



ASSESSMENT OF AMBIENT NOISE LEVEL AND MICRO-CLIMATIC PARAMETERS AT SELECTED CONSTRUCTION SITES IN OGBA/EGBEMA/NDONI LOCAL GOVERNMENT AREA, RIVERS STATE

ANI, CHIDIEBERE T.¹ AVWIRI, GREGORY O.² & UGWOHA, EJIKEME³

^{1,2 and 3;} Centre for Occupational Health, Safety and Environment, Institute of Petroleum Studies, Faculty of Engineering, University of Port Harcourt, Rivers State, Nigeria

^{3;} Department of Civil and Environmental Engi, University of Port Harcourt, Rivers State, Nigeria

Lead Author's Email; online2tochi@gmail.com

Abstract

This study assessed ambient noise levels and micro-climatic parameters at selected construction sites in Ogba/Egbema/Ndoni LGA (ONELGA) Rivers State, Nigeria. Three active construction sites located in Ubeta, Obite, and Akabuka/Ubarama were selected based on the intensity of ongoing construction activities. A cross-sectional field design was adopted, and data were collected using a sound level meter to measure noise levels, and an ambient weather meter to record temperature, relative humidity, wind speed, and wind direction. Measurements were collected once weekly over a thirteen-week period, after which noise descriptors including LAeq, L10, L90, Lmax, Lmin, Lav and Noise Pollution Level (LNP) were computed. Pearson correlation analysis was used to examine the relationship between noise and micro-climatic variables and to test for significant differences across sites. Findings revealed that all sites exhibited similar noise sources, dominated by heavy-duty machinery, vehicular movements, metal works, power generators, and human activity. Recorded noise levels ranged from 54.2–89.4 dBA across sites, with mean equivalent continuous noise levels of 88.09 dBA at Ubeta, 79.83 dBA at Obite, and 80.52 dBA at Akabuka/Ubarama. These values exceeded FME and WHO 70 dBA permissible limit for industrial/commercial zones. Computed LNP values indicated highly polluted acoustic environments. Correlation analysis showed weak associations between noise and micro-climatic factors, showing that noise levels were influenced more by construction activities than by atmospheric conditions. The study concludes that construction sites in the area expose workers and nearby communities to noise levels above recommended limits, posing risks of hearing damage, stress, and reduced productivity.

Keywords:

Ambient Noise Level, Micro-Climatic Parameters Construction Sites, Ogba/Egbema/Ndoni LGA, Rivers State.

1. INTRODUCTION

The issue of environmental noise has received increasing attention in recent years due to its strong association with rapid infrastructural development, population growth, and the expansion of urban areas. In Nigeria, over 60% of urban residents in major cities are exposed

to noise levels exceeding 80 dB, which is significantly higher than the World Health Organization's recommended daytime limit of 55 dB for outdoor living areas in residential environments (Adebayo & Umeh, 2021). Unlike transient noise events, construction noise is typically repetitive and sustained, making it particularly disruptive to both construction workers and nearby communities. These characteristics underscore the need for continuous monitoring, effective noise management strategies, and mitigation measures to reduce the adverse effects of construction-related noise pollution. Ongoing construction and operational activities within the oil and gas sector generate continuous and high-intensity noise levels that frequently exceed recommended environmental standards (Chukwu & Eze, 2022). Prolonged exposure to such noise may result in adverse health effects such as hearing impairment, occupational stress, hypertension, sleep disturbance, and reduced work efficiency.

Although environmental regulatory agencies have established guidelines to control industrial and urban noise, enforcement in many oil-producing communities remains inadequate. This situation has created a pressing need to assess the extent of noise pollution in areas such as Ogba/Egbema/Ndoni Local Government Area (ONELGA) and to examine its potential health implications for both workers and nearby residents. Systematic evaluation of noise exposure is therefore essential not only for ensuring compliance with regulatory standards but also for identifying high-risk zones, informing mitigation strategies, and protecting public health and occupational wellbeing in regions experiencing intensive construction and industrial activities.

Research in bioclimatic design further emphasizes that microclimate regulation is critical for sustainable building practices and maintaining human comfort (Sakenova et al., 2024). In the context of construction sites, understanding and managing the interaction between noise and microclimatic variability is therefore essential for occupational health, environmental quality, and the development of effective mitigation strategies. Simultaneously, construction activities and built structures modify local climatic factors, reinforcing urban heat islands, altering wind patterns, and influencing precipitation (Abdeslam, 2016; Sakenova et al., 2024).

The combined effects of noise and microclimatic variability make construction sites particularly hazardous for both workers and surrounding communities. This interaction highlights the critical need for integrated assessment approaches that simultaneously consider acoustic and microclimatic factors. Such comprehensive evaluations are essential for developing effective mitigation strategies and ensuring the protection of occupational health, environmental quality, and community wellbeing.

Ambient noise levels at construction sites often exceed recommended thresholds, and workers exposed to such levels face risks of hearing impairment, hypertension, sleep disturbance, and stress (Geetha & Ambika, 2015). Studies on building construction microclimates highlight that environmental comfort is closely tied to acoustic quality (Majerska-Palubicka & Cibis, 2019). Similarly, vernacular and bioclimatic studies in India and Kazakhstan stress the importance of orientation, shading, and ventilation to mitigate microclimate variability, and reduce thermal discomfort and energy consumption (Gupta, 2023; Sakenova et al., 2024). The interaction between noise pollution and microclimatic variability is increasingly recognised as a critical factor in environmental and occupational health assessment. Research indicates that meteorological conditions such as temperature gradients, humidity, and wind speed significantly influence the propagation, attenuation, and amplification of sound across open construction sites.

As a result, measured noise levels may vary not only due to changes in construction activities but also because of prevailing atmospheric conditions. Understanding this interaction is therefore essential for the accurate interpretation of noise measurements and for the development of effective mitigation strategies aimed at protecting workers, nearby communities, and the surrounding environment. Simulation-based studies indicate that temperature and humidity are closely interrelated and must be carefully regulated to maintain safe and comfortable working conditions (Gao et al., 2022). Variations in these parameters

influence thermal stress, worker comfort, and overall site safety, particularly in outdoor construction environments where exposure to heat and moisture is prolonged.

The strong interaction between temperature and humidity highlights the importance of continuous microclimatic monitoring as part of occupational health and environmental management strategies. Noise pollution generated by heavy-duty construction equipment such as excavators, pile drivers, and generators has become an increasing environmental concern, particularly because many construction sites are located close to residential areas and public spaces. Prolonged exposure to high noise levels poses risks to both community wellbeing and occupational health. The combined influence of excessive noise and unstable microclimatic conditions significantly heightens environmental and public health risks within ONELGA's tropical setting (Legborsi et al., 2024).

Findings from nearby Obio/Akpor Local Government Area, where construction noise levels ranged between 67.30 dBA and 81.90 dBA, suggest that similar exposure risks are likely to occur in ONELGA due to comparable construction intensity and environmental conditions (Legborsi et al., 2024). Prolonged exposure to such elevated noise levels has been associated with adverse health effects, including hearing impairment, increased stress, and reduced quality of life for both construction workers and surrounding residents.

In ONELGA's humid tropical climate, where average temperatures range between 27°C and 32°C and rainfall is frequent, these activities can intensify heat stress and respiratory discomfort among outdoor workers (Chumu et al., 2023). Airborne dust and emissions also degrade air quality in nearby communities such as Egbema, Omoku, and Ndoni, where construction sites are often located close to homes, markets, and schools. The combined exposure to elevated noise levels and fluctuating microclimatic conditions presents a compounded environmental health risk. In ONELGA, weak enforcement of occupational health standards increases workers' vulnerability to these risks. Local residents also suffer similar consequences, as dust and constant noise interfere with daily routines and overall community well-being. Despite these evident challenges, there is limited research focusing on how noise and micro-climate variability affect both workers and residents in ONELGA. Most available studies concentrate on urban centres such as Port Harcourt. This study therefore seeks to bridge that gap by assessing noise levels and micro-climate variability at selected construction sites in ONELGA, and by evaluating their implications for worker and community health.

2. MATERIAL AND METHODS

2.1 Research Design

This study adopted a quantitative, field-based cross-sectional design to measure both sound levels and microclimatic parameters at selected construction sites in Rivers State. Data collection was conducted in the afternoon to capture peak construction activity and elevated temperatures, thereby ensuring the reliability and objectivity of the measurements. Sound levels were measured using a calibrated digital sound level meter, while microclimatic conditions including temperature, humidity, and wind were recorded using an ambient weather meter. Spatial analysis was performed using ArcGIS software to generate site maps and assess the distribution of environmental variables across the study area.

2.2 Study Area and sampling technique

The research was conducted at three construction sites located in Ubeta, Obite, and Akabuka/Ubarama, within Ahoada East and Ogba/Egbema/Ndoni Local Government Areas of Rivers State. The study area lies approximately between 5°00'–5°20' N latitude and 6°40'–6°55' E longitude and features a network of roads, rivers, and small settlements. Figure 1 shows the

spatial distribution of the study locations within Ogba/Egbema/Ndoni Local Government Area of Rivers State, Nigeria. The map highlights the three selected sites (Site 1, Site 2, and Site 3) sampled purposively where noise level and microclimate measurements were conducted. The boundary of the study area is clearly delineated, alongside relevant geographic features to provide spatial context. The coordinates of each sampling point are indicated on the map, enabling accurate identification of their positions within the study area. Additionally, the figure includes a scale bar and north arrow to aid orientation and distance estimation. This visual representation provides a clear overview of the study area and supports the spatial analysis of environmental parameters assessed in this research.

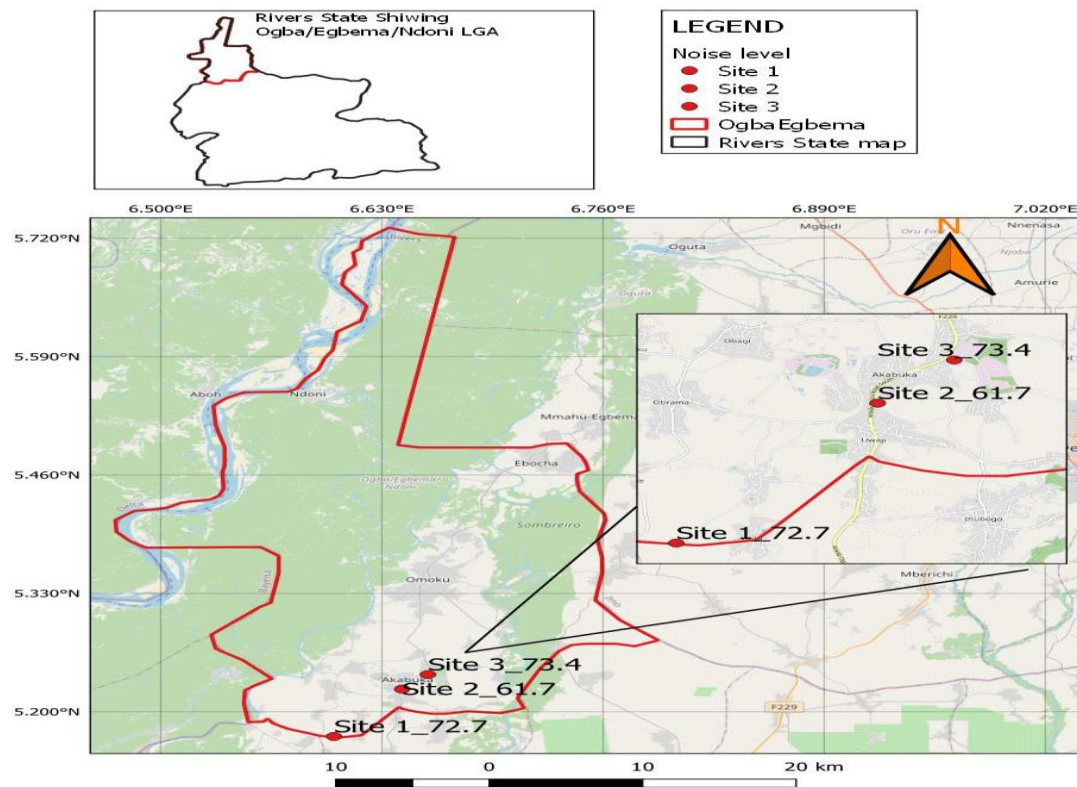


Figure 1 Study locations and coordinates

2.3 Nature Sources of Data

This study utilized both primary and secondary data. Primary data were collected using a REED R8080 digital sound level meter and a WM-4 Ambient Weather Meter at designated locations within the construction sites. A purposive sampling approach was employed to select sites based on accessibility, safety conditions, and the presence of active construction activities. The sound level meter was used to capture environmental noise levels, while the ambient weather meter recorded microclimatic parameters such as temperature, humidity, and wind speed.

Noise and microclimatic measurements were conducted twice weekly for a period of thirteen weeks at three selected construction sites. Ideally, this sampling schedule was expected to produce a total of 26 readings per site, resulting in 78 measurements across all sites. However, only Site 3 completed the full sampling schedule and recorded 26 readings. Site 1 and Site 2 recorded 20 and 19 readings respectively due to occasional community disturbances that prevented access to the sites on some scheduled sampling days. Secondary data sources included scholarly journal articles, conference abstracts retrieved from online databases, and electronic books. From these sources, information was obtained on permissible environmental noise limits, standard procedures for environmental noise measurement, microclimatic

parameters commonly assessed at construction sites, and the potential health and environmental impacts of noise pollution and microclimate variability. These materials were consulted to provide contextual understanding, support the methodological design of the study, and guide the interpretation and discussion of the results.

2.4 Methods and Instrument of Data Collection

The data collection process for this study was organised into two primary components: noise level measurement and microclimate assessment. Both components followed standardised field monitoring procedures designed to ensure precision, reliability, and comparability of data across the selected construction sites. The following instruments were employed for field measurements: REED R8080 Sound Level Meter (Type 2): The REED R8080 Integrating Sound Level Meter was used to measure environmental noise levels and WM-4 Ambient Weather Meter: The WM-4 Ambient Weather Meter was used to measure microclimatic variables including air temperature, relative humidity, wind speed, and wind direction. Garmin GPS 73 Handheld Navigator: The Garmin GPS 73 handheld navigator was used to obtain the precise geographic coordinates of each sampling location. Field Logbook: Utilized to document measurement conditions, observations, and any deviations from standard protocols and QGIS3.16.8(Quantum-GIS). All instruments were calibrated in accordance with manufacturer specifications prior to deployment and checked periodically during the measurement campaign to ensure data accuracy.

2.4.1 Noise Level Measurement

Noise levels at the selected construction sites were measured using a Reed R8080 Digital Sound Level Meter, which complies with IEC 61672 and ANSI S1.4.2 Type 2 standards and has a measurement range of 30–130 dB. The instrument was carefully calibrated before and after each measurement session to ensure accuracy and reliability. Measurements were conducted across the three sites during mid-morning to afternoon periods (11:00 am to 3:00 pm), once weekly over a thirteen-week (three-month) period, capturing peak construction activity. The sound level meter was mounted on a tripod at approximately 1.2 meters above ground level, with the microphone directed toward the primary noise source and positioned at least one meter away from reflective surfaces to minimise measurement errors due to sound reflections.

The collected noise data were used to compute key acoustic descriptors, including n-percent exceedance levels (L10, L50, and L90) and the Noise Pollution Level (LNP). Data organization and preliminary analysis were performed using Microsoft Excel, while inferential statistics, specifically Pearson's correlation, were applied to examine relationships between noise levels and selected microclimatic parameters. This systematic measurement procedure ensured that noise data accurately reflected environmental exposure conditions and supported meaningful analysis of both temporal and spatial variations in noise across the construction sites.

2.4.2 Microclimate Measurement

Microclimatic conditions were measured alongside noise levels to evaluate environmental variations across the different sites. A digital ambient weather meter with integrated sensors was used to record real-time readings of Air Temperature (°C), Relative Humidity, Wind Speed (m/s) and Direction. Readings were taken at the three sites where noise measurements were recorded. To maintain consistency and accuracy, all instruments were positioned at an average height of 1.5 meters above ground, approximately corresponding to the breathing zone of workers (Akande *et al.*, 2021). Measurements were carried out in the afternoon to capture daily variations linked to work intensity and weather patterns. The collected data provided insight

into the interplay between noise exposure and microclimatic factors such as heat, humidity, and wind speed.

2.5 Methods of Data Analysis

The data collected were analysed using descriptive statistics, noise indicators, and correlation analysis, aligning with the study objectives. Descriptive Statistics was used to compute mean, maximum, minimum, and standard deviation for noise and microclimatic variables across the three sites. Noise indicators such as Equivalent Continuous Noise Level (LAeq), and Noise Pollution Level (LNP).

1. Equivalent Noise Level

$$L_{eq} = 10 \log_{10} \sum_{i=1}^n 10^{\frac{L_i}{10}}(t_i) \quad (1)$$

Where, L_i = the noise level in dB of the i th measurement, n = the total number of measurements taken, t_i = fraction of the total measurement time. I used 1/6 for the t_i assuming you spent 2hrs each and a total of 12hrs

2. Noise Pollution Level, Lnp,

$$L_{\{np\}} = L_{\{eq\}} + k\sigma \quad (2)$$

Where; L_{eq} = The Equivalent continuous equal energy level. $K = 2.565$, σ = is the standard deviation of measured noise levels. L_{av} , L_{max} , L_{min} , L_{10} and L_{90} were also derived from instrument output and supplementary calculations.

Pearson's correlation coefficient (r) was employed to examine the relationship between noise levels (L_{Aeq}) and microclimatic parameters, including temperature, relative humidity, wind speed, and wind direction. This analysis enabled the assessment of the extent to which variations in microclimatic conditions influenced noise levels at the selected construction sites. The strength of the correlation coefficient was interpreted based on the classification proposed by Evans (1996) as follows: 0.00–0.19: Very weak, 0.20–0.39: Weak 0.40–0.59: Moderate 0.60–0.79: Strong 0.80–1.00: Very strong

3 RESULTS AND DISCUSSION

3.1 Ambient Noise Levels and Micro-Climate Variables at Ubeta

Table 1 to Table 3 presents a summary of the measured noise levels, including minimum, maximum, mean, and standard deviation values, alongside corresponding microclimatic parameters such as temperature, relative humidity, wind speed, wind direction, and their geographic coordinates within the three areas sampled for the study.

Table 1 showed that the measured noise levels at Ubeta exhibited substantial fluctuations over the monitoring period. The recorded L_{Aeq} values ranged from a minimum of 56.2 dB to a maximum of 89.4 dB, with a mean value of 75.87 ± 10.49 dB. Peak noise levels coincided with periods of intensive construction activity, including excavation, welding, and the operation of heavy machinery, while lower noise levels were observed during intervals of reduced activity or equipment downtime. Air temperature varied between 26.1°C and 38.1°C, with a mean of 33.77°C, reflecting changes in atmospheric conditions throughout the sampling sessions. Relative humidity ranged from 49.0% to 79.4%, with a mean of 60.85%, indicating moderate variation in site moisture content. Wind speed was generally low but variable, ranging from 0.2 m/s to 2.5 m/s, and wind direction fluctuated across sampling points from 205° SSW to 348° NNW demonstrating dynamic airflow patterns across the site. The variability in noise levels is

closely associated with the type and intensity of construction activities at Ubeta. Periods of high noise corresponded to operations involving heavy-duty machinery, welding, and material handling, while quieter periods reflected reduced on-site activity. The fluctuations in microclimatic parameters, particularly wind speed and direction, are likely to have influenced the propagation of sound across the construction area, with certain conditions facilitating or attenuating the transmission of noise.

The recorded noise levels at Obite as shown in Table 2 exhibited noticeable variations across the sampling period, with LAeq values ranging from a minimum of 55.2 dB to a maximum of 85.3 dB and a mean of 69.35 ± 6.77 dB. Elevated noise levels were generally observed during periods of active construction, particularly when heavy machinery such as excavators, compactors, generators, and trucks were in operation, or when there was significant movement of construction materials and personnel. Lower noise levels corresponded to intervals of reduced activity, including equipment shutdowns, breaks, or minimal on-site operations, highlighting the intermittent but repetitive nature of construction noise. Concurrent measurements of microclimatic parameters demonstrated moderate fluctuations throughout the sampling period. Air temperature ranged from 24.4°C to 38.8°C, with a mean of 34.62°C, while relative humidity varied between 49.5% and 78.3%, averaging 58.84%. Wind speed was generally low, ranging from 0.2 m/s to 2.9 m/s, and wind direction varied across the site. These microclimatic variations reflect typical short-term atmospheric changes in the Niger Delta environment and are important for understanding the influence of environmental conditions on noise propagation. The observed variations in noise levels are closely associated with the intensity and type of construction activities at Obite. Periods of high noise corresponded to operations involving heavy-duty machinery, welding, material handling, and general site activity, whereas lower noise levels were recorded during quieter periods. Variability in microclimatic parameters, particularly wind speed and direction, may modulate how noise propagates across the site. At Obite, wind speed ranged from 0.2 m/s to 2.9 m/s, while wind direction varied across all sampling points, reflecting dynamic airflow patterns that influence noise transmission and attenuation within the construction area. Wind blowing from the source toward receivers can facilitate sound transmission, leading to higher measured or perceived noise levels, while wind in the opposite direction may reduce propagation.

Table 3 present the Ambient Noise Level and Micro-climate variability at Ubarama/Akabuka. Noise measurements along the corridor exhibited marked fluctuations, with LAeq values ranging from a minimum of 54.2 dB to a maximum of 82.6 dB, and a mean of 67.68 ± 8.40 dB. Elevated noise levels were generally recorded in areas characterised by intensive construction activities, including the simultaneous operation of heavy machinery, material handling, vehicle movement, and high personnel density. Conversely, lower noise levels were observed in segments with reduced activity, temporary pauses, or less equipment operation. The standard deviation indicates considerable variability along the corridor, reflecting rapid transitions between high- and low-intensity noise zones and highlighting heterogeneous exposure conditions for workers and nearby receptors. Microclimatic parameters measured along the corridor also exhibited substantial variation. Air temperature ranged from 26.1°C to 35.6°C, with a mean of 30.87°C, while relative humidity varied between 61.1% and 83.1%, averaging 68.62%. Wind speed ranged from 0.4 m/s to 2.6 m/s, with wind direction changing along the corridor from 116° ESE to 340° NNW. These variations are influenced by terrain differences, vegetation cover, surface exposure, and the proximity of open spaces or built structures, reflecting the complex environmental conditions typical of linear construction projects. The combined analysis of noise and microclimatic data demonstrates a clear interaction between environmental conditions and operational activities along the corridor. High noise levels correspond to segments with multiple active sources, whereas quieter sections reflect reduced construction activity. Microclimatic factors, particularly wind speed and direction, temperature, and humidity, influence noise propagation. Wind blowing toward receptors can enhance sound transmission, while opposing wind may attenuate it. Temperature gradients and humidity levels

similarly affect sound absorption and scattering in the atmosphere, contributing to the spatial complexity of noise exposure along the corridor.

Overall, the combined analysis of noise and microclimatic data demonstrates that construction-related noise at three sites investigated is influenced not only by operational activities but also by prevailing environmental conditions. This highlights the importance of considering meteorological factors in environmental noise assessments, as they can significantly affect sound distribution and exposure levels across construction sites.

Table 1. Ambient Noise Level and Micro-climate variability at Ubeta

Longitude	Latitude	AIR TEMP (°C)	Relative Humidity (%)	Noise Level, L _{Aeq} (dBA)	Wind Speed (m/s)	Wind Direction
05.16922°N	006.60158°E	32.6	69.5	80.4	2.4	220SW
05.17103°N	006.60456°E	34.7	58.0	84.9	1.9	244SSW
05.17049°N	006.60430°E	30.7	65.3	80.7	1.7	223SW
05.16922°N	006.60158°E	34.1	65.2	84.0	1.2	238WSW
05.17103°N	006.60456°E	26.1	64.5	80.4	0.2	238WSW
05.17049°N	006.60430°E	37.3	54.8	63.6	0.3	249WSW
05.16922°N	006.60158°E	29.4	76.5	84.4	2.5	205SSW
05.17103°N	006.60456°E	37.4	55.2	87.9	1.8	292WNW
05.17049°N	006.60430°E	36.1	58.0	78.3	0.8	303WNW
05.16922°N	006.60158°E	38.1	50.1	89.4	1.8	258WSW
05.17103°N	006.60456°E	38.0	49.0	88.9	0.3	250WSW
05.17049°N	006.60430°E	33.2	66.2	84.6	0.4	212SSW
05.16922°N	006.60158°E	34.9	55.5	71.0	0.2	220SSW
05.17103°N	006.60456°E	33.1	65.6	73.8	0.7	308NW
05.17049°N	006.60430°E	34.2	59.2	56.2	0.5	348NNW
05.16922°N	006.60158°E	36.2	55.1	72.6	0.8	344NNW
05.17103°N	006.60456°E	32.4	56.7	62.1	0.8	274WN
05.17049°N	006.60430°E	32.1	54.2	68.7	0.6	262W
05.16922°N	006.60158°E	36.8	58.9	57.1	0.2	347NNW
05.17103°N	006.60456°E	27.9	79.4	68.4	2.4	244WSW
Mean		33.77	60.85	75.87±10.49		
Max		38.1	79.4	89.4		
Min		26.1	49.0	56.2		

Table 2: Ambient Noise Level and Micro-climate variability at Obite

Longitude	Latitude	Air Temp (°C)	Relative Humidity (%)	Noise Level, L_{Aeq} (dBA)	Wind Speed (m/s)	Wind Direction
05.2410 ⁰ N	06.6570 ⁰ E	38.1	52.3	61.2	2.9	210SSW
05.2748 ⁰ N	06.6570 ⁰ E	38.3	60.0	76.7	1.8	242WSW
05.3710 ⁰ N	06.6670 ⁰ E	34.0	61.7	70.5	1.7	228WSW
05.2410 ⁰ N	06.6570 ⁰ E	35.2	59.3	66.8	2.5	219SW
05.2748 ⁰ N	06.6570 ⁰ E	33.4	64.1	75.3	0.3	203SSW
05.3710 ⁰ N	06.6670 ⁰ E	36.7	55.1	55.2	0.2	244WSW
05.2410 ⁰ N	06.6570 ⁰ E	29.4	57.2	74.6	0.2	264W
05.2748 ⁰ N	06.6570 ⁰ E	32.5	62.2	71.0	0.2	266W
05.3710 ⁰ N	06.6670 ⁰ E	33.7	60.3	66.5	1.4	228NNW
05.2410 ⁰ N	06.6570 ⁰ E	34.4	64.9	66.3	1.4	235SW
05.2748 ⁰ N	06.6570 ⁰ E	24.4	64.7	66.5	1.8	244WSW
05.3710 ⁰ N	06.6670 ⁰ E	37.4	58.3	62.8	0.3	326NW
05.2410 ⁰ N	06.6570 ⁰ E	29.9	78.3	73.3	0.5	208WSW
05.2748 ⁰ N	06.6570 ⁰ E	37.0	51.1	69.6	0.9	219SW
05.3710 ⁰ N	06.6670 ⁰ E	37.0	53.7	73.0	0.3	288WNW
05.2410 ⁰ N	06.6570 ⁰ E	38.8	50.6	85.3	0.4	255WSW
05.2748 ⁰ N	06.6570 ⁰ E	37.0	50.5	65.3	0.5	208WSW
05.3710 ⁰ N	06.6670 ⁰ E	32.8	64.2	74.4	2.5	240WSW
05.2410 ⁰ N	06.6570 ⁰ E	37.7	49.5	63.3	0.3	223SW
	Mean	34.62	58.84	69.35±6.77		
	Max	38.8	78.3	85.3		
	Min	24.40	49.50	55.20		

Table 3: Ambient Noise Level and Micro-climate variability transverses through Ubarama and Akabuka

Longitude	Latitude	Air Temp (°C)	Relative Humidity (%)	Noise Level, L_{Aeq} (dBA)	Wind Speed (m/s)	Wind Direction
5.22453°N	6.64175°E	28.1	77.1	82.5	0.8	254°WSW
5.2748°N	6.64487°E	26.7	83.1	78.1	2.6	256°WSW
5.28213°N	6.69934°E	31.7	63.5	71.8	2	262°WSW
5.31063°N	6.70223°E	33.0	61.1	72.2	0.4	176° ENE
5.59639°N	6.60937°E	29.3	70.7	71.5	2	130° NE
5.22453°N	6.64175°E	30.8	69.2	71.7	1.43	207° SSW
5.2748°N	6.64487°E	29.7	68.5	73.3	1.2	223° SW
5.28213°N	6.69934°E	30.1	63.5	78.9	1.2	131° SE
5.31063°N	6.70223°E	28.4	68.7	74.2	1.4	243° SSW
5.59639°N	6.60937°E	26.1	81.5	57.1	0.8	332°NNW
5.22453°N	6.64175°E	27.5	80.0	82.6	1.3	116° ESE
5.2748°N	6.64487°E	30.8	69.2	71.1	1.43	207° SSW
5.28213°N	6.69934°E	28.1	73.7	72.3	1.3	203° SSW
5.31063°N	6.70223°E	35.6	63.1	65.7	1.7	134SE
5.59639°N	6.60937°E	33.2	65.7	63.4	1.8	202SSW
5.22453°N	6.64175°E	33.2	64.8	58.2	2.1	207NW
5.2748°N	6.64487°E	33.9	65.6	59.4	1.9	230SW
5.28213°N	6.69934°E	30.4	68.1	70.3	2.3	302WNN
5.31063°N	6.70223°E	30.9	67.2	54.4	2.5	333NNW
5.59639°N	6.60937°E	31.7	66.4	56.2	2	302WNN
5.22453°N	6.64175°E	32.0	67.8	54.2	2.6	340NNW
5.2748°N	6.64487°E	31.1	66.2	68.8	1.7	306NW
5.28213°N	6.69934°E	32.6	65.0	66.0	1.4	336NNW
5.31063°N	6.70223°E	33.7	66.4	58.6	1.5	310NW
5.59639°N	6.60937°E	31.9	63.8	62.9	0.6	298SSW
5.31063°N	6.70223°E	32.1	64.2	64.2	0.4	210SSW
Mean		30.87	68.62	67.68±8.40		
Max		35.6	83.1	82.6		
Min		26.1	61.1	54.2		

3.2 Comparison of Noise levels with existing Environmental Standards

Figure 2 and 3 presents a comparative assessment of measured ambient noise levels across the three study locations against the recommended limits set by the Federal Ministry of Environment (FMEnv) and the World Health Organization (WHO) respectively. This comparison provides a benchmark for evaluating the extent to which construction activities within the study area comply with established environmental noise standards and helps to identify potential risks to human health and environmental quality.

The results indicate that measured noise levels at several locations exceed the permissible limits prescribed by both FMEnv and WHO. These exceedances are particularly evident during periods of intensive construction activity, such as heavy machinery operation, material handling, and increased vehicular movement. Noise levels surpassing recommended thresholds suggest that current construction practices may be contributing to excessive environmental noise, thereby raising concerns regarding regulatory compliance and public health protection. The Federal Ministry of Environment and NESREA guidelines are designed to protect communities and workers from the adverse effects of prolonged noise exposure, while the WHO limits are based on extensive evidence linking excessive noise to a range of auditory and non-auditory health impacts. Exceeding these standards implies an increased risk of hearing impairment, stress-related disorders, sleep disturbance, reduced concentration, and cardiovascular complications, particularly for construction workers and residents living close to active sites.

The comparison further reveals spatial variability in the degree of exceedance across the three locations. Sites characterized by higher construction intensity and continuous equipment use recorded greater deviations from the recommended limits, whereas locations with intermittent or less intensive activities showed comparatively lower noise levels. This variation underscores the influence of operational characteristics and site-specific conditions on noise generation and exposure patterns. The observed exceedances highlight the need for stronger regulatory enforcement and improved compliance mechanisms within the study area. Regular environmental noise monitoring should be institutionalized to ensure early detection of excessive noise levels and prompt corrective action. In addition, construction firms should be required to implement effective noise-mitigation strategies, such as the use of well-maintained and low-noise equipment, installation of temporary noise barriers, restriction of high-noise activities to designated periods, and provision of adequate hearing protection for workers.

From an environmental management perspective, the findings of Figure 2 and 3 emphasized the importance of integrating noise control measures into construction planning and project execution. Proactive noise management not only ensures compliance with FMEnv and WHO standards but also contributes to improved occupational health, reduced community disturbance, and enhanced sustainability of construction activities. Overall, the comparison demonstrates that while construction development is necessary, it must be balanced with effective environmental protection measures to minimize adverse noise impacts within the study area.

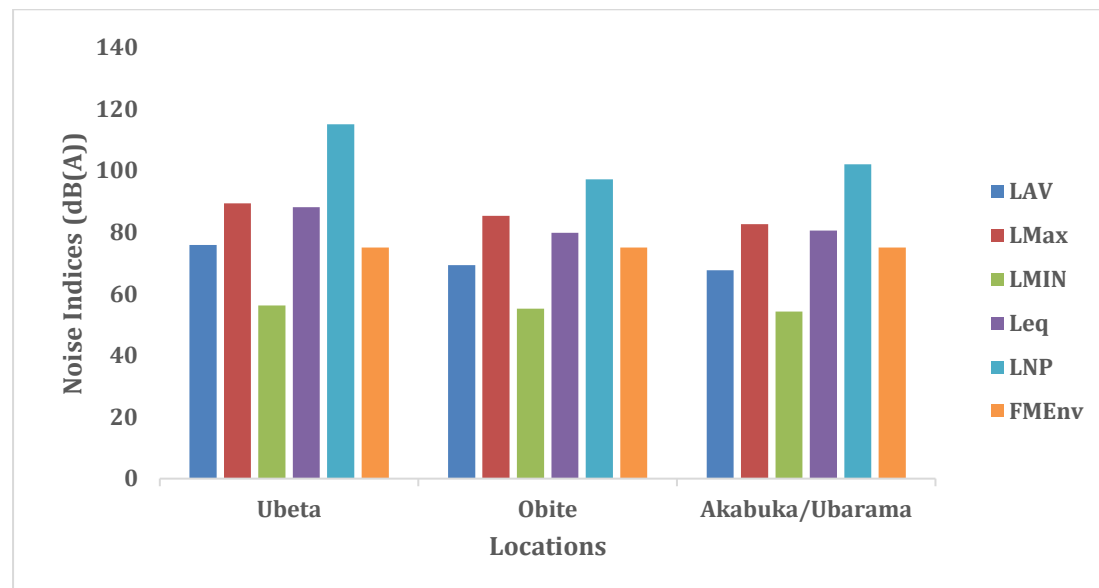


Figure 2: Computed Noise Indices for study locations in comparison with FMEnv standard

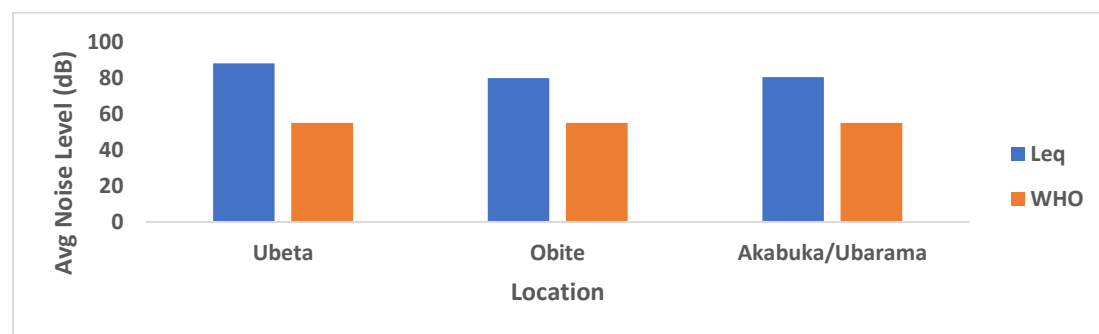


Figure 3; Comparison of Equivalent Continuous Sound Level against WHO Standard

3.3 Relationship Between Ambient Noise Level and Selected Microclimatic Variables

Table 4 presents the results of the correlational analysis carried out to examine the relationship between ambient noise levels and selected microclimatic variables at the monitored construction sites. This analysis was undertaken to determine the extent to which variations in environmental conditions—such as temperature, relative humidity, wind speed, and wind direction—are associated with changes in measured noise levels within the study area.

Correlation analysis provides a statistical measure of the strength and direction of the relationship between noise levels and microclimatic parameters. A positive correlation indicates that increases in a given microclimatic variable are associated with corresponding increases in noise levels, while a negative correlation suggests an inverse relationship. Weak or near-zero correlation values imply limited or no linear association between the variables. The results presented in Table 4.5 therefore offer quantitative evidence of how environmental conditions may influence noise behaviour at construction sites.

Temperature is one of the key microclimatic factors examined, as it can affect sound propagation through changes in air density and temperature gradients near the ground surface. Higher temperatures, particularly during periods of intense solar radiation, may enhance atmospheric instability, which can influence the dispersion of sound waves and alter measured noise levels. Observed correlations between temperature and noise levels may therefore reflect the combined effect of thermal conditions and increased construction activity during warmer periods.

Relative humidity is also an important factor in noise propagation, as atmospheric moisture influences sound absorption characteristics. Variations in humidity levels can affect how sound energy is attenuated as it travels through the air. Correlation patterns between humidity and noise levels may indicate whether higher moisture content contributes to increased sound absorption or modifies the perceived intensity of noise at different locations within the study area.

Wind speed and wind direction play a particularly significant role in shaping the spatial distribution of noise. Wind can either enhance or reduce sound transmission depending on its speed and alignment relative to the noise source and receiver. A positive correlation between wind speed and noise levels may suggest that stronger winds facilitate the downwind propagation of sound, while negative correlations may indicate increased dispersion or attenuation under certain conditions. Wind direction further influences the directional spread of noise, contributing to spatial variability in measured levels across the sites.

Overall, the correlational analysis highlights the interactive role of microclimatic conditions in influencing ambient noise levels at construction sites. While construction activities remain the primary source of noise generation, the findings demonstrate that environmental factors can modify noise intensity and distribution. This underscores the importance of incorporating microclimatic variables into environmental noise assessments, as consideration of noise levels alone may not fully capture exposure dynamics. The results presented in Table 4.5 therefore provide valuable insight for environmental management, supporting the development of more effective noise monitoring and mitigation strategies that account for both operational and atmospheric influences within the study area.

Table 4.5: Correlational Analysis of Ambient Noise Level and Micro-climate variability

Ubeta	Correlation (r value)
AIR TEMP (°C) vs Noise Level, L_{Aeq} (dBA)	0.05
Relative Humidity (%) vs Noise Level, L_{Aeq} (dBA)	0.02
Obite	
AIR TEMP (°C) vs Noise Level, L_{Aeq} (dBA)	-0.66
Relative Humidity (%) vs Noise Level, L_{Aeq} (dBA)	0.18
Akabuka	
AIR TEMP (°C) vs Noise Level, L_{Aeq} (dBA)	-0.51
Relative Humidity (%) vs Noise Level, L_{Aeq} (dBA)	0.35

4 Conclusion

The assessment of ambient noise pollution levels and micro-climate variables at selected construction sites in ONELGA Rivers State, Nigeria has been carried out. A sound level meter was used to measure ambient noise levels, while an ambient weather meter was used to measure the micro-climatic variability at selected construction site. The sites chosen for the study are situated in zones characterized by both residential and commercial activity, environments that naturally contribute to baseline background noise. To accurately capture the environmental conditions, a sound level meter was employed to measure ambient noise, while an ambient weather meter was used to record micro-climatic variables, including air temperature, relative humidity, and wind speed.

However, the results obtained shows that, although the surrounding residential and commercial activities contribute to background sound, the primary source of elevated noise at the sites was directly attributable to ongoing construction activities. These activities include the operation of heavy machinery, power tools, drilling equipment, and excavation works. The recorded noise levels were consistently high, reflecting the intensity of operations at different stages of construction. Peaks in noise levels corresponded to periods of high operational activity, such as machinery in full use or simultaneous operation of multiple equipment types, while slightly lower readings occurred during intermittent pauses in work.

A critical observation from the study is that the measured noise levels significantly exceeded permissible limits established by both the Federal Ministry of Environment (FME) and the World Health Organization (WHO) for residential and commercial areas. This exceedance highlights that construction operations in ONELGA are a significant source of environmental noise pollution. Continuous exposure to these elevated noise levels poses potential health risks to both workers and nearby residents. Among the concerns are auditory stress, potential hearing impairment, sleep disturbance for nearby residents, and general increases in stress and fatigue among site workers.

In addition to noise assessment, the study examined micro-climatic conditions at the sites. Variability was observed in parameters such as air temperature, relative humidity, and wind speed across the measurement period. These environmental factors are important because they can influence how sound propagates through the air. For example, temperature gradients affect air density, which in turn can either enhance or attenuate sound transmission. Relative humidity can modify the absorption of sound waves, and wind speed can carry noise over longer distances or cause fluctuations in perceived noise levels. Therefore, the interaction between noise levels and micro-climatic conditions is complex and site-specific, potentially exacerbating the impact of construction noise on the surrounding environment.

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