

Assessment of Noise Pollution Level in Port Harcourt City: A Location-Based Comparative Study

Eze Ambrose Chukwumeuche¹, Ibiba Taiwo Horsfall^{2,*}

Abstract

Noise pollution has emerged as a significant environmental health concern in urban centers, particularly in rapidly developing cities like Port Harcourt, Nigeria. This study presents a comprehensive, location-based comparative assessment of ambient noise levels across selected zones within Port Harcourt metropolis, including residential, commercial, industrial, and traffic-dense areas. Sound level measurements were conducted in the different areas of Port-Harcourt metropolis. High-density and low-density residential neighborhoods, busy roadways, business centers, road intersections, and passenger loading parks were the study locations chosen. In order to observe the impact of generator noise, noise levels in a few areas near telecommunication masts were also taken into account. To ascertain the degree of noise in the city of Port Harcourt, an assessment and analysis of noise pollution levels were conducted. The noise pollution level (NPL) at sampling point 1 was found to be 110.8 dB(A), significantly higher than the NPL at sampling point 2, which was 86.3 dB(A). This greater NPL may be related to the type of activities occurring at sampling point 1, primarily consisting of markets and motor parks. Following the investigation, it was found that the areas with the highest noise pollution levels were loading parks and traffic intersections, followed by business nerve centers. A consequence of industrialization and urbanization, noise pollution is now widely acknowledged as a serious issue for metropolitan regions' quality of life. The increase in the population and in the number of circulating vehicles has led to an increase in noise pollution as well, the number of generators in Nigeria has also contributed to the rise in noise pollution because most of the industries now rely on generators for the source of power supply. In order to reduce harmful health effects, findings highlight the need for efficient urban noise management plans, public awareness initiatives, and regulatory policy enforcement.

Keywords: Urban noise surge, generator-driven decibels, traffic and terminal roar, commercial zone clatter, noise hotspots mapping

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INTRODUCTION

The impact of industries, especially the production/manufacturing, power generating, telecommunication, quarrying, and logging industries on the environment, particularly the noise effect, is one of such related concerns. The majority of these are occasioned by unreliable epileptic power supply and thus total dependence on mobile electricity generators to power and sustain their operations in Nigeria. Only a few are actually a result of the industrial processes, particularly the production, processing, and timber/logging industries. Noise is a type of mechanical energy that

is usually measured in energy-related units. For listeners, sound is defined as acoustic energy in the frequency range of 20,000 Hz to below 20 Hz [1], which is typical of the human auditory system. Noise is produced by any vibrating body and is transmitted in the air only as a longitudinal wave motion. The sound output of a source constitutes its power, and the intensity of sound at a point in space is defined by the rate of energy flow per unit area. Intensity is proportional to the mean square of the sound pressure and, as the range of this variable is so wide, it is usual to express its value on a logarithmic scale, in decibels (dB). Slight variations in atmospheric pressure that can evoke the experience of hearing make up noise. Over a fairly broad range, the human ear reacts to variations in sound pressure. The human ear reacts ten million times more strongly to the loudest sound pressure than to the softest. The decibel (abbreviated as dB) scale uses logarithms to decrease this ratio to a more manageable size. According to Heggies [2], Sound Pressure Level is usually represented by the symbols SPL, L, or LP. A-weighted Sound Pressure Level is represented by the sign LA. According to Ismail et al. [3], people's hearing is less susceptible to lower and higher frequencies and more responsive to mid-frequency noises (500 Hz to 4000 Hz). Therefore, a suitable indicator of a sound's loudness is its level in decibels (dBA). In general, sources with the same dBA level sound around the same volume. A 3 dBA to 5 dBA change in sound level equates to a slight but obvious shift in loudness, but a 1 dBA or 2 dBA change in sound level is hard for most people to notice. The loudness is about doubled or halved with a 10 dBA adjustment. Statistical exceedance levels (LAN), which are defined as the A-weighted sound pressure level exceeded for N% of a particular measurement period, are frequently used to characterize sounds that change in intensity over time, such as road traffic noise and the majority of community noise. For instance, the noise level is exceeded by the LA1 1% of the time, the LA10 10% of the time, and so on. Globally, noise pollution is widely acknowledged as a significant issue affecting urban areas' quality of life [4]. Agunwamba [5], for example, proposed that noise is an undesired sound generated by a source that causes vibrations in the surrounding medium. In reality, a well-known noise issue in multi-unit housing is abnormal social behavior. A frequent source of complaints is ventilation system noise [6]. Therefore, regardless of the source, noise reduction is crucial due to the damage it poses to public health. To create baseline noise data for an area in relation to a project for the purpose of comparing future effects, Environmental Impact Assessment (EIA) studies are an essential tool [7]. Since it is already widely known that exposure to relatively high noise levels can cause direct hearing loss and/or hearing impairment, Prasher [8] noted that the majority of this study has focused on the effects of noise on the auditory system. The link between noise and non-auditory consequences, however, has been the focus of more recent studies.

This study aims to establish an environmental quality survey of noise in Port Harcourt, Rivers State.

MATERIALS AND METHODS

Description of Study Area

The study focused on an extensive unit of residential and industrial areas where people inhabit and work within Port Harcourt, Rivers State. There are industrial complexes belonging to various individuals or multinationals. Notably among them are constructions, motor parks, telecommunication, oil and gas servicing companies, agro and allied industries, plastics, etc. The residential areas chosen are places with dense populations and major markets [9]. Two sampling points were chosen in each of the fifteen sampling stations/localities for this study, making the sampling points thirty in all. They were randomly selected according to ease of accessibility and proximity to continuous noise emission sources, dwelling places/human perturbations, safety, and for the security of those carrying out the sampling [10]. They were chosen to show the gradation of the intensity and loudness, and the concept of noise continuum [11]. Sampling points 1 and 2 are those areas in each location where there are busy activities (Table 1). In the first place, the background community noise (ambient noise) was measured at each of the sampling points and was recorded (Figure 1). The sampling was recorded as either a daytime noise value or a nighttime noise value.

Table 1. Description of sampling stations.

Sampling Station	No.	Sampling Point 1	Criteria for Selection	Sampling Point 2	Criteria for Selection
Trans – Amadi Industrial Area, Port Harcourt	1	Trans/Amadi Power Station	Rivers State Power Station has many turbines and generators that produce continuous noise.	RIVOC gate	Industrial Cluster, there are more than 15 production industries within the area.
Mile 1, Port Harcourt	2	Motor Park	Major motor/central park in Port Harcourt	Mile 1 market	A major commercial center
Mile 3, Port Harcourt	3	Motor Park	Major commercial area, especially	Mile 3 market	Busy and noisy activities go on daily
Slaughter axis	4	Trans-Woji river	An industrial/commercial cluster	Market	Commercial center
Woji Axis	5	YKC junction	A commercial center	Estate Junction	Residential area
Old GRA	6	Forces Avenue	Government reserved area	BMH	Braithwaite Memorial Hospital is the major Hospital in Port Harcourt
GRA Phases II & III	7	Airtel Office	Residential/corporate area	Oxygen nightclub	A bubbling area
Elelenwo, Port Harcourt	8	St Paul’s Anglican church	A clutter point for worship	Market	Commercial center
Rumuibekwe	9	Under a mango tree	A busy bus stop	Housing estate	Residential quarters
Rumuogba	10	Miniokoro Police Station	One of the major Police stations in Port Harcourt	Housing estate	Residential quarters
Ikwerre Road	11	Wimpy junction	A major junction leading to 2 higher institutions in Rivers State	Market junction	A serene settlement
Borikiri Port Harcourt	12	NNPC mega station	Very busy and heavily populated	Lagos bus-stop	The busiest bus stop in Port Harcourt
Garrison	13	Bus stop	A major junction leading to Port Harcourt town and Trans/Amadi	Ogbunabali road	A busy road where Information and communication Technology services are rendered
Rumuola Junction	14	bus-stop	One of the busiest junctions in Port Harcourt	Rumuola town	A serene town in Port Harcourt
Rainbow town	15	RTD Quarters	Newly developed residential quarters	Amadi round about	Major intersection of major roads, parks, and markets

Data Collection

In this study, the measurement of the level of ambient noise generated from various sources within the selected areas in Port Harcourt City was made using the digital sound level meter [12]. This was done to gather information on whether the ambient noise generated from the sampling points is high or low. To back this up, questionnaires were issued to eligible respondents living or working close to noise points. This was done to determine the psychological effect of noise on the affected persons. Both primary and secondary data sources were taken into consideration to fulfill the purpose of this research work. In collecting data for the research study, the most important primary data was the readings obtained from the sampling points using the sound level meter and questionnaires issued to eligible respondents drawn from the selected sites in Port Harcourt namely; Trans –Amadi Industrial Area, Mile 1 Park and market, Mile 3 Park and Market, Slaughter – Woji Axis, Forces Avenue Old GRA, GRA Phase 2&3, Elelenwo Market, Rumuibekwe Housing Estate, Rumuogba Housing Estate, and Rainbow town. In addition, in-person oral interviews were used to supplement questionnaire responses. From the foregoing, primary data collections are considered most relevant in this study in that they provide first-hand information and assessment of the subject matter at hand. Ideally, it is expected to collaborate with

the findings from the secondary data. This will automatically form the basis of either accepting or rejecting the research hypothesis already stated. However, the secondary data used was mainly collected from textbooks, newspapers, journals, magazines, and literature notes. Also, information on the study area and noise in general was obtained from the internet and other electronic media. The choice of secondary data stems from the fact that it represents some characteristics of being either qualitative or quantitative.

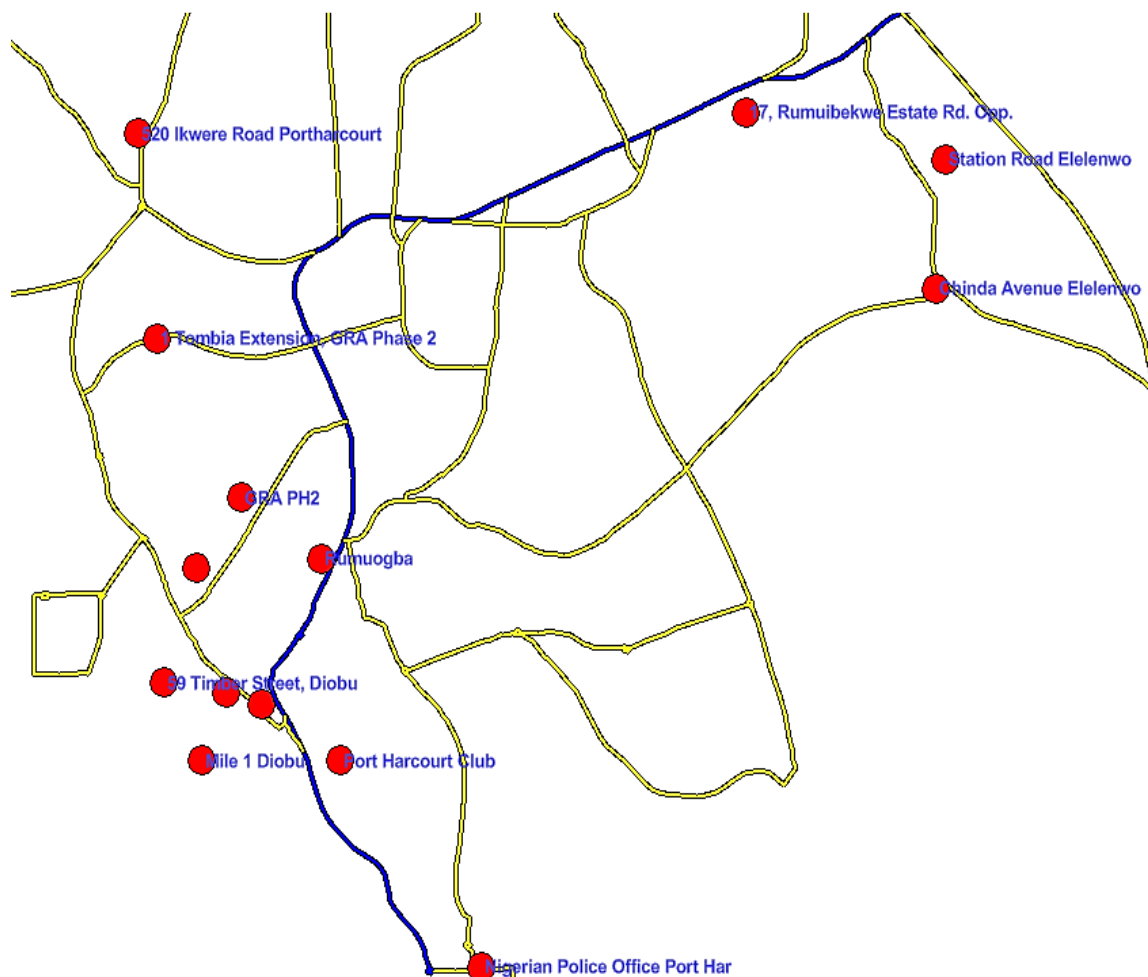


Figure 1. Map of study area showing the sampling stations.

Sample Size

For the purpose of obtaining the psychological and health effects of noise on the people, a total of 300 questionnaires were issued to eligible respondents in the 15 sampling stations. The sample size is based on the nature/type/duration/intensity/nature/type/duration/intensity/number of activities that generate noise in the selected areas [9]. After a week, about 200 of the questionnaires were retrieved from the respondents, while about 20 copies were invalid, with the other 80 copies not accounted for.

Measurement of Noise Level

The noise levels from the various sampling points were measured with a hand-held sound level metro sonic digital meter (Figure 2). The figures were automatically generated on the spot and recorded. The noise meter was placed just at the edge of the perimeter fence or at the sampling points where there is a fence to obtain the reading as close to the noise source as possible. The values obtained were recorded as point 1 and point 2 for the dwelling houses, considering a distance of about 50 m maximum. The data obtained for ambient noise was measured during the day and nighttime to obtain these values. The

distances between the sampling points of measurement for the ambient noise were more than 100 m apart from each other to avoid undue interference. The ambient noise levels around each base transceiver station (BTS) were monitored for between 5 and 10 minutes using a Cirrus 701 dosimeter [13]. The dosimeters were positioned long enough to obtain the typical recurrent/most frequent background noise levels devoid of interference by the BTSs.



Figure 2. Sound level, Metro Sonic Digital Meter at the sampling station.

Characterizing Noise Pollution Level

Noise pollution level (NPL) is a community noise measure that describes how noisily polluted a given region is:

$$NPL = L_{50} + d + \frac{d}{60} \quad (1)$$

Where, $d = L_{10} - L_{90}$

RESULTS AND DISCUSSION

Results

The various noise data recorded at the corresponding sampling points are presented in Table 2. The intensities of these noise values are a result of the various activities going on in various places. The sampling stations with social amenities like motor parks, markets, production facilities, and playgrounds have high noise decibels, while those with little or none of these activities had the lowest values. The results and analyses of acquired field data for the two sampling points on sampling stations 1–15 are presented in Table 2. The noise level acquired from sampling point 1 for each of the sampling stations. Noise levels range from 60.1 dB(A) at sampling station 6 to 98.9 dB(A) at sampling station 3. In the interim, these noise levels seem to be within the permissible limits set by the EPA for sampling point 1. Similarly, the noise level was acquired from sampling point 2 for each of the sampling stations. Noise levels range from 60.2 dB(A) at sampling station 6 to 77.4 dB(A) at sampling station 3.

To properly describe and characterize noise distributions within the sampled environment, the data were ranked [14] and the Weibull distribution or method of evaluating ranked data was used to determine some very important parameters, and their level of equality or exceedance was applied [15], as shown in Tables 3 and 4.

The distance is measured between the sampling station and the nearest residential area.

Table 2. Noise level at sampling points 1 and 2.

Sampling stations	Sampling point 1		Sampling point 2	
	Noise level (dBA)	Distance (m)	Noise level (dBA)	Distance (m)
1	80.1	600	66.4	500
2	72.3	50	67.8	70
3	98.9	45	77.4	30
4	73.3	55	66.9	60
5	71.0	20	63.7	10
6	60.1	20	60.2	15
7	64.2	30	60.4	10
8	64.9	15	66.5	10
9	60.4	10	60.6	10
10	61.9	25	63.3	10
11	65.3	15	65.1	10
12	76.8	20	76.6	5.0
13	72.9	45	71.2	15
14	72.5	50	63.9	30
15	61.9	45	63.3	20

Table 3. Noise level equality or exceedance for sampling points 1.

Sampling stations	Distance (m)	Noise level (dBA)	Rank (m)	% noise level equality or exceedance
3	45	98.9	1	6.25
1	600	80.1	2	12.50
12	20	76.8	3	18.75
4	55	73.3	4	25.00
13	45	72.9	5	31.25
14	50	72.5	6	37.50
2	50	72.3	7	43.75
5	20	71.0	8	50.00
11	15	65.3	9	56.25
8	15	64.9	10	62.50
7	30	64.2	11	68.75
10	25	61.9	12	75.00
15	45	61.9	13	81.25
9	10	60.4	14	87.50
6	20	60.1	15	93.75

Characterizing noise pollution level for sampling point 1, Figure 3 is a plot showing L_{10} , L_{50} , and L_{90} , i.e., the noise levels that equaled or exceeded 10%, 50% and 90%, respectively, of the sampled data.

From Figure 3, the $L_{10} = 87.62$ dB(A), $L_{50} = 71.00$ dB(A) and $L_{90} = 60.28$ dB(A). Therefore, computing the noise pollution level (NPL) using Eq. (1) yields 110.8 dB(A). However, further analysis with the trend line by a power function, with a goodness of fit of 95% as shown in Figure 4.

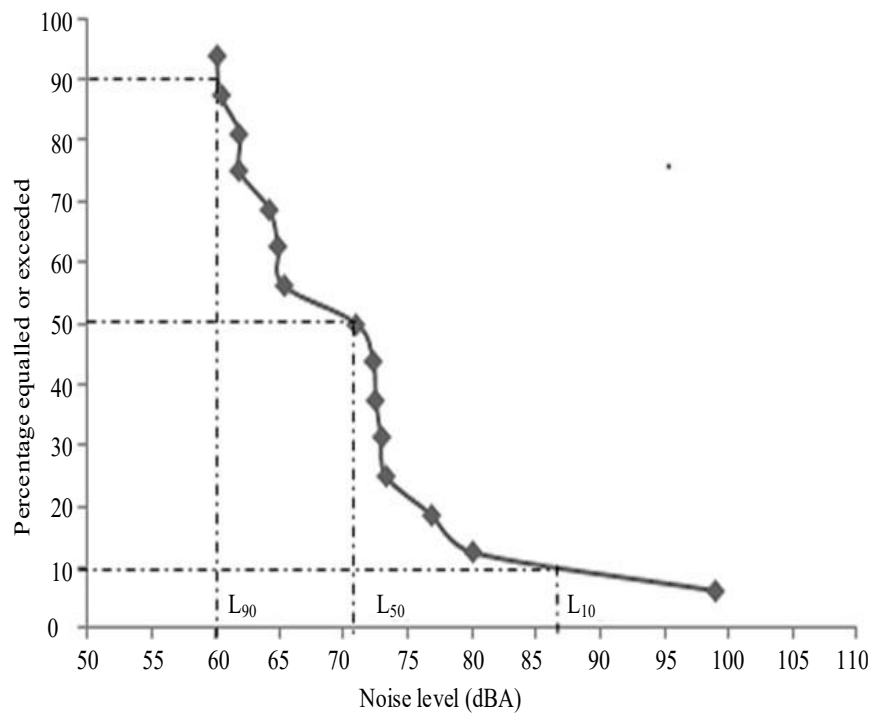


Figure 3. Noise level equality or exceedance for sample point 1.

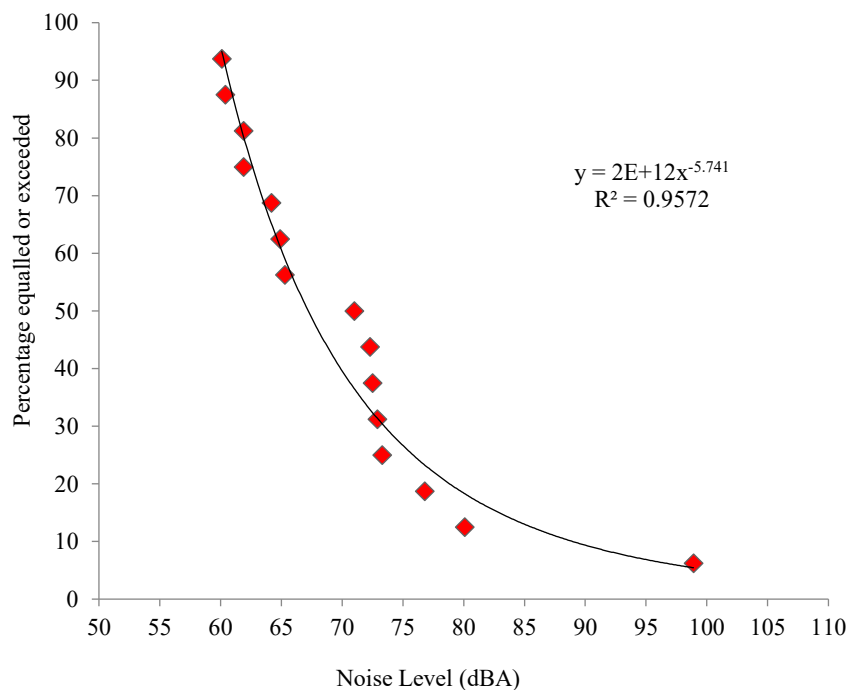


Figure 4. Power function approximation of noise level exceedance for sampling point 1.

The approximated goodness of fit is given as:

$$y = 2 \times 10^{12} L_y^{-5.741} \quad (2)$$

where y = noise level equality or exceedance and L_y = noise level in dB(A). However, rearranging Eq. (2), we have:

$$L_y = \left(2 \times 10^{\frac{12}{y}} \right)^{-5.741} \quad (3)$$

This is the approximate equation describing the noise level equalled or exceeded for sampling point 1 distribution.

Table 4. Noise level equality or exceedance for sampling points 2.

Sampling stations	Distance (m)	Noise level dB(A)	Rank (m)	% Noise level equality or exceedance
3	30	77.4	1	6.250
12	5	76.6	2	12.50
13	15	71.2	3	18.75
2	70	67.8	4	25.00
4	60	66.9	5	31.25
8	10	66.5	6	37.50
1	500	66.4	7	43.75
11	10	65.1	8	50.00
14	30	63.9	9	56.25
5	10	63.7	10	62.50
10	10	63.3	11	68.75
15	20	63.3	12	75.00
9	10	60.6	13	81.25
7	10	60.4	14	87.50
6	15	60.2	15	93.75

From the Figure 5 $L_{10} = 76.92$ dB(A), $L_{50} = 65.10$ dB(A) and $L_{90} = 60.32$ dB(A). Therefore, the noise pollution level (NPL) was computed as 86.3dB(A) as illustrated in Figure 6.

The approximated goodness of fit for sampling point 2 is given by

$$y = 4 \times 10^{19} L_y^{-9.885} \quad (4)$$

where y = noise level equality or exceedance and L_y = noise level in dB(A)

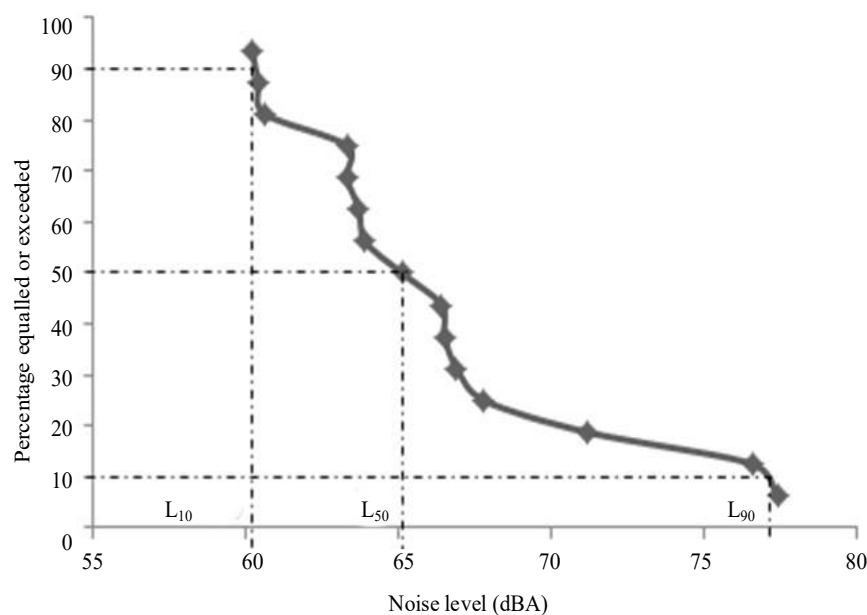


Figure 5. Noise level equality or exceedance for sample points 2.

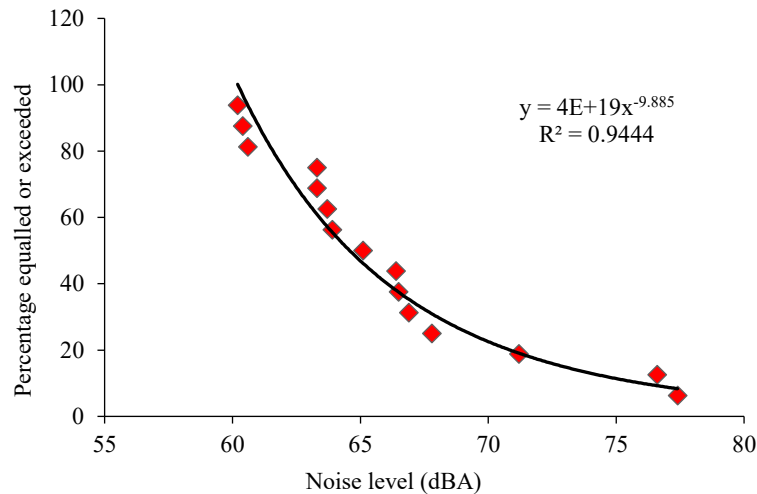


Figure 6. Power function approximation of noise level exceedance for sampling points 2.

Rearranging Eq. (4), we have:

$$L_y = \left(4 \times 10^{\frac{19}{y}}\right)^{-9.885} \quad (5)$$

This is the approximate equation describing the noise level equalled or exceeded for sampling point 2 distribution (Tables 5 and 6).

Table 5. Measured noise level for the motor parks and markets.

Sampling Stations	Noise level dB(A)	
	<i>Sampling point 1</i>	<i>Sampling point 2</i>
Mile 1, Port Harcourt	72.3	67.8
Mile 3, Port Harcourt	98.9	77.4
Slaughter axis	73.8	66.9
Elelenwo	64.9	66.5
Borikiri	76.8	76.6

Table 6. Noise gradient of motor parks and markets across a distance of 120 m from sampling point 2.

Distance from motor park and market (m)	Noise level (dBA) along Azikiwe road	Noise level (dBA) along Ikwerre road
1	72.3	67.8
10	58.8	65.1
20	60.6	64.6
30	57.1	64.5
40	61.0	66.1
50	59.1	69.2
60	58.2	68.9
70	66.4	72.9
80	62.3	73.1
90	60.5	73.3
100	64.9	73.3
110	61.5	73.4
120	61.9	73.3

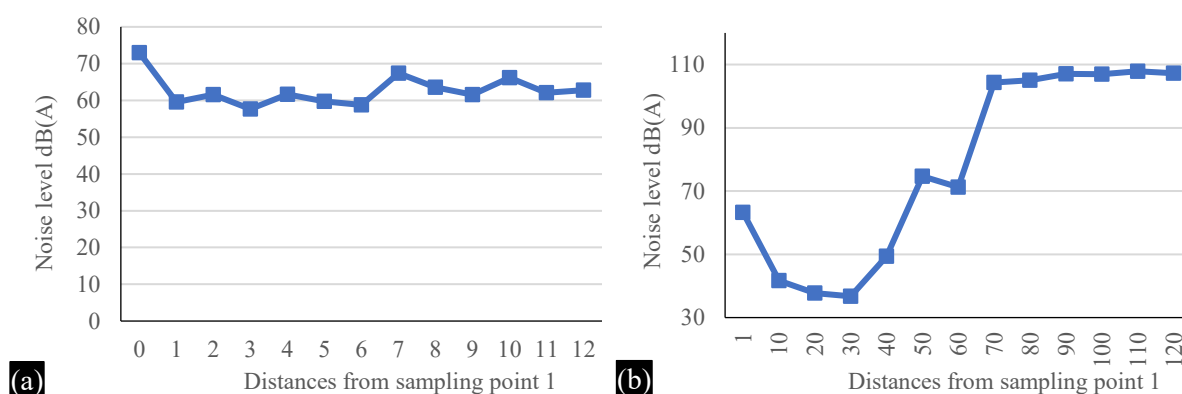


Figure 7. (a) and (b) Noise gradient of sampling points 1 and 2 across the distance.

DISCUSSION

Comparison of Noise Pollution Levels Between Sampling Points

It was observed that the noise pollution level (NPL) for sampling point 1, which was 110.8 dB(A), was much higher than that of sampling point 2 was 86.3 dB(A). This higher NPL could be attributed to the nature of activities that are going on at sampling point 1 (mainly consisting of motor parks and markets). In the same vein, sampling point 2 consists mainly of industrial sectors, though this finding agrees with the report of Nwaogazie and Owate [9]. However, the noise pollution level is lower because in the industrial work environment, most devices, instruments, and equipment that could have produced high levels of noise are either damped or caged in confined spaces. In essence, residents around motor parks and marketplaces are more prone to noise pollution than those within an industrial environment (Figure 7).

Noise from Motor Parks and Markets

Motor parks in Nigeria and other developing countries are known for the unhealthy noise that emanates from them. But the source of noise for these Motor Parks is the blaring of horns from vehicles and buses, the sound of vehicle engines as they zoom in and out, and the various outcries of car loaders as they scout for vehicles. These sounds are not expected to exceed certain decibels at the source of generations, but the reverse is the case. Table 5 presents the data of all the motor parks and markets as recorded in this study. They were measured on different points within the various parks and markets (Table 5). Noise gradient of motor parks and markets across a distance of 120 m from sampling point 2 (Table 6).

The noise from the sampling points 1 and 2 (motor park and markets) in question was measured at 10 m intervals away from the parks and markets. This was done to obtain the noise values away from the sampling points to establish a noise continuum. The data obtained is presented in Table 6. The measurement went on to a distance of more than 120 m within the sampling point and sampling area. For instance, some manufacturing industries have old power generation sets that are already producing high levels of noise [15], and if the country's current power situation is not improved, there will be more cases of noise due to the over-reliance on power generators, which will eventually produce disturbing levels of noise if proper maintenance is not performed on them. High ambient noise levels may not be a major problem because these events are likely to last for a short time and are therefore unlikely to have a significant impact on the noise exposure of the general public.

CONCLUSION AND RECOMMENDATION

Noise measurements at 15 sampling stations across two sampling points for ambient noise and the focal point showed that the mean daily noise emission at the strategic points is likely to exceed the 85 dB(A) first action level defined in the Noise at Work Regulations. But the noise is not continuous, and the high decibels usually do not last long. The risk of hearing harm to the person's dwelling surrounding area is therefore regarded as small. Environmental noise analysis at selected places was presented to

show typical loudness and also typical background noise level at numerous selected sites in the study. It's noteworthy to note that background noise levels are greater around major roads, marketplaces, and the edge of an industrial region when sampling stations are located close to these locations than when they are located close to residential neighborhoods. All of this region will be developed in the near future, it was noted. The noise level will rise in tandem with the nation's development, particularly in that particular area, during the course of the next five to ten years. Therefore, industries should be made to comply with statutory regulations on maximum permissible/tolerable noise. Similarly, industrial units/production facilities should be fully equipped with brand new and well-serviceable/maintained power-generating sets and other operating units since reliance on PHCN is not feasible for now. All old and noisy power sets should be replaced or at least muffled to avoid or reduce the noise emanating from them.

Power systems or associated facilities should be situated/sited at least 50 m from dwelling places and should incorporate an adjustable volume control that enables operators to listen to generated sounds at a comfortable level.

REFERENCES

1. Nilsson ME, Berglund B. Noise annoyance and activity disturbance before and after the erection of a roadside noise barrier. *J Acoust Soc Am.* 2006; 119(4): 2178–2188. <https://doi.org/10.1121/1.2169906>.
2. Heggies Pty Ltd, Proposed Gas Turbine Power Station Noise Assessment of Air-Cooling Option, NSW 2066 Australia, 2008. www.heggies.com.
3. Ismail AR, Nor MJM, Mansor MRA, Tahir MFM, Zulkifli R. Environmental Noise Assessment and Modeling in Malaysia: A Comparative Monitoring Study. *Eur J Sci Res.* 2009; 30(2): 236–244.
4. Piccolo A, Plutino D, Cannistraro G. Evaluation and analysis of the environmental noise of Messina, Italy. *Appl Acoust.* 2005; 66: 447–465.
5. Agunwamba JC. Waste Engineering and Management Tools, Immaculate Publications Ltd, Enugu, Nigeria. 2001. 273–290.
6. Lambert J, Vallet M. Study Related to the Preparation of a Communication on a Future EC Noise Policy. Bron Cedex, 2004, France: INRETS, LEN report no. 9420.
7. Okoli EC. Noise Pollution Studies from Global System of Mobile Telephony: A Case Study of MTN Nigeria Communications Limited. Masters in Engineering [Thesis]. University of Port Harcourt, Nigeria. 2006.
8. Pathak V, Tripathi BD, Mishra VK. Evaluation of traffic noise pollution and attitudes of exposed individuals in working place. *Atmos Environ.* 2008;42(16):3892–8. doi:10.1016/j.atmosenv.2007.12.070.
9. Nwaogazie IL, Owate IC. Noise pollution studies of Port Harcourt refinery, part-1: The spatial variations and dispersion. *NSE Tech Trans.* 1995; 30(4): 60–71.
10. Bruel PV Kjaer V. Environmental Noise Booklet, Published by Bruel and Kjaer Cooperation, 2000, Denmark www.bksv.com.
11. Berglund B, Lindvall T. Community noise. *Arch Cent Sens Res.* Stockholm, Sweden, 1995; 2(1): 1–195.
12. Narendra S, Davar SC. Noise Pollution- Sources, Effects and Control Department of Commerce, Kurukshetra University, Kurukshetra 136119, Haryana, India, *J Hum Ecol.* 2005; 16(3): 181–187.
13. ISO. Acoustics—Guide to International Standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings. Geneva, Switzerland: International Organization for Standardization, International Standard ISO 2204-1979(E), 1979.
14. ISO. Acoustics—Preferred frequencies for measurements. Geneva, International Organization for Standardization, International Standard ISO 266-1975(E), 1975.
15. HSE. Noise at Work Regulations 1989, Statutory Instrument 1989 No. 1790. London: Health & Safety Executive, 1989.