBE	30.34	940.50
Natural vegetation	GRA	25.15	996.50
	OGBE	28.85	956.50
Recreational area	GRA	38.81	1319.50
	OGBE	26.63	825.50

Table 3. Variation in proximity of neighbourhood facilities to dwelling units

	Religious	School	Commercial area	Transport station	Animal area	Industrial area	Event centre	Natural vegetation	Recreational area
Mann-Whitney U	526.000	445.500	316.500	484.000	486.000	486.500	444.500	460.500	329.500
Wilcoxon W	1156.000	1040.500	911.500	1045.000	1014.000	1047.500	940.500	956.500	825.500
Z	-.254	-1.153	-2.903	-.400	-.142	-.347	-.934	-.292	-2.648
Asymp. Sig. (2-tailed)	.799	.249	.004***	.689	.887	.729	.350	.770	.008***

*Statistical significance: * p<0.10; ** p<0.05; *** p<0.01*

In promoting a conducive urban environment, strategies towards urban planning and regulations are essential in a bid to relief the residents from environmental stress. These findings on noise pollution in urban areas affirm that relationship exist between land use, pattern of activities and noise disturbance. The findings also corroborate studies that focused on non-traffic parameters, such as land use type and pattern as well as physical distance from a given source in assessing noise level [16,5,17,23,24].

5. CONCLUSION

This paper investigated the spatial distribution of neighbourhood facilities and its association with noise level in Benin City. The land use pattern examined in relation to noise level reveals that relationship exists between land use, pattern of activities and noise disturbance in the urban areas. Results showed that neighbourhood facilities hosting commercial (such as market), transportation, and industrial activities were the closest to dwelling units. Also there was spatial variation in distribution of neighbourhood features especially the presence of markets and recreational areas with respect to noise exposure level.

Spatial separation of incompatible land uses is one of the primary principles of city planning. Land uses such as hospitals, educational institutions and residential areas are noise-sensitive, as such, it is inappropriate to have noisy urban area (e.g. transportation, manufacturing, and commercial) around them. Conversely, most Nigerian cities are characterized with mixed land uses, making noise abatement seemingly unachievable. The land zoning principle provides that in the areas of high noise level, dwellings, schools or hospitals should be built. However, this has not been followed in most Nigeria's cities. It is therefore clear that effective planning control is required in the Nigerian cities towards ameliorating the adverse effect of noise pollution.

In addition, a valuable step towards decreasing noise pollution in a mega city like Benin is the preparation of noise maps. This baseline data will provide valuable assistant for town planners, architects, engineers, other professionals as well as researchers when making planning decisions and during project execution. Till date, most Nigeria's cities have no updated noise pollution maps. With the aid of Geographical Information System (GIS), an efficient and accurate

approach to city noise mapping and abatement can be achieved. Finally, policy enforcement for existing law and development of new guidelines on environmental pollution and land use will no doubt enhances overcoming the problem of noise pollution in many urban areas in Nigeria.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Abbaspour M, Karimi E, Nassiri P, Monazzam MR, Taghavi L. Hierarchal assessment of noise pollution in urban areas – A case study. *Transportation Research Part D*. 2015;34:95–103. DOI: 10.1016/j.trd.2014.10.002
2. Öhrström E, Skanberg A, Svensson H, Gidlof-Gunnarsson A. Effects of road traffic noise and the benefit of access to quietness. *J. Sound Vib*. 2006;295:40–59.
3. Stansfeld S, Berglund B, Clark C, Lopez-Barrio I, Fisher P, Öhrström E, Haines MM, Head J, Hygge S, van Kamp I, Berry BF. Aircraft and road traffic noise and children's cognition and health: A cross-national study. *Lancet*. 2005;365:1942–1949.
4. Bluhm G, Berglund N, Nordling E, Rosenlund M. Road traffic noise and hypertension. *Occup. Environ. Med*. 2007;64:122–126.
5. Gidlof-Gunnarsson A, Öhrström E. Noise and well-being in urban residential environments: The potential of perceived availability to nearby green areas. *Landscape and Urban Planning*. 2007;83:115–126.
6. Ahmad K. A study of noise pollution in Dhaka City, Bangladesh: Department of Environment (DOE); 1998.
7. Abel AA. Urban noise pollution in Nigerian cities: Imperatives for abatement. *British Journal of Applied Science & Technology*. 2015;10(6):1-9.
8. Oyedepo SO. Noise pollution in urban areas: The neglected dimensions. *Environmental Research Journal*. 2012;61(4):259-271.
9. Egunjobi L. Perception of environmental noise problems: A pilot study centered on the city of Ibadan. Ibadan: Nigerian Institute of Economic Research; 1983.

10. Ariza-Villaverde AB, Jiménez-Hornero FJ, Gutiérrez De Ravé E. Influence of urban morphology on total noise pollution: Multifractal description. *Sci. Total Environ.* 2014;472:1–8.
11. Mehdi MR, Kim M, Chang Seong J, Hassan Arsalan M. Spatio-temporal patterns of road traffic noise pollution in Karachi, Pakistan. *Environ. Int.* 2011;37(1):97–104.
12. Banihani Q, Jadaan K. Assessment of road traffic noise pollution at selected sites in Amman, Jordan: Magnitude, control and impact on the community. *Jordan Journal of Civil Engineering.* 2012;6(2):267-278.
13. Abolade OO, Adeboyejo AT. Contributions of urban informal enterprises to noise pollution in Ibadan, Nigeria. *British Journal of Arts and Social Sciences.* 2013;14(2):133-147.
14. Oloruntoba EO, Ademola RA, Sridhar MKC, Agbola SA, Omokhodion FO, Ana GREE, Alabi RT. Urban environmental noise pollution and perceived health effects in Ibadan, Nigeria. *Afr. J. Biomed. Res.* 2012;15:77–84.
15. Mehdi MR, Arsalan MH, Gazder U, Kim M, Seong JC, Namdeo, Chang S. Who is the bigger culprit? Studying impacts of traffic and land use on noise levels in CBD area of Karachi, Pakistan. *Environ Dev Sustain.*; 2017.
DOI: 10.1007/s10668-017-9941-9
16. Baloye DO, Palamuleni LG. A comparative land use-based analysis of noise pollution levels in selected urban centers of Nigeria. *Int. J. Environ. Res. Public Health.* 2015;12:12225-12246.
DOI: 10.3390/ijerph121012225
17. Islam MN, Rahman KS, Bahar MM, Habib MA, Ando K, Hattori N. Pollution attenuation by roadside greenbelt in and around urban areas. *Urban Forestry & Urban Greening.* 2012;11(4):460–464.
18. Aguilera I, Foraster M, Basaganã X, Corradi E, Deltell A, Morelli X, et al. Application of land use regression modelling to assess the spatial distribution of road traffic noise in three European cities. *Journal of Exposure Science & Environmental Epidemiology.* 2015;25(1): 97–105.
19. Suárez E, Barros JL. Traffic noise mapping of the city of Santiago de Chile. *Sci. Total Environ.* 2014;466–467,539–546.
20. City Population. Benin City Population; 2017.
Available:<http://populationcity/nigeria/benin-city/>
21. Oviasogie AC. Assessing noise levels, land use diversity and wellbeing in selected neighbourhoods of Benin City, Nigeria. Master of Philosophy Thesis. Submitted to Department of Architecture, Federal University of Technology Akure, Nigeria; 2018.
22. Ogunseye TT, Jibiri NN, Akanni VK. Noise exposure levels and health implications on daily road side petty traders at some major roundabouts in Ibadan, Nigeria. *International Journal of Physical Sciences.* 2018;13(19):257-264.
DOI: 10.5897/IJPS2018.4775
23. Oviasogie AC, Ikudayisi AE. Comparative assessment of noise sources in two residential neighbourhoods in Benin city, Nigeria. *International Journal of Environment and Pollution Research.* 2019;7(3):21-28.
24. Oviasogie AC, Ikudayisi AE. Implication of noise pollution on residents' wellbeing in Benin City, Nigeria. *Journal of Humanities and Social Science.* 2019;24(12):17-23.

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