JAEHR
Journal of Advances in Environmental Health Research
J Adv Environ Health Res, 2024; 12(1): 16-22. doi: 10.34172/jaehr.1311
http://jaehr.muk.ac.ir

Original Article

Evaluation of Noise Pollution Levels in Selected Markets and Motor Parks in Delta State, Nigeria

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Article history:
Received: August 27, 2022
Accepted: January 18, 2023
ePublished: February 13, 2024

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Abstract

Background: The control of environmental noise pollution has been hampered by lack of sufficient knowledge of its effect on human. Noise pollution is associated with several health conditions and affects both health and behavior. This study evaluated the noise pollution level in selected market and motor parks in local government areas in Delta State.

Methods: The physical parameters were measured using a digital sound level meter and a mobile-based global positioning system (GPS), in September 2021. To determine noise pollution all over the city, the noise measurements were collected in the morning and evening. The selected areas of the study were market places, road junctions/busy roads and passenger loading parks. The noise pollution levels were measured in Ogwashi-Uku Market, Ogwashi-Uku Motor Park, Nwasi Motor Park, Ibusa Market, Central Motor Park Asaba, Delta Line Park Asaba, Onitsha Park and Oko Market Asaba.

Results: The results showed that the average pollution level in the morning hours were 89.33, 90.1, 90.3, 91.72, 86.59, 90.11, 92.15 and 90.3 dB in Ogwashi-Uku Market, Ogwashi-Uku Motor Park, Nwasi Motor Park, Ibusa Market, Central Motor Park Asaba, Delta Line Park Asaba, Onitsha Park and Oko market Asaba, respectively. In the evening, the corresponding measured values were 83.65, 74.90, 90.04, 90.90, 85.07, 83.44 and 91.79 dB respectively. These values were higher than the Federal Environmental Protection Agency (FEPA) and World Health Organization (WHO) standard limits for outdoor environment.

Conclusion: The people who are working and living in the areas under study may be at risk of noise related health hazard due to continuous daily exposure.

Keywords: Noise, Pollution level, Motor park, Market places, Delta State

Please cite this article as follows: Ijabor BO, Efere JT, Orioge O, Agu FN, Ogodo OB, Okei BC. Evaluation of noise pollution levels in selected markets and motor parks in Delta State, Nigeria. J Adv Environ Health Res. 2024; 12(1):16-22. doi:10.34172/jaehr.1311

Introduction

Several countries lack regulations or legislation pertaining to noise pollution, often due to a lack of political will or an insufficient understanding of its detrimental effects on the environment and ecosystems. One of the environmental pollution that occurs all over the world is noise pollution. Urbanization and industrialization have led to an elevated level of noise, now acknowledged as an emerging form of environmental pollution. As a byproduct of urbanization and industrialization, noise constitutes an unwelcome sound.[1] One of the most prevalent forms of environmental pollution is noise, which is highly linked to anthropogenic (man-made) activities like commercial, industrial, institutional, and recreational ones. Noise pollution is an environmental problem that endangers both the environment and public health. It has a negative effect on a person's physical, social, and psychological health which can cause temporal or permanent hearing loss. It has been demonstrated that noise pollution exacerbates chronic conditions such as hypertension and other cardiopulmonary diseases.[2] The adverse impact of noise pollution on human health should not be underestimated. It is dependent on duration, distance from the source, and level of the noise. Health effects of noise pollution encompass hearing loss, cardiovascular illnesses, mental health decline, communication problems, sleep disorders, diminished academic and professional performance, among others.[3]

Alarmingly, public complaints regarding excessive noise are increasingly prevalent, particularly in parking lots and markets. Markets serve as assemblies where buyers and sellers convene to engage in commercial, economic, and social transactions, contributing to the formation and sustenance of communities. Their collective activities

generate noise pollution as they gather. The presence of numerous suppliers and consumers in the public market areas has resulted in a significant environmental noise issue. Several vendors employ loud shouting or amplified speakers to promote their goods, contributing to elevated noise levels. Moreover, certain sellers operate grinding machines using small power generator sets, thereby posing significant noise hazards.[1] The market is crisscrossed by pathways, with heavy vehicular traffic, including trucks, lorries, cars, tricycles, and motorcycles transporting both people and goods within the market premises. This is another source of noise in the entire market area because there is heavy human activity on both sides of the road, which causes environmental pollution.[4]

People who are living nearby parks are directly or indirectly subjected to noise pollution from automobiles' horns, running engines, generators, broken exhaust pipes, and loud speakers used to recruit commuters.[3] According to the World Health Organization (WHO), 328 million adults and 32 million children worldwide (more than 5% of the world's population) experienced hearing loss. Exposure to loud noise has been cited as one of the disability causes.[5] After air and water pollution, noise pollution is regarded as the third of the most dangerous sort of pollution.[6] It is one of the physical and environmental variables influencing human health in the modern world. It is also a pollutant that is growing as a result of the globe's extremely high population, transportation, traffic, and advancements in commercial, industrial, and social activities.[7] In rapidly expanding cities such as those in the south- eastern Nigeria, it has been recognized that noise pollution caused by road traffic noise is severe in this area because of poor planning of the cities and insufficient control of noise level.[8,9] Research conducted on environmental noise pollution in Ilorin metropolis, Nigeria, unveiled a notable observation: the noise map created depicted elevated noise exposure concentrated at the heart of the metropolis. This area is characterized by intense commercial activities, high traffic volume, and densely packed buildings, housing a large population.[10] observed that the level of noise produced in cities and urban areas are taken for granted especially in Nigeria. Noise pollution affects both health and behavior. Unwanted sound (noise) can damage physiological health. However, it specks a concern to evaluate noise pollution levels in selected markets places and motor parks in Delta State. The outcomes of this research hold significant relevance for various stakeholders including transporters, marketers, customers, organizations, communities, and the state as a whole. This study delves into the impact of noise pollution, advocating for a proactive approach towards effective noise control. By doing so, it aims to substantially minimize health concerns such as hearing impairment, cardiovascular disorders, hypertension, sleep disturbances, and other detrimental effects. Furthermore, this investigation will empower residents to adopt healthier habits, potentially contributing to an increased life expectancy.

Materials and Methods

This research evaluated noise pollution levels in selected markets and motor parks in Oshimili South and Aniocha South local government area of Delta State. Figure 1 shows

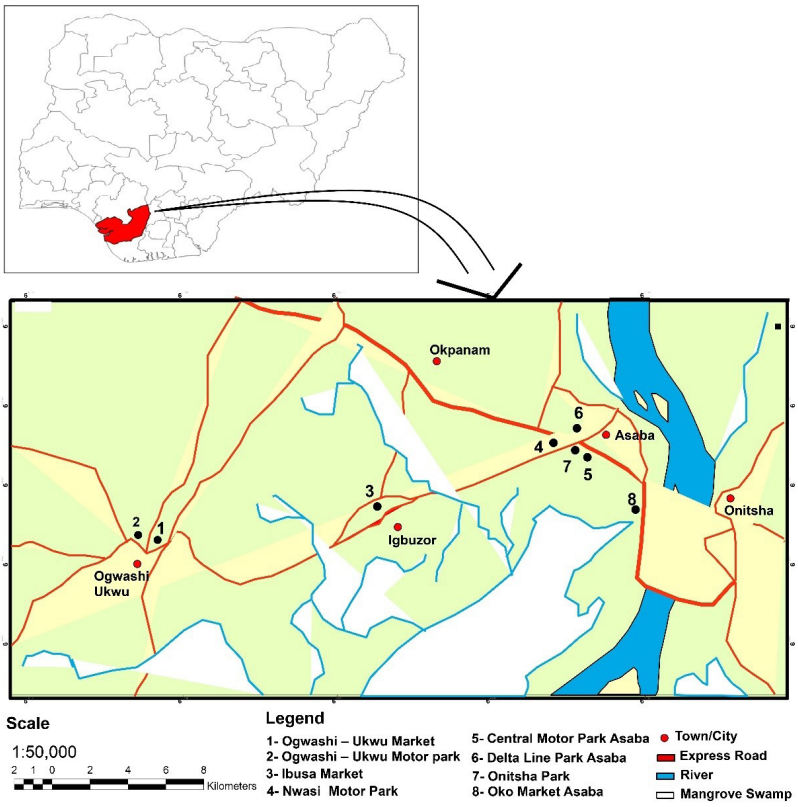

Figure 1. Map of the study area showing the sample locations

the sample location where measurement was taken.

The equipment used in this study was a digital sound level meter (model IEC 651 TYPE II BK with precision of 732) and global positioning system (GPS) map reader. The meter and the GPS are shown in Figures 2 and 3, respectively.

Digital Sound Level Meter

The digital sound level meter (Type II BK with precision of 732 and model IEC 651 ANSI 51.4 TES-1350A) consisting of a microphone, electronic circuit and a display screen was used to measure the noise. The microphone serves to detect subtle changes in air pressure corresponding to sound, which are then converted into electrical signals. The device's electronic circuitry processes and presents these signals as the measured noise level in decibels. The digital sound level meter captures instantaneous sound pressure levels (SPL) when it is positioned in a specific location. This meter is purposefully designed to fulfill the sound level requirements of technicians, engineers, health and quality control personnel in diverse environments, including schools, offices, and homes. Additionally, it measures noise levels in places like airports, factories, and serves the purpose of evaluating the acoustics in auditoriums, home hi-fi setups, and studios. It has a frequency range from 30 Hz to 12 kHz which can carry out measurements in the A and C-weighting system. The meter is shown in Figure 2. The level ranges in dB are as follows:

- Low: 30–80 dB
- Medium: 50–100 dB
- High: 80–130 dB
- Frequency weighting: A and C
- Time weighting: slow and fast
- Maximum hold: hold noise reading with delay of three minutes.
- Auxiliary outputs: AC/DC output
- Microphone: electrical condenser microphone.
- A–Weighting for noise level determination.
- C–Weighting for measuring sound level of acoustic materials

The A–weight network was used in this study because it is the most suitable approach for measuring the environmental noise.[8] The A–weighting selects low frequency sound energy that correlates with the response of the human ear.

Figure 2. The used Noise Level Meter in the study

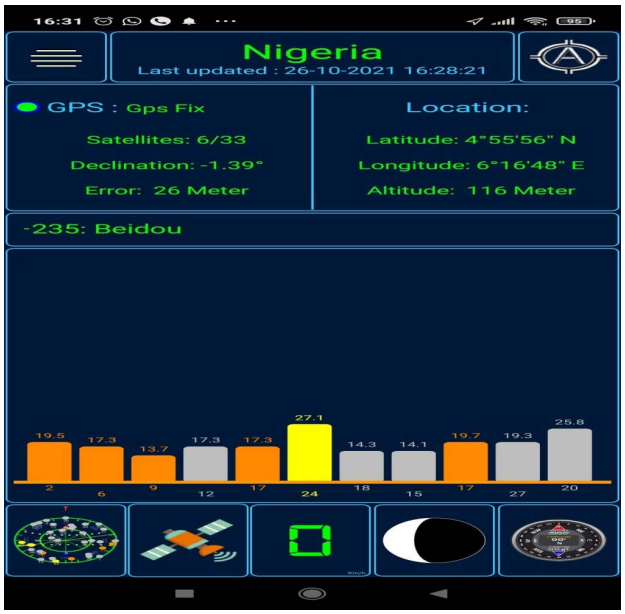

Figure 3. The geographical positioning system (GPS) used by an Android phone (GPS Application Interphase)

Noise Measurement Procedure

The sound meter was calibrated by the internal sound level calibrator as defined by IEC 60942 for checking the accuracy of the hand-held indicating instruments before making measurements at each site. All the instruments are in accord with IEC standards. The location of primary source of noise was determined before measurements were taken. The measurements were collected from market places, road junctions and passenger loading parks. It was a standard walk-through survey employing the sound level meter held comfortably away from the body at an approximate height of 1.2 m above the ground level. The device was positioned at a distance of 2 to 3 m from noise sources, in accordance with the methodology outlined in prior studies,[11] with the microphone oriented horizontally toward the surrounding noise sources. The minimum and maximum values of the sound meters and their average were also recorded. The microphone was appropriately positioned at a height of 1.2 m above the ground, which is the distance between a human being's ear and the ground.[12] The measurements were taken between the hours of 9 AM to 6 PM under comfort climatic conditions. All measurements were made in decibels (dB) (A), and the GPS location for each place was noted. The ambient sound level in various Delta State market places and parks was measured and compared with standards.

The noise pollution level was obtained using Equation 1[9]:

$$L_{NP} = Leq + k\sigma \quad (1)$$

Where the LNP, k, Leq and σ are noise pollution Level, constant value of 2.565, equivalent energy level and standard deviation of the acquire Leq values, respectively. The σ value is estimated using Equation 2:

$$\sigma = \frac{\sqrt{\Sigma\left(Leqi - Leq(\alpha)\right)^2}}{N-1} \quad (2)$$

In which the Leqi, Leqα and N are single equivalent energy level, average equivalent energy level and number of measurements or points, respectively.

Equivalent Energy Level (Leq)

This is the standard measure of sound level over a specified period. It is written as Leq which indicates the constant level in decibels that produces the same amount of sound energy as a series of events having fluctuating sound levels. The linearity of Leq tends to increase as noise events become more closely spaced throughout the entire measurement period. It is written as Equation 3:

$$\text{Leq}(\alpha) = \frac{\Sigma Leqi}{N} \quad (3)$$

Sound Pressure Level

Sound pressure level (SPL) is mostly used for measuring the magnitude of sound. SPL has an SI unit is Pascal (Pa). Sound pressure in the air is measured using the microphone while it is measured using the hydrophone in water. SPL can be considered as a relative quantity because it is the ratio of actual sound pressure to a fixed reference pressure.

The sound pressure level is obtained by Equation 4:

$$\text{L} = 10\,log_{10}\left(\frac{P_1}{P_0}\right)^2 \text{dB} = 20\log\left(\frac{P_1}{P_0}\right)\text{dB} \quad (4)$$

where L, P_1 and P_0 represent SPL, the given sound pressure and constant value of 2×10^{-5} Pa, respectively.

Results and Discussion

This study aimed to estimate the average noise levels generated by selected markets and motor parks in delta State, Nigeria to explore whether the noise levels are within the recommended standards or not. Measurements were performed twice a day at specific market locations and junctions, namely during the morning hours of 9-11 AM and the evening hours of 4-6 PM. Table 1 shows the noise level standard in some countries. The average sound levels recorded from different markets and motor parks in Delta State are presented in Tables 2 and 3 respectively.

Table 1. Noise Level Standard (dB) in Some Countries Compared With WHO and US, EPA[15]

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

While the average measured noise level for markets ranged from 74.04 dB in Ogwashi-Uku market to 76.14 dB in Oko market in the morning and 69.31 dB in Ogwashi-Uku Market to 77.20 dB in Ibusa Market in the evening, the average measured noise level for motor parks ranged from 73.08 dB in Delta Line Park to 77.56 dB in Central motor park in the morning and 66.43 dB in Delta Line Park to 75.81 dB in Onitsha Park in the evening. All these values exceed the WHO standard limit of 55 dB for commercial areas.

The estimated SPL for the eight locations ranged from 147.55 dBA in the morning and Central Motor Park Asaba to 148.02 dBA in Ogwashi-Uku motor park in the evening. However, for the evening period, the computed SPL for the eight locations ranged from 146.69 dBA in the Central Motor Park Asaba to 147.8 dBA in Ogwashi-Uku Motor Park.

Most of the noises in the motor parks were generated by traffic and commercial activities in the area. This is similar to the findings of previous studies[13,14] in which the predominant source of noise in the environment was mainly traffic noise. In addition to the traffic and commercial sources of noise, grinding machines used in the markets generated a significant amount of noise.

Figures 4 and 5 show that Central Motor Park and Ibusa Market had the highest noise level in the morning and evening respectively. Also, they all exceeded the WHO recommended standard.

It is observed in Figure 6 that noise levels in the markets were higher in morning compared to the evening periods. Commercial activities are always at the highest level in the mornings as the vendors and buyers will sell or buy their good at these early hours. The increase in commercial activities at this time results in the highest level of noise. The noise level in the evening is further reduced compared to the morning, as many vendors and buyers have likely left the market and returned home after their day's transactions.

Figures 7 and 8 show the counter maps of noise levels in the study area. The figures help to understand visualization of the noise distribution in the area. The noise level in morning and evening have been presented in the Figures.

Due to rapid growth of business in the most of the eight study areas, it is important to measure the noise pollution level. Some of the major effects of noise on human health were reported in this study. The results of noise pollution level measurements at Ogwashi – Uku Market, Ogwashi – Uku Motor Park, Nwasi Motor Park, Ibusa Market, Central Motor Park Asaba, Onitsha Park, and Oko Market Asaba indicated the values that surpass the World Health Organization (WHO) standard of 55 dBA for both daytime and nighttime outdoor environments.[16-18] Those who are living and working in these environments are

Table 2. Noise Level (dB) in the Selected Commercial Area (Markets)

Location	Time (9-11 AM) (4-6 PM)	Noise Level (Leq)				L_{NP}	SPL
		Min	Max	Average	σ		
Ogwashi – Uku Market	AM	68.08	80.0	74.04	5.96	89.33	147.62
	PM	63.72	74.9	69.31	5.59	83.65	147.04
Ibusa Market	AM	67.98	81.3	74.64	6.66	91.72	147.69
	PM	71.86	82.54	77.2	5.34	90.90	147.98
Oko Market	AM	70.62	81.66	76.14	5.52	90.30	147.86
	PM	67.78	74.86	71.32	3.54	80.40	147.87

SPL, sound pressure level.

Table 3. Noise Level (dB) in the Selected Motor Parks

Location	Time (9-11 AM) (4-6 PM)	Noise Level (Leq)				L_{NP}	SPL
		Min	Max	Average	σ		
Ogwashi – Uku Motor Park	AM	67.00	79.96	73.48	6.48	90.10	147.55
	PM	63.24	69.78	66.51	3.27	74.90	146.69
Nwasi Motor Park	AM	67.28	80.30	73.79	6.51	90.49	147.59
	PM	68.72	80.68	74.7	5.98	90.04	147.70
Central Motor Park Asaba	AM	74.04	81.08	77.56	3.52	86.59	148.02
	PM	69.78	78.36	74.07	4.29	85.07	147.62
Delta Line Park Asaba	AM	66.44	79.72	73.08	6.64	90.11	147.50
	PM	59.8	73.06	66.43	6.63	83.44	146.68
Onitsha Park	AM	67.84	81.48	74.66	6.82	92.15	147.69
	PM	69.58	82.04	75.81	6.23	91.79	147.82

SPL, sound pressure level.

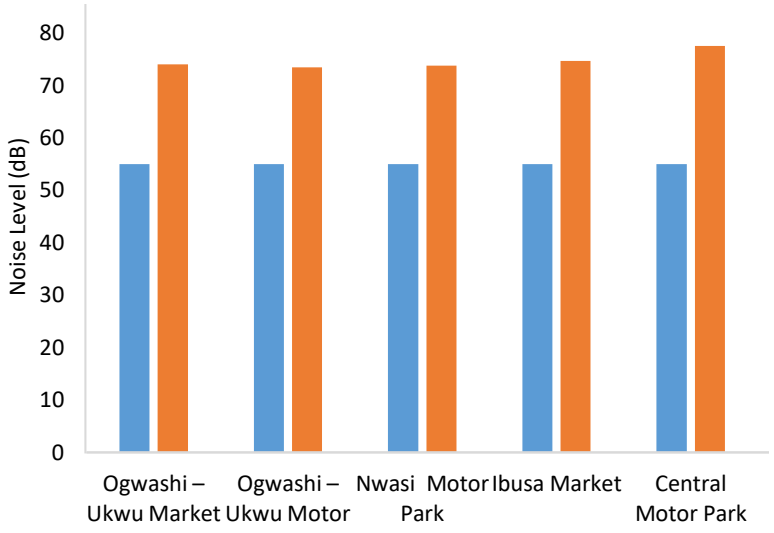

Figure 4. Comparisons of Morning Noise Levels at Nigeria (orange bar) with WHO Standard (blue bar) of 55 dBA for Out-door Limit at Day Time

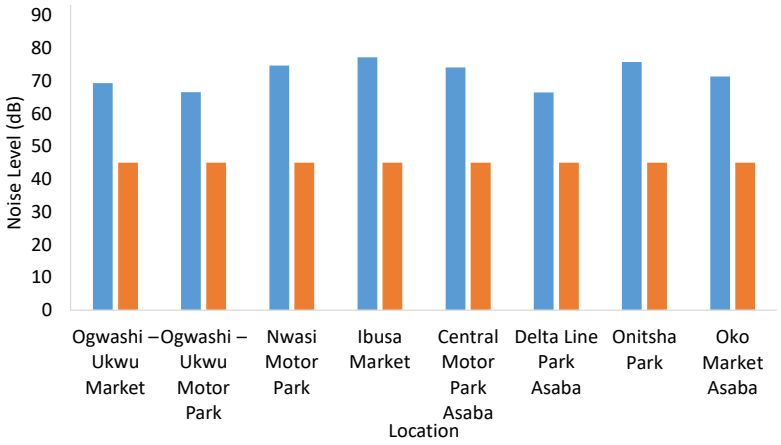

Figure 5. Comparison of Evening Noise Levels at Nigeria (blue bar) with WHO Standard (orange bar) of 45 dBA for Outdoor Limit at Night Time

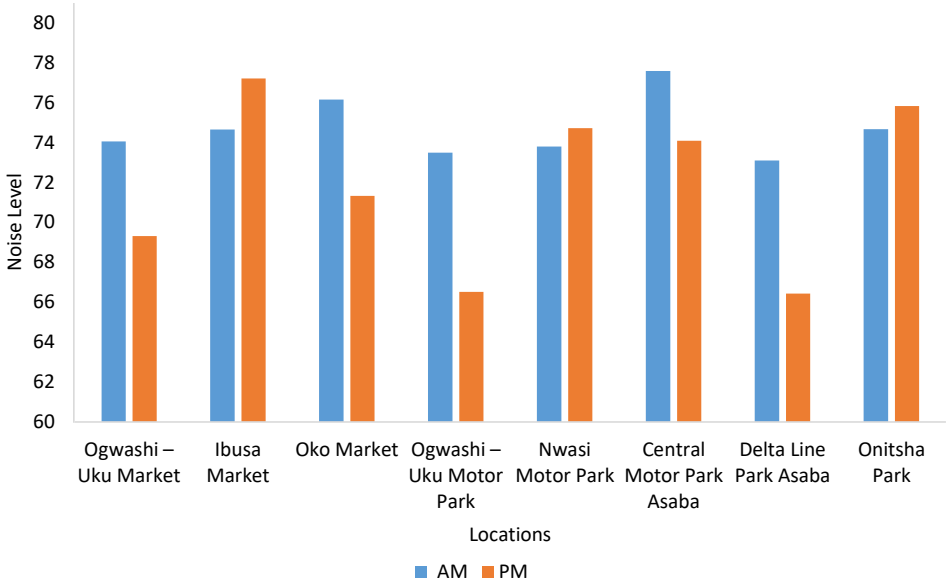

Figure 6. Comparison of Noise Level Between the Morning and in the Evening Hours

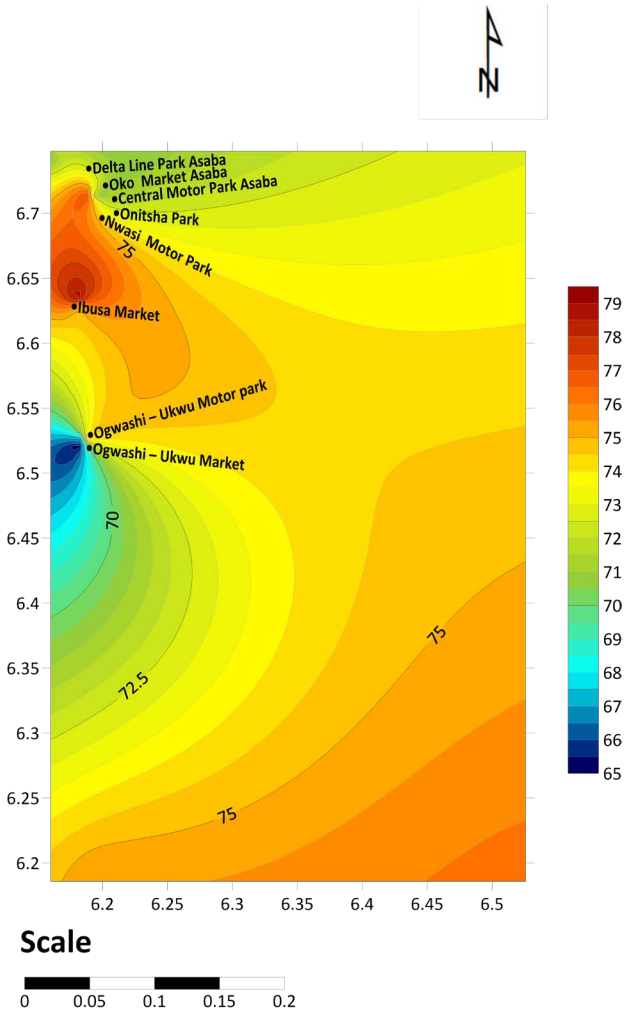

Figure 7. Contour Map of Study Area Morning Hours

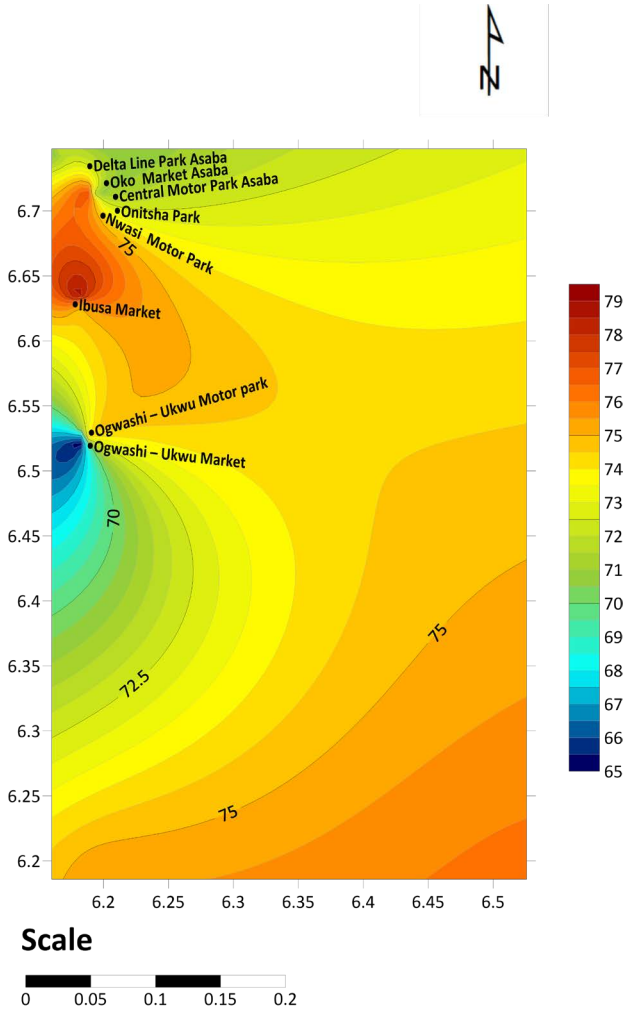

Figure 8. Contour map of Study Area During Evening Hours

at risk of adverse health effects. The SPL, Leq, LNP and Average Noise Level were all computed in this research. The data indicates that individuals residing and working in these eight locations may be at risk of noise-induced hearing loss (NIHL) due to prolonged exposure to these elevated levels of noise pollution.

Comparing this study with others, it has been observed that markets are considered to be noise-intensive environments.[1] This research also revealed that the noise pollution levels at the motor park are lower compared

with available data from other studies.

The highest noise level was 82 dB, which is lower than the recorded value of 92 dB by Ibekwe et al.[2] This is also lower than the 86 dB recorded in the heavily trafficked areas of Abraka, Delta State, Nigeria. However, this remains unsatisfactory, as noise of such magnitude from these sources could pose significant health hazards of varying classes and magnitudes, including cardiovascular disorders. Sorensen et al[19] noted that a 10 dB increase in chronic exposition of noise in humans increases the risk of cardiovascular accident and systolic blood pressure by 14% and 0.26 mmHg, respectively.

Conclusion

The evaluation of noise pollution levels in selected markets, junctions, and motor parks was conducted in the eight locations namely Ogwashi – Uku Market, Ogwashi – Uku Motor Park, Nwasi Motor Park, Ibusa Market, Central Motor Park Asaba, Onitsha Park, and Oko Market Asaba. The results showed that all the industrial clusters had noise levels that exceeded the WHO standard, making them dangerous to the health of individuals residing around these areas. The noise quality description of these clusters showed that the noise levels were not healthy for human. Prolonged exposure to these noises may lead to hearing impairment which may gradually lead to NIHL that may be temporary or permanent. There was no limitation to the study

Authors' Contribution

Conceptualization: Blessing Okeoghene Ijabor, Jatari Timothy Efere, Onome Orioge.
Data curation: Blessing Okeoghene Ijabor, Jatari Timothy Efere, Onome Orioge, Fransisca Ngozi Agu, Oghenerabome Blossom Ogodo, Blessing Chiwendu Okei.
Formal analysis: Efere Jatari Timothy.
Funding acquisition: Onome Orioge, Fransisca Ngozi Agu, Oghenerabome Blossom Ogodo, Blessing Chiwendu Okei.
Investigation: Blessing Okeoghene Ijabor, Jatari Timothy Efere, Onome Orioge, Fransisca Ngozi Agu, Oghenerabome Blossom Ogodo, Blessing Chiwendu Okei.
Methodology: Jatari Timothy Efere.
Project administration: Blessing Okeoghene Ijabor.
Supervision: Blessing Okeoghene Ijabor.
Visualization: Blessing Okeoghene Ijabor.
Writing–original draft: Blessing Okeoghene Ijabor.
Writing–review & editing: Blessing Okeoghene Ijabor.

Competing Interests

The authors declare no conflict of interest.

Ethical Approval

All ethical principles were considered in this article.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

References

1. Joshua YG, Onoja S, Jatau RY. Evaluation of noise level in selected markets in Jos-North, Plateau state. Int J Res Environ Sci. 2020;6(3):27-35. doi: 10.20431/2454-9444.0603003 .
2. Ibekwe T, Folorunso D, Ebuta A, Amodu J, Nwegbu M, Mairami Z, et al. Evaluation of the environmental noise levels in Abuja municipality using mobile phones. Ann Ib Postgrad Med. 2016;14(2):58-64 .
3. Salami JT, Sawyerr HO, Oluwatuyi VS. The state of noise levels in major motor parks in Ilorin metropolis, Kwara state, Nigeria. Int J Res Innov Appl Sci. 2020;5(9):151-7.
4. Akpan AO. Environmental noise pollution and impact in major markets of Akwa Ibom state, Nigeria. Glob J Hum Soc Sci. 2018;18(1):1-6.
5. WHO. Deafness and Hearing Loss Fact Sheet. World Health Organization Media Centre. 2015. https://www.who.int/mediacentre/factsheets/fs300/en/.
6. Anomohanran O. Evaluation of environmental noise pollution in Abuja, the capital city of Nigeria. Int J Res Rev Appl Sci. 2013;14(2):470-6.
7. Raymond TA, Akogwu EA, Tracy IK, Kever DG, Ntuk J. Assessment of levels of noise pollution at Wurukum and North Bank areas of Makurdi, Benue state Nigeria. Trends Appl Sci Res. 2020;15(1):43-53.
8. Onuu MU. Environmental noise control: review and assessment of theories and models. Niger J Phys. 1999;11:91-6.
9. Oyedepo SO. Environmental noise pollution in Ilorin metropolis, Nigeria. Nat Environ Pollut Technol. 2012;11(4):553-67.
10. Avwiri GO, Nte F. Environmental sound quality of some selected flow stations in the Niger Delta of Nigeria. J Appl Sci Environ Manag. 2003;7(2):75-7. doi: 10.4314/jasem.v7i2.17215.
11. Parzych D. Handling of Barriers in ISO 9613-2. Baltimore, Maryland: NOISE-CON; 2004. Available from: http://poweracoustics.com/Tech%20Papers%20PDF/NoiseCon_2004_Paper.pdf.
12. Nwaogozie JL, Owate IO. Noise pollution modeling of Port Harcourt refinery part 1&2. Technical Journal of Nigerian Society of Engineers. 2000;35(1):92-104.
13. Nelson PM. Transportation noise. Noise Control Eng Journal. 1998;46(4):159-166.
14. Olayinka OS, Abdullahi SA. Changing noise climate of Ilorin metropolis. Environ Eng Sci. 2008;25(6):797-808. doi: 10.1089/ees.2007.0018.
15. Chauhan A, Pawar M, Kumar D, Kumar N, Kumar R. Assessment of noise level status in different areas of Moradabad city. Rep Opinion. 2010;2(5):59-61.
16. World Health Organization (WHO). Occupational and Community Noise. WHO-OHS; 2005.
17. WorkSafeBC. Basic Noise Calculations. 2009. Available from: http://www.worksafebc.com.
18. WHO. (1998). Environmental Criteria and Standard: Noise Abatement and Control, 24 CFR parts 58.
19. Sørensen M, Hvidberg M, Hoffmann B, Andersen ZJ, Nordsborg RB, Lillelund KG, et al. Exposure to road traffic and railway noise and associations with blood pressure and self-reported hypertension: a cohort study. Environ Health. 2011;10:92. doi: 10.1186/1476-069x-10-92.