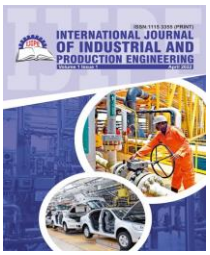

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ASSESSMENT OF NOISE POLLUTION LEVELS IN ONITSHA METROPOLIS: A CASE STUDY OF MAJOR DISTRICTS.

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ABSTRACT

Noise pollution is an increasingly pressing issue in urban areas around the world, including Onitsha, Nigeria. This study aims to assess the noise pollution levels in the several districts of Onitsha such as Onitsha main market, Awada, Fegge, Okpoko, Inland town, Woliwo and GRA, through identifying the hot spots and taking the noise readings using the sound level meter, calculating the noise levels using the decibel models and to analyse the results to identify the noise situation of the city. Through a combination of field measurements, surveys, evaluations and literature review, this research provides a comprehensive overview of the noise pollution problem in Onitsha and suggests practical solutions to mitigate its effects. Results show that districts like Onitsha main market, Woliwo, Awada, etc., have unsatisfactory daytime levels of noise of 90.2db, 89.8db, 84.8db respectively, only GRA have a noise level that is satisfactory (76.6db), hence, to control this unsatisfactory noise levels a control measure are outlined and recommendations given.

Keywords: Noise pollution, Onitsha, noise levels, noise measuring meter, decibel models.

1. Introduction

Noise can be broadly defined as "any unwanted or disruptive sound" (Smith, 2020; Darbyshire et al., 2019; Josua et al., 2020). It can be temporary or continuous, it can be natural (e.g., Thunder) or human made (e.g., Music, Machinery) (Akpan, 2018). On the other hand, the term “Noise Pollution” can be defined as an excessive and harmful noise that contaminates the environment.

Noise pollution is a frequently underestimated environmental issue with serious consequences for public health and urban living (Idoko et al., 2021). Noise pollution, defined as any undesired or unpleasant sound that interferes with regular tasks, can have a variety of negative consequences, including hearing loss, stress, sleep difficulties, and lower productivity (World Health Organization [WHO], 2018). Noise pollution is especially significant in metropolitan areas with high population density and human activity, and it can cause structural damage (Olayinka, 2012; Smith & Brown, 2018).

Noise pollution, a growing and environmental concern, is the excessive and unwanted sound that can harm human health, wildlife, and the environment, prolonged exposure to high noise levels can lead to hearing loss, sleep disturbances, cardiovascular diseases, and mental health issues (Ibekwe et al., 2016; Basner et al., 2014; Salami et al., 2020).

Onitsha, a bustling commercial city in southeastern Nigeria, is no exception to this global issue. Known for its vibrant markets, heavy traffic, and industrial activities, Onitsha faces significant noise pollution challenges. The rapid urbanization and economic growth in the city have worsened noise levels, impacting the quality of life for its residents (Anomohanran, 2013; Raymond et al., 2020). However, Ijabor et al. (2024) & Oguntunde et al. (2019) established that 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. Despite its importance, noise pollution in Onitsha has not been thoroughly studied, leaving a gap in understanding its extent, sources, and impacts.

The city major districts and junctions, such as Onitsha main market, Upper Iweka, and Owerri Road, are particularly affected due to high traffic volume, industrial activities and social events. Despite the growing concern about noise pollution, there is a lack of comprehensive studies on the subject in Onitsha metropolis. This demographic tended to be more predisposed to the environmental effects of noise levels above the human-specified receiving threshold as advised by the WHO for various categories of anthropogenic activities, because they frequently found themselves working in areas with high levels of human activity and where noise pollution is not regulated (Tunde & Abdulquadri, 2021). Existing studies have focused on specific sources of noise pollution, such as traffic or industrial noise (Ugbebor & Yorkor, 2015; Farooqi et al., 2020), but a holistic assessment of noise pollution levels in the city is needed. A similar study carried out by Ohaeri & Obafemi (2024) identified that vehicular traffic accounted for 33%, 42%, 39% and 40% of cause of noise pollution in Yenagoa, Port Harcourt, Uyo and Calabar respectively, while Yenagoa recorded 12%, Port Harcourt 15%, Uyo 13% and Calabar 17% noise from generating sets. In addition, Onwuka et al. (2017); Datti & Okonkwo (2020), found that traffic and generating plants are also significant sources. However, the study concentrated on the investigation of noise pollution from generators on the people at Robinson Plaza, Effurun, Delta state, Nigeria. The least source of in the area is noise from aircraft which was 1%, 5%, 1%, and 5% for Yenagoa, Port Harcourt, Uyo and Calabar respectively. Followed by neighbourhood noise recorded as 3% in Yenagoa, 2% in Port Harcourt, 5% in Uyo and 3% in Calabar.

This study aims to bring this knowledge gap by assessing noise pollution level in Onitsha metropolis, with a focus on major district and junctions. The study will provide a comprehensive understanding of the noise pollution situation in the city, identify areas with high noise levels, and inform strategies for mitigation and control.

2. Materials and Method

2.1 Research Approach

Based on the nature of this work, there is exchange of numeric data (Quantitative) between the hardware (noise gauge) and the software (decibel model) components of the system. Narrative data (Qualitative) are also gathered for identifying the suitable locations for the study, both the numeric and the narrative data are utilized in the assessment of noise level in Onitsha. Hence, the research approach adopted for this study is the mixed approach (Okeagu and Mgbemena 2022; Onuoha, et. al., 2022; Mgbemena and Okeagu 2023)**.**

2.2 Materials Used for the Study

The research adopted measurement of noise levels with the use of a Sound Level Meter (SLM) for field data collection using standard procedures (Fig. 1). A total of forty sampling points and one

control point were selected and used for the study across Onitsha metropolis. The sampling points were selected in accordance with World Health Organization (WHO) 2005 guidelines for sampling point selection at the designated study areas.

Fig. 1: Digital Sound Level Meter 200663

The decibel model is then used to evaluate the noise levels of the locations under study.

2.3. Methodology

The study area coverage is approximately 16kilometer square and is located in Onitsha commercial city and three adjoining LGAs. Onitsha metropolis comprises of Onitsha North LGA, Onitsha South LGA, part of Oyi, Idemili & Ogbaru LGAs. It lies in the outer fringes of Eastern Nigeria.

The datum point is Borromeo/Ziks roundabout with latitudes N 06º 08'.801" and longitudes E 006º 48'. 831" and Control point at Ideani/Nnobi–Nkpor Rd junction in Idemili LGA which lies within latitudes N 06º 05'. 282" and longitudes E 006º 55'.891". In the 2006 Nigerian census, Onitsha had an estimated population of over quarter a million people. It's urban area has been projected to reach around 6,000,000 inhabitants in 2021.

There are basically two seasons obtainable in Onitsha zone in particular and Anambra state in general. These are the Dry and Rainy seasons. But in recent time, there is death of exquisite harmattan, which has elicited complaints from farmers and agriculturists. These may not be unconnected with climate change and global warming as a result of man's activities, developments and insensitivity to nature and no thought or plan for environmental sustainability.

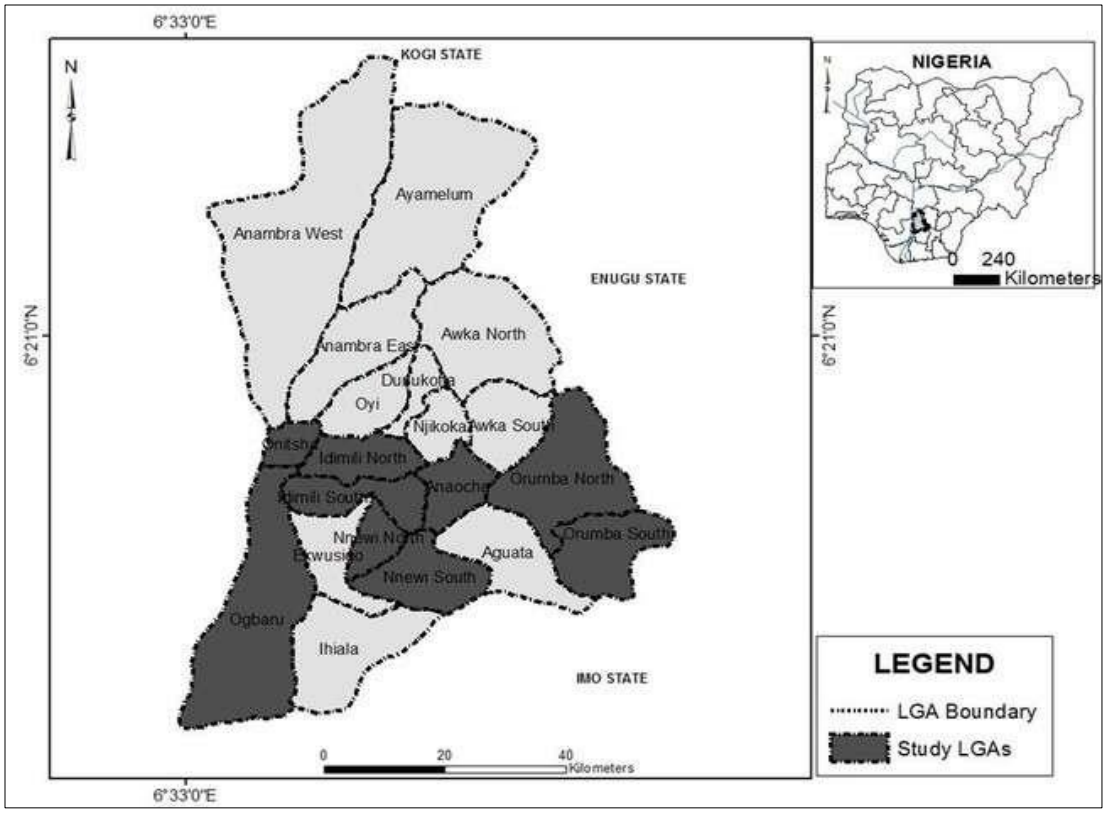

Fig. 2: Map of Anambra State Showing Onitsha Metropolis

Firstly, the major districts in Onitsha are identified, such as Upper iweka, main market, fegge etc (Fig. 3). The noise level readings in the various district are recorded. Noise measurement was carried out in all the sampling stations in the morning, afternoon and evening (8am – 9am, 11am – 12pm, 4pm – 5pm, and 8pm - 9pm). The sound level meter was held upright at arms level in a suitable and stable elevation without shaking and turned on at the power button of the device. The instrument was set at automatic mode to run continuously for 20 – 30 mins. This is because the instrument faithfully follows all the fluctuations, stores them in its memory and at the end of the measurement calculates the Maximum and Minimum energy which is recorded in decibels (dBA), but only the maximum noise level obtained are considered.

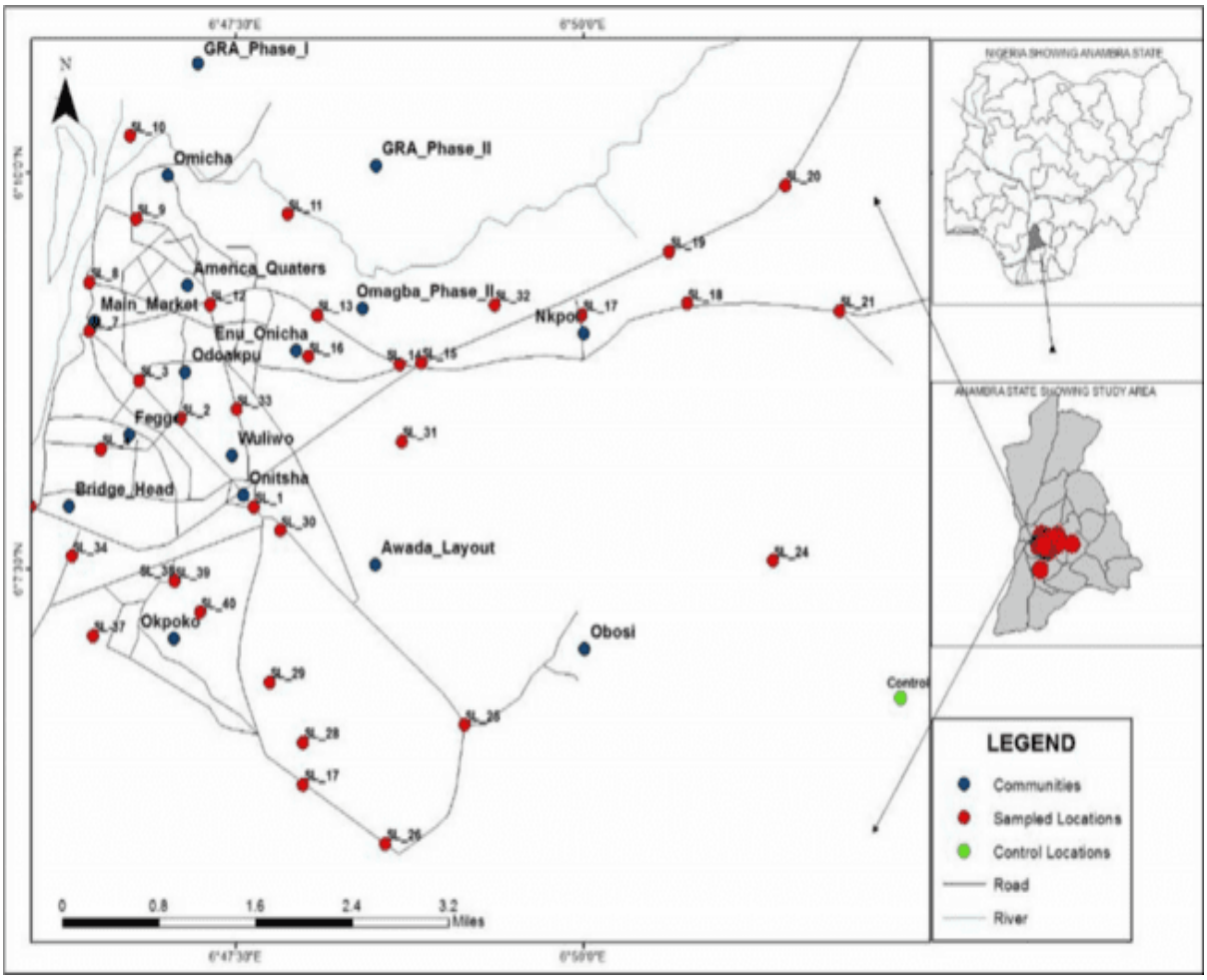

Fig. 3: Map of Description of the Study Area

2.3.1 Derived Equation Used to Evaluate the Day Time Noise Level, Night Time Noise Level, and the Day-Night Noise Levels.

The measured equivalent noise level are the input data in the calculation of the day time noise level (L_D) and the night time noise level (L_N). These calculations are carried out using the decibels equations, equations 1 and 2 (Olayinka, 2012).

$$L_D = 10\ log\left[\frac{1}{2}\left\{\left(10^{L_{AeqM}/10}\right) + \left(10^{L_{AeqA}/10}\right)\right\}\right] \quad (1)$$

$$L_N = 10\ log\left[\frac{1}{2}\left\{\left(10^{L_{AeqE}/10}\right) + \left(10^{L_{AeqN}/10}\right)\right\}\right] \quad (2)$$

Where,

L_{Aeq} = The A-weighted equivalent sound pressure level

L_{AeqM} = The equivalent sound pressure for the morning measurement

L_{AeqA} = The equivalent sound pressure level for the afternoon measurement

L_{AeqE} = The equivalent sound pressure level for the evening measurement

L_{AeqN} = The equivalent sound pressure level for the night measurement

L_D = Day time noise level

L_N = Night time noise level

The results obtained from equations 1 and 2, are applied to determine the day-night noise level (L_{DN}) of the City. This is carried out by using the relation shown in equation 3 (Olayinka, 2012).

$$L_{DN} = 10\ log\left[\frac{1}{24}\left\{\left(15 \times 10^{L_D/10}\right) + \left(9 \times 10^{(L_N+10)/10}\right)\right\}\right] \quad (3)$$

The equations are used to calculate noise levels of the identified locations, the results are compared to the standard noise levels as stipulated by the World Health Organization (WHO). The locations with high noise levels are identified, and measures for noise control given.

3. Results and Discussions

The record of noise level for the 35 locations in the city is presented in table 1. Table 1 shows the seven districts in the city and the various measuring points where measurements were taken. It also contains the day time sound level, the night time sound level and the day-night sound level calculated using equations 1, 2 and 3 respectively.

The results obtained from equation 1, 2 and 3 were compared with the day time and night time noise quality classification index as shown in table 2.

Table 1: Results of the equivalent noise level of different locations in Onitsha.

Districts	Locations	L_D (dBA)	LN (dBA)	L_{DN}	Mean L_D (dBA)	Mean L_N (dBA)	Mean L_{DN}
Onitsha Main market District (OMMD)	Main Market	103	84	105	91.2	65.6	90.2
	New MotorPark	87	59	83			
	Ochanja Market	94	69	94			
	Sokoto Road	83	54	81			
	Menax Market	89	62	88			
Awada District	Awada Layout.	88	53	86	84.8	56.8	84.6
	Awada Market	85	61	85			
	St.Mary Catholic Church	85	52	83			
	Awada Primary School	80	48	78			
	Niger Street	86	70	91			

Fegge District	Fegge Market	90	64	89			
	Fegge Onitsha Primary School	82	56	81			
	Christ the King Catholic Church	82	57	82			
	Fegge Junction	87	62	87			
	Hausa Quarters	86	53	84	85.4	58.4	84.6
Okpoko District	Okpoko Market	85	57	83			
	Okpoko Pri. Sch	82	47	80			
	St Joseph Church	79	60	77			
	OkpokoWaterfront	81	60	79			
	NEPA Office	86	57	84	82.6	56.2	81
Inland Town District	InlandTownPrimary School	81	54	80			
	InlandTownMarket	87	48	85			
	St.JohnAnglican Church	80	62	83			
	InlandTown Hall	86	60	85			
	Owerri Road	92	67	92	85.2	58.2	85
Woliwo District	Woliwo Layout	88	73	93			
	Woliwo Market	97	78	99			
	Woliwo Primary School	84	46	82			
	Woliwo Junction	92	75	96			
	Onitsha/Obosi Road	88	77	87	89.8	69.8	91.4
Government Residential Area (GRA) District	Government House	77	52	77			
	Anambra State High Court	80	54	79			
	Onitsha Local Government Secretariat	73	46	72			
	Onitsha General Hospital	75	49	74			
	GRA Pri. Sch	78	52	77	76.6	50.6	75.8

Table 2: Noise quality description for day time and night time duration (WHO).

Leq (dBA)	Day-time Noise Quality Description	Leq (dBA)	Night-time Noise Quality Description
0 – 30	Excellent Quality	0 – 30	Excellent Quality
31 – 40	Very good quality	31 – 40	Very good quality
41 – 60	Good quality	41 – 50	Good quality
61 – 75	Satisfactory quality	51 – 65	Satisfactory quality
76 – 90	Unsatisfactory	66 – 75	Unsatisfactory
91 – 110	Hazardous quality	76 – 90	Hazardous quality
>111	Not allowed	> 90	Not allowed

Analysis of table 1 using the model shows that the Onitsha Main Market Districts (OMMD) has the highest day time equivalent noise value of 91.2 dBA in the city. This high value is attributed to the fact that the area is the bill hap of activities during the day time. The volume of vehicles plying the network of roads in the area is very high coupled with the high business activities going on in this area on a daily basis. This result agrees with the finding of Onwuka et al. (2017); Datti & Okonkwo (2020), that most environmental noise results from road traffic and commercial activities.

The day time equivalent noise level of Woliwo district is next to Onitsha Main Market District with a value of 89.8 dBA. This area is also characterized by high traffic built up, commercial and business activities.

GRA and Okpoko districts have less commercial and business activates hence their day time mean equivalent noise level is comparatively lower with values of 76.6 and 82.6 dBA respectively. Fegge and Inland Town district have a day time noise level of 85.4 and 85.2 dBA respectively.

The map showing the day time noise spread of the city is presented in Figure 4. Figure 4 shows that the noise value reduces from the Onitsha Main Market District (OMMD) in all direction.

The night time mean equivalent noise measurement shows that Woliwo District possess the highest value of 69.8 dBA followed by Onitsha Main Market District with a value of 65.6 dBA. The rest of the districts have values less than 60 dBA with the least being the GRA District with a value of 50.6 dBA. This is followed by Okpoko District with a noise value of 56.2 dBA. The reason for the low value from GRA is the lack of commercial and residential activities in this area at night. You could only occasionally hear the sound of vehicles plying the road.

Woliwo and Onitsha Main Market districts are characterized by commercial and residential activities during the night hence they possess the highest values of night time equivalent level as shown in Table 4.

Awada and Okpoko districts are high profile residential area with very little or regulated commercial activities during the night. This accounts for the low noise value recorded for both districts.

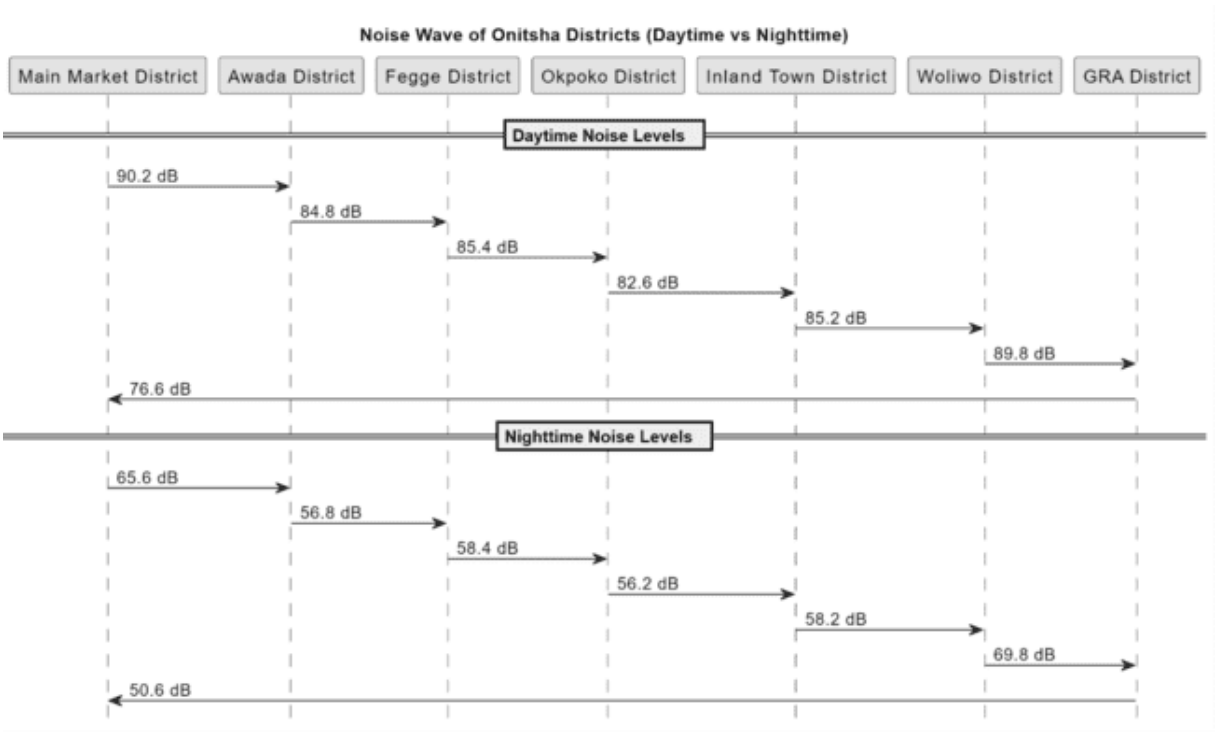

Fig. 4: Noise Wave of Onitsha Districts (Daytime vs Nighttime)

With Figures 3 & 4, one can decide where to work if he has an option and where to live. Even where there is no option of where to work, one can decide where to live in to cushion the effect of noise from work environment.

- Both Woliwo and Main Market districts experience high noise levels during the daytime, with Main Market being slightly louder than Woliwo.
- At night, the noise significantly reduces in both districts. However, the Main Market District shows a greater reduction (24.6 dB) compared to Woliwo (20 dB), indicating a more dramatic drop in noise levels at night.
- Main market located in the central part of the city and according to the map in Figure 3, the noise level moves out away from the center then to the southern part of the city and then to the various location of the city. This indicated that the central part of the city is more populated with markets which draws industrial activities towards it, hence, in need for noise mitigation strategies.
- Woliwo district is located at the southern part of this city, Noise travels from the central part of the city to the southern part, the noise level recorded from this district in the day time was high and this can be caused because this district has few buildings which can amplify wind level due to open space. This high wind level amplifies the noise coming from the central region and also the noise coming within due to traffic and industrial activities.

- GRA district has the least noise level. This is because;

1. GRA is predominantly a residential area, which typically has less commercial and industrial activity compared to other districts like Main Market or Woliwo. This leads to fewer noise sources, resulting in a quieter environment.

2. Zoning Regulations: The area is often subject to zoning laws that restrict noisy activities, such as factories or heavy commercial operations, which helps maintain lower noise levels.

3. Reduced Traffic: Compared to busier commercial districts, GRA experiences lower traffic volumes. Fewer vehicles on the roads mean less noise from honking, engines, and tire noise.

4. Natural Barriers: The presence of trees, parks, and other natural elements can help absorb sound and act as a buffer against noise pollution from surrounding areas.

5. Distance from Noise Sources: GRA's distance from major sources of noise, such as markets, industrial zones, and highways, further contributes to its quieter environment.

Table 5: Day time and night time noise quality level of the city.

	Day time		Night time	
LOCATIONS	Leq (dBA)	Noise Quality Description	Leq (dBA)	Noise Quality Description
Onitsha Main Market District	90.2	Not Allowed	65.6	Satisfactory
Awada District	84.8	Unsatisfactory	56.8	Satisfactory
Fegge District	85.4	Unsatisfactory	58.4	Satisfactory
Okpoko District	82.6	Unsatisfactory	56.2	Satisfactory
Inland Town District	85.2	Unsatisfactory	58.2	Satisfactory
Woliwo District	89.8	Unsatisfactory	69.8	Unsatisfactory
GRA District	76.6	Satisfactory	50.6	Good quality

Analysis of the night time noise level as shown in Table 5, reveal that Only GRA District possess good quality noise level. Woliwo have night time noise level that is Unsatisfactory. Hence living in these parts of Onitsha that its noise quality are described as unsatisfactory is not conducive and safe noise wise.

Other Districts like Fegge, Onitsha main market, Inland Town and Okpoko possess night time noise level that is satisfactory. Hence, living in the city at night is conducive and safe noise wise. The day-night noise level as determined from this study revealed that the mean day-night noise level in Onitsha Main Market is 90.2 dBA, Awada district is 84.6 dBA, Fegge district is 84.6 dBA, Okpoko district is 81 dBA, Inland Town district is 85 dBA, Woliwo district is 91.4 dBA and GRA district is 75.8 dBA.

Analysis of the day-night noise level shows that Onitsha main market and Woliwo distrcts have a day-night noise level that is not allowed. Awada, Fegge, Okpoko and Inland Town districts have a day-night noise quality level that is unsatisfactory. Only GRA districts have a satisfactory noise quality level.

4. Conclusion

Onitsha, a bustling commercial city in southeastern Nigeria, is known for high levels of noise pollution due to its vibrant business activities, dense population, and heavy traffic. Major contributors to the city's noise pollution include vehicular traffic, markets, industrial operations, religious activities (loudspeakers from churches and mosques), and social gatherings. The situation is compounded by poor urban planning and a lack of effective noise control policies.

First, sampling points which are the major junctions and districts in Onitsha metropolis were identified, and located using their coordinates. Readings from the various sampling points were taken, A total of 7 major districts in Onitsha were selected for the study, readings were taken in 5 locations each of the districts using noise meter (Figure.1)

Readings from the sampling points were taken using the noise meter in the morning, afternoon and evening (8am – 9am, 11am – 12pm, 4pm – 5pm, and 8pm - 9pm). The noise data collected from this various locations were used to find the daytime noise level, nighttime noise level and day night noise level (Table 1) and this was done using the decibel models (Equation 1,2 & 3)

The daytime and the nighttime noise levels calculated and compared to the standards recommended by the WHO (Table 2). It was discovered that most areas in Onitsha e.g. main market, woliwo, awada etc., has a very high noise level that exceeds the normal noise level recommended by the WHO (Table 5).

This study has exposed the high noise level in Onitsha and the dangerous effect on the millions of residents living in the area or doing business. The government, non-governmental organizations, and the people should join hands together to tackle this menace. The following measures can be applied to mitigate the noise pollution in most of these districts in Onitsha. The measures are divided into 4 control strategies, from the control at source e.g. vibration control, barrier, etc., control in transmission path e.g. noise barrier along highway, etc., control from receiver e.g. implementing noise cancellation devices like ear pods, etc., and control by implementing government policies; such as proper urban planning etc.

Future works are recommended especially on the noise health impact assessment, and the need for government to implement different noise regulation policies. Recording and calculating the noise levels in different seasons will give a more robust document that will give guide the authorities on the approach to adopt.

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