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HIGHER EDUCATION INSTITUTION (HEI) NOISE LEVEL MAPPING: THE CASE STUDY OF PLATEAU STATE UNIVERSITY BOKKOS, NIGERIA.

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ABSTRACT

Noise pollution is a growing environmental problem that is hurting cities, particularly colleges, where its impact on individuals' health, well-being, and academic performance can be considerable. At Plateau State University in Bokkos, Nigeria, this study investigated the geographical distribution of noise pollution, identified the primary sources of noise, and determined the levels of noise pollution. Using geo-mapping software and a sound level metre, fifteen monitoring locations situated in the vicinity of the university were chosen on the basis of land use. One-hour intervals were taken throughout the course of a week for the purpose of taking three readings: one in the morning, one during lunch, and one in the evening. The geographical distribution of noise level in the research region was interpolated using inverse distance weighted (IDW) interpolation, which was performed with the ArcGIS 10.5 application. The results were considered after comparing the recommendations for noise levels established by the World Health Organisation and the National Environmental Regulatory Agency. The main sources of noise in the study area, according to the results, are students and traffic. All of the chosen locations had high noise levels, particularly the classroom sections where the decibel level was higher than the typical educational area restriction of 50 dB. Base on the findings of the study, the university should plant trees on campus, construct soundproof barriers, and reassign conflicting land uses in order to manage and mitigate noise pollution. By doing this, noise pollution would be reduced, which would lessen disruptions to campus academic activity.

Keywords: Bokkos, Noise Level Mapping, Noise pollution, Plateau State University.

1. INTRODUCTION

A noise is a sound that is either undesirable or damaging, according to James (2016) and Latha, Ganesan, & Madhan Kumar (2022). Also, according to Basner et al. (2014), noise pollution is the presence of dangerous or excessive noise levels in the environment which disturb the natural acoustic equilibrium and subsequently adversely affect people's health and wellbeing. Noise is generally an unpleasant sound made by equipment or people that can be considered pollution. Air conditioners and heaters, and metal chairs scratching the floor are the causes of indoor noise pollution; outdoor noise pollution is found to be caused by garbage trucks, traffic, construction equipment, lawnmower manufacturing process and many other things (Mahajan, 2016).

Seven classes of harmful health impacts of noise pollution in people were recognized by the World Health Organization (2018). These include hearing loss and mental health problems,

verbal communication problems, heart problems, poor performance in tasks, sleep problems, and unpleasant social and irritated responses. Noise pollution still constitutes a disturbance and its adverse impact on human physical, social and psychological health has been reported by El-Sharkawy & Alsubaie (2014) & Ibekwe et al. (2016). Prolonged exposure to noise causes pain, interferes with sleep, damages cardiovascular and metabolic systems, impairs cognitive function in youngsters, and results in negative health outcomes (Najmaldin, 2024).

Annual premature deaths and new cases of ischaemic heart disease due to ambient noise are estimated at 12,000 and 48,000 by the World Health Organisation. Furthermore, 6.5 million individuals will be affected by chronic severe sleep disruption, and 22 million will have chronic severe irritation (Basner & McGuire, 2018). According to the WHO study, then, it is critical to understand these implications in efforts to create effective public health interventions in order to reduce the harmful effects of noise pollution on the population (WHO, 2018).
Higher education institutions (HEIs) such as universities are basically places to learn, research and develop oneself, and are very sensitive to high noise levels. There is an increasing concern about campus noise levels, mainly from automotive traffic, social events and construction activities, as the noise impacts academic performance, health and general campus life (Paulo et al. 2013). It is very difficult to acquire knowledge in cacophonous settings (Ogbodo, 2020). In higher educational institutions, learning performance correlates with noise levels in a negative way which shows that noise pollution affects learning ability (Haines et al. 2001; Ozer et al. 2013, Gilavand & Jamshidnezhad, 2016; Akintunde, Julius, Bayei & Akintunde, 2020). Smaldino et al. (2008) define such noise that results from external factors such as traffic and internal disturbances that are student talks and movement in halls as the classroom background noise. Gilavand & Jamshidnezhad (2016) emphasizes that identifying the environmental factors that affect the educational process and integrating them in planning will lead to the mental health of students and reduce stress, and in the meantime, enhance educational performance.

Despite their status as the country's centres of knowledge and intellectual debates, the higher education institutions in Nigeria have found themselves bogged by increased noise levels. Those who design noise control areas are the educational institutions, medical facilities and government-designated zones, and they do not allow noise above what NESREA (2009) stipulated for National Environmental Noise Standards and Control Regulations. The increase in ongoing development and building activities in the vicinity of the Plateau State University (PLASU) campus, Bokkos is gradually resulting in a noise pollution problem on the campus. Bigger social contacts and gatherings are made because of the high number of the student population. It gives different levels of noise on the basis of the type of contact, and the intensity of the activities taking place. Noise in this environment is unregulated, this interferes with communication, disrupts academic activities, leads to a loss of productivity and academic performance, and impedes concentration. This especially has adverse effects on the mental and physical health of the students. Noise levels that are elevated disrupt personnel in the workplace as well as students during class, in the library, laboratory and dorm.
In Nigerian universities, there has been little study on noise level mapping, despite attempts to increase understanding of the problem and use effective mitigation techniques. Here we outline the main causes of noise pollution at Plateau State University, Bokkos, quantify the amount of noise on campus, and depict the geographical spread of noise pollution. Its stated goal is to measure the amount of noise pollution within the school and to pinpoint its exact location. The

focus was on Plateau State University students. The findings may be utilized to create a nurturing academic atmosphere and provide practical recommendations for enhancing the campus climate.

2. MATERIALS AND METHOD

2.1 Study area

Established by the Plateau State Government, Plateau State University (PLASU) Bokkos is a state-owned university. Geographically, it is between latitudes 9°00′N and 9°20′N of the Equator and longitudes 8°40′E and 9°00′E of the Greenwich Meridian (Figure 1). Established in 2005, the institution was formally registered as the 24th state-owned university and the 66th university in Nigeria on April 29, 2005, under the National Universities Commission (NUC) designation. About 70 kilometres from Jos, the capital of Plateau State, and roughly 10 kilometres from Bokkos town, the local government headquarters, PLASU is situated in Diram Village along the Butura-Tarangol axis in Bokkos Local Government Area.

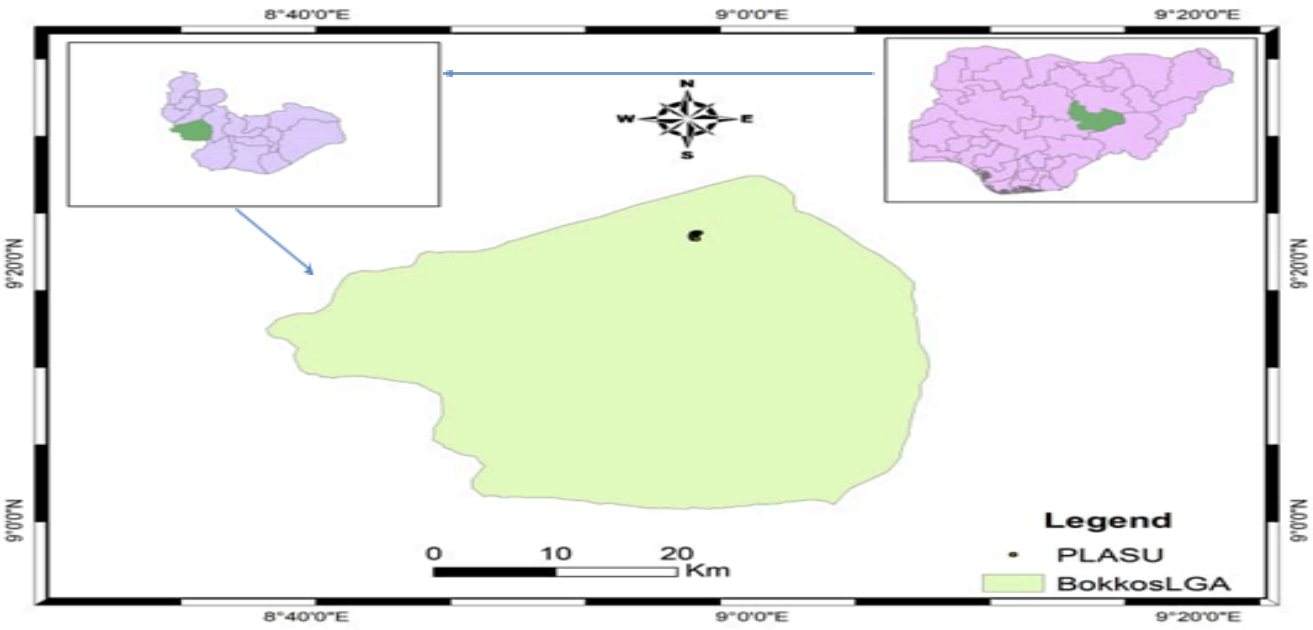

Figure 1: The study area, Plateau State University, Bokkos

Comprising 296.167 km², PLASU campus features buildings and infrastructure covering over one-fourth of the whole land area. Designed to offer a secure, pleasant, and suitable environment for study, research, and production, the university has several basic amenities like libraries, lecture halls, dorms, research centres, student hubs, staff offices, and dining halls. The university consisted of seventeen departments spread across four colleges from May 2018 and July 2023. Reflecting the institution's continual expansion and dedication to academic quality, by September 2023 this has grown to 23 departments with the inclusion of three additional faculties.

2.2 Data collection

For the purpose of obtaining coordinates of the selected locations on the PLASU campus, data were gathered through the use of a Global Positioning System (GPS). An instrument known as a

Sound Level Meter (SLM) was utilised in order to evaluate the campus map as well as the normalised audio levels.

2.2.1. Sampling method

The study made use of a technique called stratified sampling. Dividing the PLASU campus into the following main land use categories—residential, educational, commercial, health, and recreational—was the initial phase. Second, at least two or three places were carefully chosen inside every class depending on their importance to the objectives of the university. For instance, the gossip centre is well-known for causing excessive noise levels on campus. A selection was made for the educational category, which included the library and classroom areas; the residential category, which included the students' hostel; the commercial category, which included the students' centre and cafeteria; the health category, which included the university clinic area; and the recreation category, which included the mini stadium, gossip centre, and Simon Bako Lalong park and garden (Table 1). The selection of fifteen (15) different locations for the purpose of data collection was made in general.

Table 1: Selected sites in Plateau State University Campus, Bokkos

Land use class	Selected sites
Educational	Library
	Social Science Faculty
	Management faculty
	Faculty of Natural/Applied Sci. LCT Block
	Classrooms (CLR) Block
	UA (University Auditorium)
	Lecture theatre classroom
Residential	Male hostel
	Female hostel
Health	University clinic/ Health Science
Administrative	Senate building
Commercial/relaxation	Student Center/ Cafeteria
Recreational	Gossip centre
Relaxation	Mini Stadium
	Lalong garden and park

2.2.2. Locational/Geographic Coordinate Information

Coordinates for the chosen sites were gathered using a handheld Global Positioning System (GPS) device. The equipment was precisely calibrated to guarantee a minimum of five (5) satellites were visible on its display, hence reducing measurement mistakes. At least four satellites must be in view to produce correct spatial data as the GPS gadget uses trilateration to ascertain location. Every site where coordinates were obtained was exactly noted and recorded to guarantee consistency in the next noise level readings.

2.2.3. Noise Level Data

Sound Level Meter (SLM) was employed to collect data on sound levels. Sound level measurements were recorded hourly from Monday to Sunday with a sound level meter. The readings were conducted in the morning (9:00 am to 10:00 am), afternoon (12:00 pm to 1:00

pm), and evening (4:00 pm to 5:00 pm). Considering the fluctuating noise levels, noise measurements were conducted using a calibrated sound level meter configured to quick response mode. A weight is employed in measuring sound levels because of its resemblance to the human ear's response to noise. Mahajan (2016) & Akintunde, Bayei, & Akintunde (2022) assert that the unit of measurement is decibels per acoustic. An average decibel (dB) measurement is what a sound level meter records over a defined time period, represented by the variable t. The run time (t), peak (dB), and maximum dB(A) are all presented at the bottom of the screen.

2.3 Data Processing

The locations of the selected areas on campus and the recorded noise level data were illustrated and visualized using ArcGIS 10.5 software. The whole PLASU campus area was georeferenced after a photo was taken from Google Earth and converted to the area's shapefile. To create the map of the given locations, we first imported the noise level data into ArcMap, then translated the coordinates, exported them as points, and used them.

2.4. Analysis of data

The noise levels at the specified locations were assessed using an objective methodology. There are a number of steps involved in qualifying noise, such as designing methodology for noise computation, determining what data sets are needed, creating a dataset for calculating noise levels, and finally, doing a post-processing analysis. A number of noise properties were extracted from the sound level meter readings using the procedure outlined in Equations 1, 2, and 3:

$$Leq\,T = 10log\,[\,\frac{1}{n}\sum_{i=1}^{9} 10\,\frac{Li}{10}] \quad (1)$$

Where, Leq = noise levels measured between time intervals t and the n^{th} measurement duration (Joshi et al., 2015).

Average noise level (LP) is given as:

$$LP = 20Log\,\frac{1}{n}\sum_{j=1}^{n} 10\,[\frac{Li}{20}] \quad (2)$$

Where n represents the number of SPL readings taken.

Lj= jth SPL, for j = 1,2,3n (Arenu et al., 2015)

LNP = Leq x 2.566

LNP Noise pollution level is denoted by Leq= equivalent noise level, and ∂ = standard deviation (Joshi et al., 2015).

$$LNP = LAeq. + (L10 - L90)\ or\ LNP = LAeq + KS \quad (3)$$

Where K=2.56 and "S" is the standard deviation of the A-weighted instantaneous noise level (Owojori, 2017).

A digital conversion tool transformed the data obtained from the sound level meter at a frequency of 6000 into decibels. The objective of this process was to determine if the average noise level on campus significantly differs from the permissible Threshold Limit Values (TLV) for educational environments established by the Nigerian Environmental Standards and Regulations Enforcement Agency (NESREA) and the World Health Organization (WHO). Furthermore, the recorded noise levels were assessed against the benchmarks set by the International Standards Organization (ISO) in 1999.

ArcMap was utilized with the Inverse Distance Weighted (IDW) interpolation technique to illustrate the spatial distribution of noise pollution, resulting in a detailed noise pollution map for PLASU. ArcScene then imported the IDW layer, which was shown in three dimensions to evaluate its impact. To exactly show noise strength at every point, a vertical extrusion of the IDW noise layer was done with little exaggeration. This 3D visualisation showed noise levels rising with increasing elevation to show variations in intensity at many points on the university. Offering a complete picture of campus noise pollution, the last result consisted of two-dimensional (2D) and three-dimensional (3D) noise level maps.

3. RESULTS AND DISCUSSION

3.1 Distribution of Morning Noise Levels on Campus

The morning noise levels indicate the diverse noise measurements obtained at the specified locations inside the PLASU Campus (Table 2 & Figure 2). The male hostel, Classroom Blocks (CLR), the Social Science and Management Science faculty buildings, the Student Centre, Lecture Class Theatre, the University Auditorium, and the Gossip Centre all exhibited noise levels surpassing the educational area standards set by the World Health Organisation (WHO). The WHO deems a noise level between 40 and 50 dB suitable for an educational setting. Nonetheless, the Lecture-Class Theatre (LCT) and Classroom Block (CLR) had elevated noise levels of 78 dB. These locations are active during the day and function as lecture halls for several departments.

Table 2: Noise Levels at Plateau State University Campus, Bokkos

S/n	Location	Longitude	Latitude	Altitude (m)	Morning (dB)	Afternoon (dB)	Evening (dB)
1	Male Hostel	8.959540	9.373560	1379	70	59	72
2	Student Center	8.957710	9.373780	1376	71	63	77
3	Female Hostel	8.957410	9.373630	1376	61	55	66
4	Health Science	8.955940	9.373010	1389	58	58	51
5	Library	8.955540	9.371750	1378	60	67	55
6	Natural Applied Science	8.957460	9.371240	1390	61	76	70
7	Lecture-Class Theatre	8.956970	9.370600	1375	78	77	80
8	Management Science	8.955520	9.370370	1377	72	81	77
9	Social Science	8.954770	9.370080	1376	72	81	71
10	Classroom Block	8.955540	9.368890	1376	78	65	70
11	Mini Stadium	8.954890	9.368250	1386	70	61	71
12	Senate	8.955370	9.366260	1398	68	66	40
13	Lalong Park	8.957680	9.365960	1400	52	62	69
14	Auditorium	8.956892	9.371568	1386	77	78	77
15	Gossip Centre	8.957306	9.371255	1385	71	76	70

Likewise, they are lecture rooms designed to handle a substantial number of students simultaneously. There is an excessive amount of noise produced as a result of the vast number of students who are either waiting for lectures or transitioning between successive sessions. Debnath, Nath, & Barthakur (2012) found that students were responsible for 40% of the elevated noise levels on a campus in Nagaon, India. The elevated noise levels at this site result from the nearby parking spots, which are strategically located in the vicinity. These places are also connected to the primary thoroughfare originating from the Natural Science building. Vehicular movement may contribute to the noise emanating from LCT and CLR structures. These are predominantly automobiles utilised by employees with morning classes or administrative duties. Also, approximately 45% of the noise levels on campus are attributed to automobile activity, according to Debnath, Nath, & Barthakur (2012). The gossip centre is surrounded by trees, which may have acted as a barrier between the lecture halls.

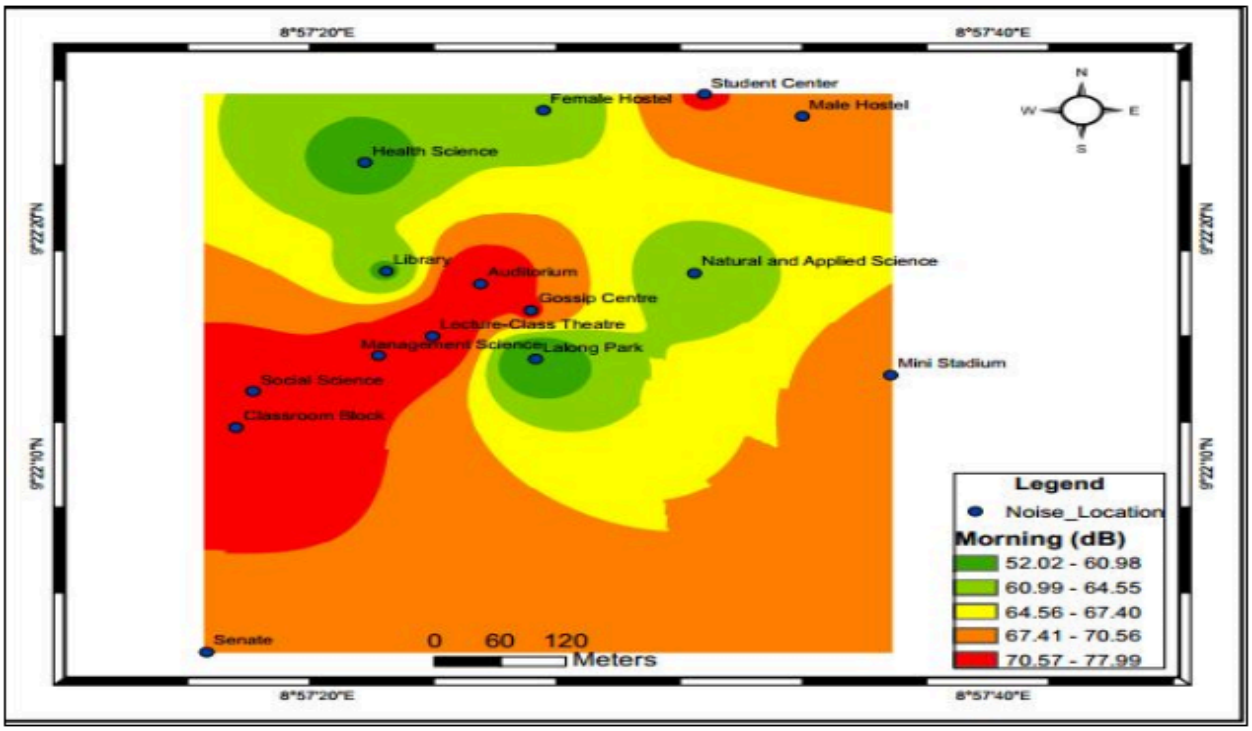

Figure 2: Noise Level in the Morning at Plateau State University

Additionally, lawn mowers substantially contribute to the elevated noise levels in this vicinity. During the data collecting period, lawns are mowed using hand-held lawn mowing equipment that generates considerable noise levels. The Student Center serves as a gathering place in the morning, particularly for breakfast and commodity purchases. This location produces a lot of noise because a large number of students carry out their transactions at the student centre in the mornings. The health science building, library, and Lalong Park exhibit the lowest levels of activity during the early hours. The buildings for the natural and applied sciences and the female dormitories have low noise levels. The minimum noise level documented for the morning throughout the study period was 52 dB at Lalong Park and Garden (Table 2). Despite the fact that it is located at the highest height on campus, the garden is surrounded by a number of trees that help to reduce the amount of noise that is produced by the surroundings. According to Savale (2014), vegetation reduces the propagation of sound through the processes of dispersion (for example, stems and branches) and absorption (for example, foliage). During the morning hours, Lalong Park has the lowest levels of noise, which can be attributed to the fact that there is basically no activity going on.

3.2 Distribution of Afternoon Noise Levels on Campus

As shown in Figure 3 and Table 2, the areas with the lowest afternoon noise levels were Health Science (58 dB), Mini Stadium (58 dB), Male (59 dB), and Female (55 dB) hostels. Every location is on the periphery, far from academic institutions, with the exception of Lalong Park (62 dB), which is close to the campus centre. A reduction of 78 dB to 65 dB was made to the noise level in the classroom block (CLR). However, increased noise levels were maintained at the university auditorium (78 dB), lecture theatre (77 dB), social and management science

department buildings (81 dB), and gossip centre (76 dB). The noise level at the department building for natural and applied sciences is 76 dB higher than average (Table 2).

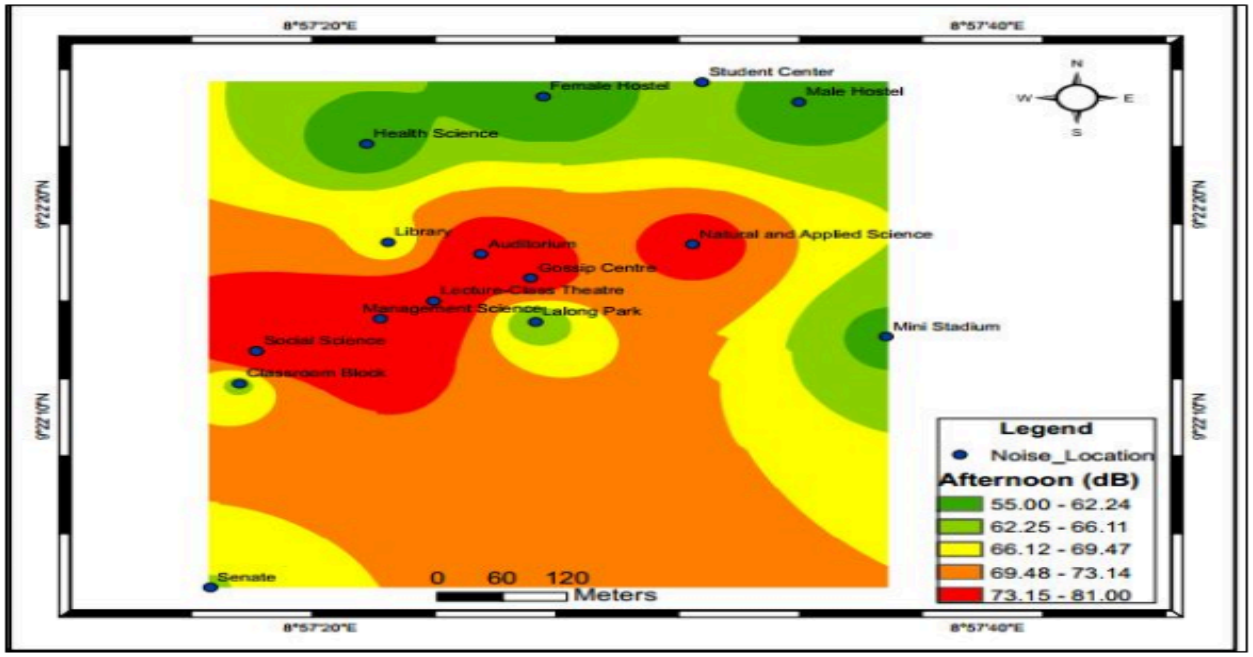

Figure 3: Noise Level in the Afternoon at Plateau State University, Bokkos

During the study period, the management science and social faculty buildings exhibited the greatest average noise level of 81 dB at midday, as seen in Table 2. At noon, the mean noise level in the female hostel was the lowest, recorded at 55 dB. The previously fairly loud regions surrounding the college hub have become brown. This indicates that afternoon noise levels in the area exceed those of the morning (Figure 3 and Table 2). Research indicates that noise levels of 74 dB or more are detrimental to the environment of educational institutions (Arenu, Aremu, & Olukanni, 2015; Akintunde et al., 2022). The sound intensity in the student centre measures 63 dB. The source of the noise was the students' recreational activities in the student union and additional tutorial lessons in the lecture rooms. Music players, audio speakers, and generators are additional sources of noise. The student facility serves as both a commercial and recreational focus for pleasure and business activities. The noise levels recorded were 67 dB in the library, 66 dB in the senate building, and 58 dB in health science. The classroom is somewhat remote from these sites. Trees surround these areas, perhaps reducing noise pollution in the vicinity. Debnath, Nath, & Barthakur (2012) assert that educational institutions have to consider establishing buffer zones with trees and vegetation since these plants can mitigate noise levels by 4 to 6 dB, depending on their characteristics. This conclusion corroborates their findings. This outcome corroborates Savale's (2014) assertion that the establishment of green belts in India can reduce noise levels. The classification of the green belt influences the level of attenuation.

3.3 Distribution of Evening Noise Levels on Campus

Figure 4 illustrates the geographical distribution of evening noise levels at Plateau State University, ranging from 51 to 80 decibels (dB). The evening noise level distribution indicates

that the campus core is predominantly characterised by elevated noise levels. Peripheral regions in the northwest and southwest exhibit low to moderate noise levels. Noise levels are elevated in areas with relatively quiet mornings and afternoons, such as Lalong Park (69 dB). The male and female dorms recorded noise levels of 72 dB and 66 dB, respectively, although the senate building (40 dB), health centre (51 dB) and library (55 dB) had lower noise levels.

The management science building (77 dB), small stadium (71 dB), lecture class theatre (80 dB) and university auditorium (77 dB) all exhibited relatively elevated noise levels. Evening noise levels were reduced at the social science department building (71 dB), natural and applied science (70 dB), CLR (70 dB) and gossip centre (70 dB). This is due to a reduction in night-time classes. By dark, a significant number of students had departed the campus for their residences or dormitories. This may be the reason for the student centre's present elevated noise level of 77 dB, which was reduced in the afternoon. A variation in noise levels from morning to evening is observable. There were many sustained sites with elevated noise levels throughout the early hours. In the afternoon, this significantly diminished, with the focus concentrated around the campus hub. The region of elevated noise intensity was significantly reduced during the evening. The prevalence of university events throughout the morning and afternoon hours, as opposed to the evening, indicates a constant trend in such activities. Most on-campus events would have concluded by that time, and staff and students would have relocated from the campus hub to the residential halls.

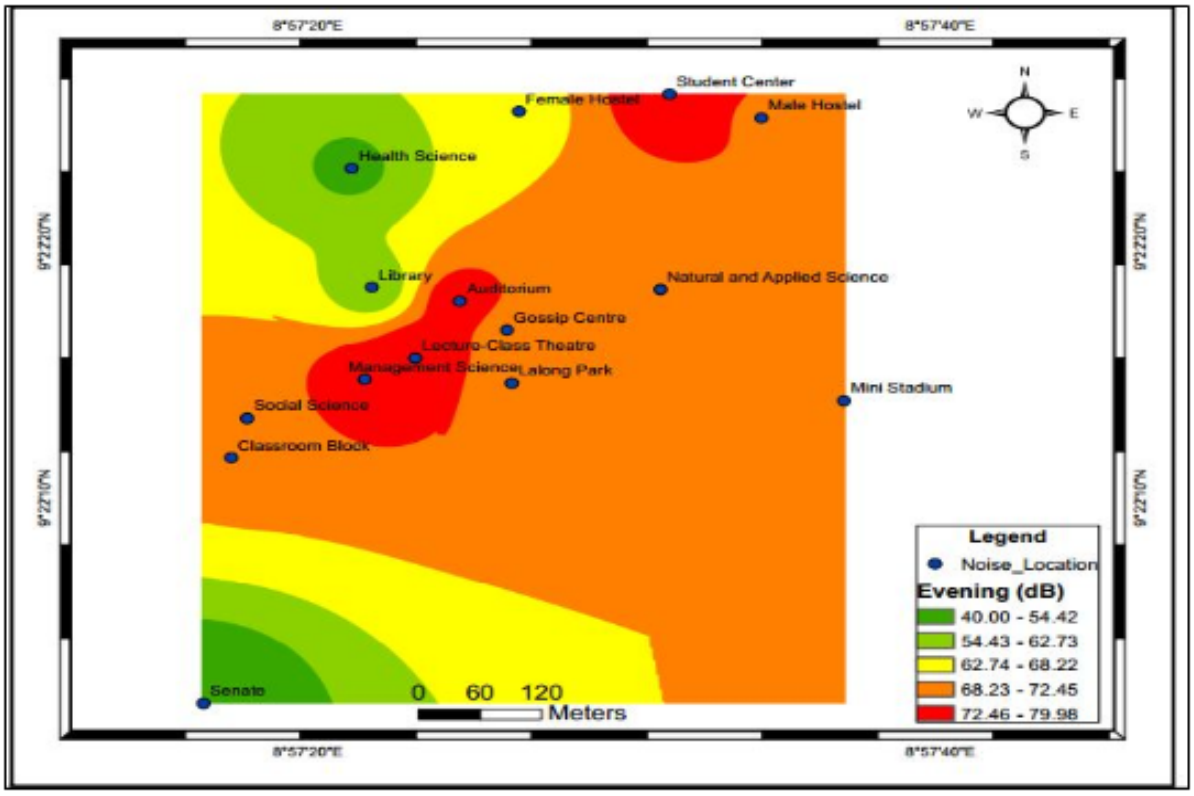

Figure 4: Noise Level in the Evening Plateau State University

Table 3: Noise Quality Levels

Noise (dBA)	Recommendation
0 – 30	Excellent
31 – 40	Very Good
41 – 60	Good
61 – 75	Satisfactory
76 – 90	Unsatisfactory
90 – 100	Hazardous
>111	Not Allowed

Source: Kanu, Targema, Isa &Nyusamia (2022).

Kanu et al. (2022) showed the World Health Organisation (WHO, 1999) standards utilising data from many sources (Table 3). The World Health Organisation (1999) stipulates that noise levels in educational institutions should not exceed 72 dB daily, and during study and lecture sessions, they should be below 35 dB (Seetha et al., 2008). Elevated noise levels can induce stress, distract from learning, and impede students' comprehension of lectures or classes (International Standard Organisation, ISO, 1999; Tiesler, Machner & Brokmann, 2015; Chijioke, Mathias, Ifeanyi, & George, 2019). The National Environmental Standards and Regulations Enforcement Agency (NESREA) established a permissible maximum of 45 decibels during the day and 35 decibels at night, as stipulated in the 2007 Establishment Act, for "any building utilised as a hospital, convalescent home, facility for the elderly, sanatorium, institutions of higher education, conference rooms, public libraries, and environmental or recreational centres. These guidelines are crucial for assessing the impact of campus noise levels on students (Table 3). The data collected for the campus sites is compared with the permissible levels established by the WHO and Nigeria for schools.

Table 4 demonstrates that the average noise levels are "Good" in just two (2) places (Sealth science and Senate Building) and "Unsatisfactory" in three (3) locations. The remaining ten places were rated "satisfactory." Three (3) "Good" rating locales are included in both the morning and evening.

Table 4: Campus Noise Quality

Location	Morning dB	Quality	Noon dB	Quality	Evening dB	Quality
Male Hostel	70	Satisfactory	59	Good	72	Satisfactory
Student Center	71	Satisfactory	63	Satisfactory	77	Unsatisfactory
Female Hostel	61	Satisfactory	55	Good	66	Satisfactory
Health Science	58	Good	58	Good	51	Good
Library	60	Good	67	Satisfactory	55	Good
Natural and Applied Science	61	Satisfactory	76	Unsatisfactory	70	Satisfactory
Lecture-Class Theatre	78	Unsatisfactory	77	Unsatisfactory	80	Unsatisfactory
Management Science	72	Satisfactory	81	Unsatisfactory	77	Unsatisfactory
Social Science	72	Satisfactory	81	Unsatisfactory	71	Satisfactory
Classroom Block	78	Unsatisfactory	65	Satisfactory	70	Satisfactory
Mini Stadium	70	Satisfactory	61	Satisfactory	71	Satisfactory
Senate	68	Satisfactory	66	Satisfactory	40	Good
Lalong Park	52	Good	62	Satisfactory	69	Satisfactory
Auditorium	77	Unsatisfactory	78	Unsatisfactory	77	Unsatisfactory
Gossip Centre	71	Satisfactory	76	Unsatisfactory	70	Satisfactory

sessions. Although the Health Science and Library locations were suitable for both periods, the Senate Building was rated as "Good" in the evening and Lalong Park as "Good" in the morning. There were four "unsatisfactory" sites for the evening session (Student Centre, Lecture Class Theatre, Management Science, and University Auditorium) compared to three (3) for the morning session (Lecture Class Theatre, Classroom Block, and Auditorium) (Table 4). The most unfavourable figures occur in the afternoon session. There are six (6) "unsatisfactory" places (student centre, lecture theatre, management science, male hostel, gossip centre, and university auditorium) and three (3) "satisfactory" locations (male and female dormitories, and health science). The only institution that receives a "Good" quality recommendation all day long is the health science facility. The lecture-class theatre and university auditorium have been rated as having "unsatisfactory" quality. Being the two biggest lecture halls on campus, they can accommodate almost every student, especially in large classes with hundreds of people attending lectures at once. This is common among first-year students or "General Courses" provided by almost all departments. According to WHO (1999) criteria, only seven (7) of the 15 sites regularly fulfil the 72dB maximum noise level exposure requirement in educational institutions (Table 4). Lalong Park, the library, the Senate building, the Health Science Centre, the male and female dorms and the small stadium are all included in the designated zones. The other buildings are not academic institutions, with the exception of the health science building. Noise levels are anticipated to remain consistently low. However, they still surpass the WHO (1999) threshold of 35 dB, which is the highest noise level that educational institutions are permitted to have during lectures and instructional activities. There are no known locations with noise levels lower than 35 dB. A noise level of 40 dB was recorded in the Senate building in the evening after business ended. As a result, not every venue passes the evaluation. This suggests that the noise level

generated on the Plateau State University campus in Bokkos is higher than what is acceptable for students to be exposed to. Campus noise levels are considered "satisfactory" with an average of 68 dB, which is below the exposure threshold. However, it is significantly more than the amount permitted for educational reasons. As a result, it has the potential to disrupt learning and cause stress. An important learning environment is a higher education institution. Research is conducted, laboratory work is completed, lectures are given, and students are inspired to participate in a rigorous and comprehensive educational process. It is expected that there will be minor distractions that might weaken pupils' ability to concentrate and focus while studying. As a result, several standards have been established to guarantee that the learning environment is favourable for instruction and learning. Noise levels above 35 dB are not suitable for an educational setting, according to the WHO (1999).

The noise level on the Plateau State University campus exceeds this threshold significantly. The Threshold Limit Value (TLV) for educational institutions serves as a widely recognized standard within academic circles (Tiesler, Machner, & Brokmann, 2015). The decibel level measured is 55 dBA. Throughout the study, the mean noise level recorded on campus was 68 dBA, accompanied by a standard deviation of 7 dBA. The average noise level surpasses the acceptable threshold limit value (TLV). Furthermore, it surpasses the 45dBA allowable limit established by NER (2009) for higher education institutions in Nigeria. ISO (1999) and Obot & Ibanga (2013) indicate that noise levels exceeding 55 dB can lead to stress in students and hinder their studying capabilities. Educational processes are significantly affected by various health issues that can arise from stress, including depression, headaches, and insomnia. High noise levels can lead to various serious health effects, including aggressive behaviour, increased pain sensitivity, and elevated blood pressure (Moudou, 2009; Chijioke, Mathias, Ifeanyi, & George, 2019).

According to Kanu et al. (2022), noise levels above reasonable limits can cause irritation, interfere with student-teacher and student-student communication, impair information learning, reading comprehension, and dissemination, and negatively impact socialisation. Therefore, this is not suitable for institutes of higher learning. Because it improves research findings from several universities in Nigeria and elsewhere, this study is crucial. According to Otutu (2011), Delta State University's Abraka campus had noise levels that were higher than allowed, which would have made it more difficult for students to study. Furthermore, noise levels at the University of Uyo in Akwa Ibom State and the University of Technology in Owerri, Imo State, were found to be greater than that allowed for higher education institutions by Obot & Ibanga (2013) and Chijioke, Mathias, Ifeanyi, & George (2019). According to Akintunde, Bayei, & Akintunde (2022), noise levels at the University of Jos in Nigeria were higher than permitted for postsecondary educational establishments. The findings of this study at the Bokkos campus of Plateau State University support earlier findings.

4. CONCLUSION

Noise pollution adversely affects students' academic performance as well as their physical and emotional well-being. The study indicates that noise levels exceed permissible limits in many areas of the PLASU campus. Throughout the week, the noise intensity in the study area varied from 51 to 81 dB. This exceeded the suggested indoor noise level limit of 35 dB for educational settings. Such occurrences take place in settings where educational content and presentations are provided, particularly within lecture halls. The noise level on the Plateau State University campus exceeds the limits established by the Nigeria Environmental Standards and Control

Regulatory Agency (NERA) and the World Health Organisation (WHO) for suitable study environments, yet it stays within the allowable exposure threshold.

5. RECOMMENDATIONS

The implementation of advanced sound insulation materials, such as acoustic panels, foams, and composites, which are engineered to absorb and block sound effectively, along with the creation of tree and vegetation buffer zones that can diminish noise levels by 4-6 dB, and the halting or segregation of loud activities are therefore advised. It is essential for security personnel to establish protocols that effectively manage vehicle speed limits on the university campus. It is essential for students to be motivated to participate in public awareness initiatives that inform them about the health risks linked to noise pollution and encourage changes in behaviour. This would significantly impact the productivity of PLASU personnel and the academic success of students.

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