



TRAFFIC NOISE LEVEL EVALUATION AT MAJOR INTERSECTIONS IN SABON-GARI LGA IN ZARIA METROPOLITAN CITY OF KADUNA, NIGERIA.

Abraham, A. I. , Igboro, B. S., Sani, S. B., George, I. and Owoicho, A.

Department of Water Resources and Environmental Engineering, Faculty of Engineering, Ahmadu Bello University Zaria, Kaduna State, Nigeria

Correspondent Email: apeh4life@gmail.com

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Abstract

One of the indicators of environmental degradation globally is noise pollution. Therefore, there is a demand to expand the understanding of the magnitude of the noise level in order to mitigate the consequences of its impact. This has necessitated this study in ascertaining the traffic noise level in nine (9) selected intersections at Sabon-Gari LGA in the interval of 7:30-8:30 AM, 1:00-2:00 PM, 5-6 PM, and 10-11 PM using the Extech model 407750. The diurnal noise indicators for the day time (L_D), evening time (L_E), night time interval (L_N), and the noise equivalent for L_D , L_E and L_N represented as L_{DEN} exceeded the World health organization (WHO) and National Environmental standards regulations Enforcement Agency (NESREA) standard. The L_{DEN} ranged from 88.0 dB (A) at ABU main gate (2) to 97.2 dB (A) at the Kwangila site (1). Which exceeded the 70 dB (A) of the WHO standard and 75 dB (A) of the NESREA standard. The Traffic Noise index (TNI) average ranged from 116.4 dB (A) at the Kwangila site (1) to 101.5 dB (A) at MTD which exceeded the compared standard of 74 dB (A) while the Noise pollution (L_{PN}) ranged from 108.3 dB (A) at Kwangila to 96.5 dB (A) at Emanto junction which exceeded the compared standard of 72 dB (A). The single factor ANOVA for the noise percentiles between L_{10} and L_{90} showed that there is a significant difference as $P < 0.05$, while there is no significant difference between TNI and LNP as $P > 0.05$ at a confidence level of 95%. The noise level exceeded the compared standards. Adequate soundproofing and public awareness would serve as mitigating measures.

Key Words: Environment, NESREA, Noise, Traffic, Pollution and WHO

Introduction

Noise is virtually everywhere. It has gradually become the main burden on the quality of life globally. Noise pollution is well-defined as a type of air pollution that is a perceptible unwanted, and unpleasant sound that poses a significant threat to a person's predisposed to it. The exponential increase in the number of vehicles, musical instruments, mega and small-scale industries, urbanization, transportation, hawkers, discotheques, private electric-generating plants, grinding machines, and other human activities have been identified as the sources of noise pollution in the ecosystem (Abraham *et al.*, 2022; Sultan, 2020; Minirreza *et al.*, 2019; Mohamadi *et al.*, 2015; Barcelo *et al.*, 2016). These have necessitated diverse environmental implications globally. Consequently, these effects range from psychosocial to public health concerns, such as sleep deterioration, increase in stress level, exacerbate annoyance, Tinnitus, cardiovascular response, facilitate an increase in blood pressure, complicated pain management, facilitating depreciation of mental capabilities and especially cognitive prowess and memorization aptitude of children (European Noise Directive (END), 2020, WHO, 2011; Hanninon *et al.*, 2014; Lee *et al.*, 2014).

In Europe, experts confirmed that about 170 million people experience various effects of noise pollution. Necessary action to reduce environmental noise has a lower priority than other environmental problems such as air and water pollution due to inadequate of noise level data. Therefore, there is a need for effective management of environmental noise on a national and local scale. Recognizing this as a prime issue, the European Commission adopted the European Noise Directive (END, 2002). The EU's 7th EPA 'Living well, within the limits of our planet' highlighted that the majority of European countries living in major urban areas are exposed to high levels of noise which have adverse health effects on the population (END, 2002-2020). Studies have made known that more than 20% of the global population are predisposed to undesirable noise levels and virtually 60% of the European population are recipients of high noise levels in their daily activities (Sivia *et al.*, 2003; Akintuyi *et al.*, 2015; WHO, 2011).

The dB (A), and dB (C) are the units of sound intensity, which is referred to as decibel (dB). Except that before the measurement is made, sounds of high and low frequencies are heard poorly or not at all by the human

ear. These have to be filtered out, which is done automatically by the inbuilt mechanism of the sound meter. The letter A and C refer to two filtering methods. The A-weighted network filters out very low frequencies very severely, and C hardly filters out any sound. The human ear does not detect certain low-pitched and high-pitched sounds equally. Mathematical adjustments were made to measure sounds to reflect the way that the average person hears them. The adjusted measurements are called A-weighted decibels, dB (A) (Chhatwal *et al.*, 1989)

In Nigeria studies conducted in Zaria, Abuja, Akure, Ibadan, Lagos, Port Harcourt and Ota, the mean noise levels equivalent of these cities exceeded the WHO health and National Environmental Standard Regulation Enforcement Agency (NESREA) of Nigeria's general mean standard of 55dB(A) with it attendant health consequences (Ibekwe *et al.*, 2016; Ugbebor and Yorkor, 2015; Oloruntoba *et al.*, 2012; Oyedepo *et al.*, 2009). The recipients of this noise level might be predisposed to the effect of environmental noise pollution. The need for routine evaluation of noise levels in developed and developing countries has been reaffirmed by (END, 2020; WHO, 2011; Anommoharan, 2013) as this would promote effective measures to determine noise level threshold and effective noise management that would spur proactive policies by government and Non-government organization in proffering mitigations measures and punishing offenders who deliberately trivialize such policies. In developing countries, multifaceted anthropogenic activities take place at major intersections such as motor pack, commercial activities, the hooting of vehicles, human traffic, light industry, and plaza that result in noise pollution. These have necessitated this study on the evaluation of sources of noise generation and measurement of traffic noise levels from Nine [9] purposefully selected intersections in Sabon-gari LGA of Zaria Metropolis,

Kaduna State, Nigeria.

Materials and Methodology

The detailed description of materials used, procedures on data surveyed, governing equations used for the analysis, statistical hypothesis and compared standards to determine noise level exceedance.

Study Location

Sabon-Gari Local Government Area is one of the most fast populated areas in Zaria Metropolis in Kaduna state of Northwestern region of Nigeria in West Africa. The area of the study location is 263 km³ and its density of 1,495/ Km³. Figure 1 represented the geographical coordinates and ranged from 11.1231°N to 7.7322°E with a population of 291358 people from the Nigeria National population census of 2006. The study locations comprise several high institutions such as Ahmadu Bello University, School of Aviation, National Transport Institute, Leather research institute, School of Nursing, and several commercial areas such Sabon-Gari Market, Samaru Market, Several road interstates intersections leading and intrastate highways.

Nine [9] purposeful intersections were selected they are, Ahmadu Bello University (ABU) main gate intersection, 1 and 2 respectively. Kwangila intersection which is a multi-diverse intersection was delineated into Kwangila intersection sites [1,2 and 3] correspondingly. Bank Junction PZ intersection was delineated into sites 1 and 2. Emanto and MTD intersections were evaluated distinctly. They were delineated and selected as a result of the routine and the concentration of the multifaceted anthropogenic activities. At Kwangila, ABU main gate, and PZ junction were sub-delineated as a consequence of the complex nature of the intersections and due to the nature of human activities at each of the study intersections.

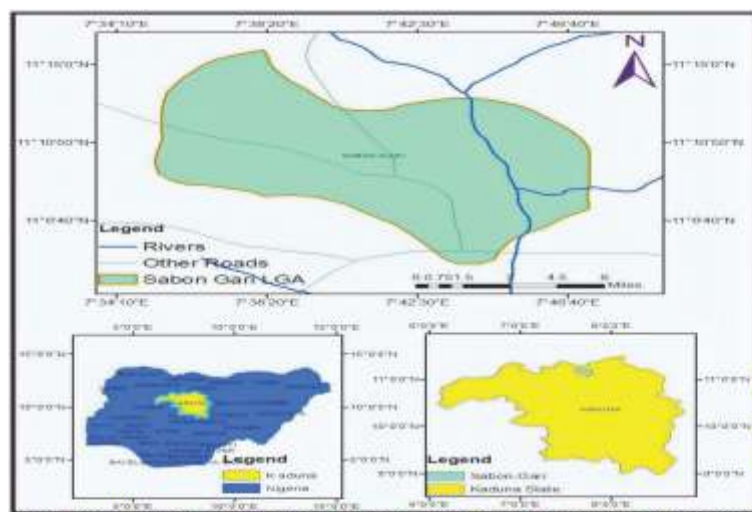


Figure 1: The Map of the Study Location Showing the Map of Nigeria and the Map of Kaduna State

Methodology

The traffic noise evaluation was conducted on each day for each study location from September 1st to 14th of October, 2019. The Noise level model 407750 of Extech was calibrated at 94 dB (A) to certify the measurement is within the calibration tolerance. The noise meter ranged from 0 to 130 dB (A) for the sound measurement with an accuracy of ± 1.5 dB (A). The resolution is 0.1 dB and the frequency range is 20 Hz to 8.5 kHz. The noise meter was mounted on the tripod stand at an angle of 90° with 1.5 m height above the ground and (1.5 - 3.5) m before any facade. Intervals of four time zones were purposefully selected due to peak hourly activities observation for the measurement from 7:30 AM -8:30 AM, 1:00 PM - 2:00 PM, 4.30 PM -5.30 PM and 10:00 PM to 11:00 PM at each study location. About (120) data were logged at each study interval every 30 seconds using a stopwatch and each measurement is represented as $L_{N1}, L_{N2} \dots L_{NN}$ as seen in equation 1. The Noise level was entered into Excel program version 2019 for the evaluations of the logarithmic sound energy average equivalent. Pertinent precautionary measures by the International Organization for Standardization (ISO), World Health Organization (WHO), European Union of Noise directive(EU), and NESREA for taking environmental sound measurements were strictly adhered to (Bazaras *et al.*, 2008; WHO, 2011; Oyedepo and Saadu, 2009; Berglund *et al.*, 1999; NESREA, 2009).

Equation (1) ($L_{(A)EQN}$) was used for evaluation of the logarithmic sound energy equivalent for morning equivalent ($L_{(A)EQ(Morning)}$), afternoon equivalent ($L_{(A)EQ(Afternoon)}$), evening equivalent ($L_{(A)EQ(Evening)}$) and night equivalent ($L_{(A)EQ(Night)}$) using Excel micro-office 2019. Equation (2) $L_{(A)DAY}$, was used for the evaluation of the logarithmic equivalent of noise level at the day interval. Equation (3) ($L_{(A)Evening}$) was used for the evaluation of the logarithmic equivalent of noise level at an evening time interval. Equation (4) ($L_{(A)Night}$) was used for the logarithmic equivalent of noise level at the night time interval computed using. Equation (5) the $L_{(A)DEN}$ was used for the evaluation of the diurnal logarithmic equivalent of the noise level at each study location, with the addition of 5 dB (A) and 10 dB (A) penalty added to the $L_{(A)Evening}$, the $L_{(A)Night}$ due to noise severity variability at the period interval of the day (END, 2002-2020; Ismail, 2009; Anommoharan, 2013; Oyedepo and Saadu, 2009).

The L_{90} is the 90% exceedance doing the period of measurement which is also referred to as the background noise. L_{10} is the 10% of exceedance doing the period of measurement while L_{50} is the 50% of exceedance doing the period of measurement obtained using the excel program (2009). Equation (6), was used for the evaluation of the Traffic noise index (TNI), equation (7), was used for the evaluation of Noise pollution level (L_{NP}), and equation (8) was used for the evaluation of noise climate (NC). The logarithmic noise equivalent interval for the day ranged from 07:00 AM to

7:00 PM, the logarithmic noise equivalent for evening interval (L_E) ranged from 7:00 PM to 11:00 PM and for the night logarithmic interval (L_N) ranged from 11:00 PM to 07:00 AM (European Noise Directive, 2002-2020; Ismail, 2009).

$$L_{(A)EQN} = 10 \cdot \log(10^{\frac{L_{N1}}{10}} + 10^{\frac{L_{N2}}{10}} + \dots + 10^{\frac{L_{NN}}{10}}) \quad (1)$$

$$L_D = 10 \cdot \log_{10} \left\{ \frac{1}{2} \left[\left(10^{\frac{L_{(A)EQM}}{10}} + 10^{\frac{L_{(A)EQA}}{10}} \right) + \left(10^{\frac{L_{(A)EQE}}{10}} \right) \right] \right\} \quad (2)$$

$$L_E = 10 \cdot \log_{10} \left\{ \frac{1}{2} \left[\left(10^{\frac{L_{(A)EQE}}{10}} + 10^{\frac{L_{(A)EQN}}{10}} \right) \right] \right\} \quad (3)$$

$$[L_N = 10 \cdot \log_{10} \left\{ \frac{1}{2} \left[\left(10^{\frac{L_{(A)EQN}}{10}} + 10^{\frac{L_{(A)EQM}}{10}} \right) \right] \right\}] \quad (4)$$

$$L_{DEN} = 10 \cdot \log_{10} \left\{ \frac{1}{2} \left[12 \cdot 10^{\frac{L_{DAY}}{10}} + 4 \cdot 10^{\frac{L_{EVEN}}{10}} + 8 \cdot 10^{\frac{L_{NIGHT}}{10}} \right] \right\} \quad (5)$$

$$L_{NP} = L_{Aeq} + (L_{10} - L_{90}) \quad (6)$$

$$TNI = 4 \cdot (L_{10} - L_{90}) + L_{90} - 30 \quad (7)$$

$$(NC) = (L_{10} - L_{90}) \quad (8)$$

Statistical hypothesis for Single Analysis of Variance (ANOVA)

When $p\text{-Value} \leq \alpha$: Where $\alpha = 0.05$, the null hypothesis was rejected but there is a significant difference between the variance between the compared variables
When $P\text{-Value} \geq \alpha$: Where $\alpha = 0.05$, the null hypothesis was accepted and there is a significant difference between the compared variance of the compared variables

The compared standard

The evaluated noise level at the major intersection was compared with the World Health Standard (WHO) of 70 dB (A) and the National Environmental Standard Regulation enforcement Agency of 75 dB(A). While the Traffic Noise index (TNI) and Noise Pollution Level L_{NP} compared standards of 74 dB (A) and 72 dB (A), respectively (Berglund *et al.*, 1999; NESREA, 2009; Schlole *et al.*, 1971).

Results and Discussion

The result was expressed in terms of the site with the maximum noise level to the site with the minimum noise level. A single factor Analysis for Variance was conducted between L_{10} and L_{90} and TNI and L_{NP} .

Selected Major Intersections and Noise Sources for Noise Level Assessment

Table 1 presented comprehensive and detailed information on the names of the identified major intersections, their coordinates which were used for the noise survey measurement and the various sources that constitute the emission of sound at the time of the assessment of the study locations. The findings on the sources of noise were re-affirmation with the findings of (WHO, 2011; Sultana, 2020; END, 2020; Oyedepo and Saadu, 2009; Oyedepo *et al.*, 2013). Their finding affirmed that traffic, hawking and other commercial activities were the major sources of noise at road intersections.

Table 1: Selected Major Intersections and Noise Sources for Noise Level Assessment

Site	Sub-Points	Latitudes	Longitudes	Sources of noise
ABU Main Gate	A1	11.154814 ⁰	7.658766 ⁰	Traffic, commercial activities
ABU main Gate	A2	11.155167 ⁰	7.65714 ⁰	Generators and light-scale industries
EMANTO		11.135232 ⁰	7.697965 ⁰	Traffic, commercial, loudspeakers, and light industries
Kwangila	A1	11.129188 ⁰	7.70409 ⁰	Traffic Activities, commercial activities
Kwangila	A2	11.12648 ⁰	7.703528 ⁰	Loudspeakers, hooting and Hawking
Kwangila	A3	11.128854 ⁰	7.703495 ⁰	Small Scale Industries
MTD				Traffic and commercial activities
Bank Junction PZ	A1	11.08882 ⁰	7.719248 ⁰	Traffic, commercial, Generators, and loudspeakers
Bank Junction PZ	A2	11.098987 ⁰	7.7196099 ⁰	Commercial activities

Multifaceted Noise Indicators of Major Selected Intersection

Tables 2A to 2B present the logarithmic average of noise level equivalent to $L_{(A)Eq}$ for the four-consecutive period of measurement as $L_{(A)EQ(Morning)}$, $L_{(A)EQ(Afternoon)}$, $L_{(A)EQ(Evening)}$ and $L_{(A)EQ(Night)}$. The logarithmic grand mean ranged from the minimum value of 82.8dB(A) at Emanto junctions to the maximum value of 92.1 dB (A) Kwangila site (1). The noise level equivalent day time intervals ($L_{(A)D}$) ranged from the minimum value of 83.7 dB(A) at Emanto to the maximum value of 93.4 dB(A) at Kwangila site (1) intersections. The noise level equivalent for the evening time intervals ($L_{(A)E}$) ranged from the minimum value of 81.4 dB (A) at Emanto junction to the maximum value of 91.3dB(A) at Kwangila site (1). The nighttime noise level ($L_{(A)N}$) equivalent ranged from a minimum value of 81.4dB(A) at the MTD junction to a maximum value of 92.1dB(A) at the Kwangila site (1). The $L_{(A)DEN}$ grand equivalent for each of the study sites ranged from a minimum value of 88.0 dB (A) at ABU main gate site (1) to the maximum value of 97.2 dB(A) the at Kwangila site (1). The evaluated noise level equivalent ranging from minimum to maximum exceeded the WHO and NESREA thresholds of 70 dB(A) and 75 dB(A) respectively (Berglude *et al.*, 1999; NESREA, 2009). In a related study conducted in Ilorin, Akure, Federal Capital Territory in Nigeria, United States of America, Barcelona in Spain, Kerman in Iran, and Khulna Metropolitan city in Bangladesh, their findings revealed that the noise levels were above the recommended compared threshold which was in confirmation with the finding in this study (Sultan, 2020; Lee *et al.*, 2014; Usikalu *et al.*, 2018; Ugbebor and Yarkov, 2015; Oyedepo and Sadu, 2009; Oyedepo *et al.*, 2013; Akintuyi, 2015; Anonoharan, 2013). The variation of noise level was necessitated by the difference in concentration of the sources of noise emission in the different locations. The study reveals that an increase in anthropogenic activities as presented

in Table 1, leads to proportional increases in noise levels, if there are no mitigating measures as emphasized by previous researchers (Ugbebor and Yarkov, 2015; Abraham *et al.*, 2022; Anonomiran, 2013; Oyedepo and Saadu, 2009; European Environmental Policy, 2020; Sultana, 2020).

The noise percentile as present in Table 2A to 2B, the L_{10} and L_{50} , exceeded the WHO and NESREA specification in all the studied locations for the logarithmic equivalent for $L_{(A)EQ(Morning)}$, $L_{(A)EQ(Afternoon)}$, $L_{(A)EQ(Evening)}$ and $L_{(A)EQ(Night)}$ during the period of measurement. The logarithmic grand mean for L_{10} ranged from a minimum value of 85.7dB (A) at ABU main gate site (2) to the maximum value of 95.5 dB (A) at the kwangila site (1) exceeding the WHO and NESREA standard of 70 dB (A) and 75 dB (A) respectively. While the L_{50} , logarithmic grand mean ranged from the minimum value of 77.7 dB (A) at ABU main gate site (1) to a maximum value of 86.5 dB (A) at the Kwangila site (1) exceeded the WHO in all the surveyed sites. The logarithmic average equivalent for L_{90} percentile exceedance for $L_{(A)EQ(Morning)}$, $L_{(A)EQ(Afternoon)}$, $L_{(A)EQ(Evening)}$ and $L_{(A)EQ(Night)}$ exceeded WHO and NESREA standards in about 72.2% representing 28 diurnal surveyed intervals times. The logarithmic grand equivalent L_{90} ranged from a minimum value of 71.3dB (A) at ABU main Gate (2) to 82.3dB (A) maximum value at Kwangila (site 1) intersections. The noise level in this study exceeded the permissible limit in most of the surveyed sites and necessitated sources of noise as intermixed in Table 1. This is a re-affirmation with other related studies conducted in Ilorin where the noise percentile exceeded in most of the study sites (Oyedepo ad Saadu, 2009). The Traffic Noise Index (TNI) and Noise pollution level (L_{NP}) exceeded the Scholes, Sergeants and salvidge standard of 74 dB (A) in all the surveyed sites as presented in Table 2A to 2B. The grand logarithmic mean TNI ranged from a minimum value of 101.5 dB (A) at MTD to 116.4 dB

(A) maximum value at the Kwangila site (1) intersection. Noise pollution level (L_{NP}) ranged from a minimum value of 96.5 dB (A) at MTD to the maximum value of 109.8 dB (A) at Emanto intersections respectively and it exceeded the Scholes, Sargent and Savidge standard of 74 dB (A) and 72 dB (A) respectively. The Noise climate (NC) ranged from a minimum value of 13.2 dB (A) to an 18.6 dB (A) maximum value. The variation in the noise level from the different studies was necessitated by difference in sources of noise emission which is in agreement with the study conducted in Ilorin and Akwure where the

Traffic Noise index and Noise pollution level exceeded in most of the noise surveyed sites (Oyedepo and Saadu, 2009). It had been acknowledged by several studies that recipients who are predisposed to noise pollution exceeding the permissible standard could be predisposed to diverse effects of noise pollution such as headache, annoyance, cardiovascular diseases, deterioration of cognitive prowess, hearing impairment, tinnitus, affect efficiencies and job performance (Abraham *et al*, 2022; Sultan 2020; END, 2020; WHO, 2011; Ibekwe *et al*, 2016, Ugbebor and Yorkor, 2015; WHO, 2009-2011).

Table 2a: Multifaceted Noise Indicators of Major Selected Intersection

Site	PO F	Noise level Indicators dB (A)										
		LAeq	L10	L50	L90	TNI	LPN	LD	LE	LN	NC	L _{DEN}
Kw site (1)	M	94.5	97.4	87.9	80	115.6	110.3	93.4			16.4	
	A	91.4	95.4	79.9	84.8	111.9	106.9				15.5	
	E	93.6	96.8	85.5	78.4	122	109.8		91.3		18.4	97.2
	N	86.4	91.6	88.6	83.1	76.6	99.4			92.1	12	
Log A Kw (1)		92.5	95.5	86.5	82.3	116.4	108.1	93.4	91.3	92.1	16.1	97.2
Kw (2)	M	90.6	93.8	86.7	78.7	109.1	105.7	90.9			15.1	
	A	88.3	91.5	85.4	81	93	101.1				10.5	
	E	92.7	95.9	84.4	78.3	104.7	104.7		90.5		14.1	
	N	87.3	90.6	83.1	79.1	95.9	99			89.3	11.7	95.1
Log A Kw (2)		90.2	93.4	85.1	79.4	104.8	103.4	90.9	90.5	89.3	13.2	95.1
Kw (3)	M	92.9	90.1	83.7	76.7	107	110.3	90.7			16.4	
	A	85.7	89	82.2	76.4	96.8	106.9				15.5	
	E	91.6	94.4	85.6	75.9	102.9	109.8		90.6		18.4	
	N	89.3	92.1	83.4	77.8	107	102.9			91.2	14.8	96.2
Log A Kw (3)		90.6	92.	83.9	76.8	104.9	108.3	90.7	92.7	91.2	16.5	96.2
BJPZ (1)	M	86.8	92.7	86.8	74.4	117.6	105.1	87.2			18.3	
	A	88.1	91.4	84.4	76.4	110.2	104.3				16.2	90
	E	86.5	89.8	80.6	75.3	103.9	100.9		84.2		14.4	
	N	78.8	77.4	67.4	57.6	106.8	98.6			84.4	19.8	
Log A (BJPZ)		86.1	90.3	83.3	74.2	112.5	102.9	87.2	84.2	84.4	17.6	90
BJ PZ (2)	M	84.5	88.6	78.8	74.4	103.2	99.2	84.4			14.2	
	A	82.7	86.0	79.9	72.8	96	95.9				13.3	90.2
	E	85.6	88.7	81.2	71.6	106.4	101.8		83.6		16.2	
	N	79.9	82.8	70.7	63.7	98.9	96.2			82.8	16.3	
Log (BJPZ)		88.7	86.4	79	72	102.8	99	84.4	83.6	82.8	15.2	90.2
Emanto J	M	82.7	85.4	80.3	75.9	87.9	93.2	86.0			14.2	
	A	87.2	89.8	80.2	75.7	92.9	91.2				11.8	
	E	86.8	89.9	82.5	77.1	94.3	85.6		85.7		11.5	
	N	84.2	87.4	76.1	68.1	107.3	101.5			83.5	17.3	93.5
Log A Emanto J		85.6	88.5	80.3	75.2	101.7	96.5	86	85.7	83.5	14	93.5

Table 2b: Multifaceted Noise Indicators of Major Selected Intersection

Site	POF	Noise level Indicators (dbA)										
		LAeq	L10	L50	L90	TNI	LPN	LD	LE	LN	NC	L _{DEN}
MTD	M	87.7	91.0	81.5	77	104.2	102.1	86.7			14.3	88.7
	A	85.2	87.9	79.3	73.6	100	99.3				14.1	
	E	82.8	85.6	78.9	73.4	99.8	96.9		84.1		14.4	
	N	79.9	82.9	75.4	64.7	100.1	115.5			81.6	20.2	
Log A MTD		84.8	87.8	79.3	73.9	101.5	109.8	86.7	84.1	81.6	16.6	88.7
ABUMGSite(1)	M	86.2	89.3	77.7	70.7	110.7	103.7	84.8			17.5	
	A	83.5	86.7	80.4	74.8	100.4	98.6				13.9	
	E	84.4	86.9	77.1	69.4	107.8	99.9		82.2		17.1	
	N	77.6	80.4	71.2	64.5	106.1	97.8			83.8	17.9	
Log A ABUMG1		84	86.8	77.7	71.3	107.6	100.7	84.8	82.2	83.8	18.1	88.6
ABUMG2	M	85.9	88.8	74.9	66.3	110.7	104.5	83.8			18.6	88
	A	79.4	82.1	83.4	83.4	105.3	97.7				18.3	
	E	83.6	86.7	76.9	67.5	108.2	102.4		81.4		17.1	
	N	76.8	80.2	70.6	64.1	104.5	94.4			83.4	17.6	
Log ABUMG 2		82.8	85.7	78.9	77.6	107.4	101.3	83.8	81.4	83.4	17.9	88.0
Note: POF= period of measurement KW= kwangila, Log A= Logarithmic average; BJPZ=Bank junction Peterson Zachonis; ABUMGI= Ahmadu Bello University main gate intersections site; M= Monday; E= Evening; A= afternoon; N= Night												

Single Factor Analysis of Variance (ANOVA) for Noise Percentile between L_{10} and L_{90}
 The single factor ANOVA between L_{10} and L_{90} showed that there was a significant different as $F(1,70)=130.12$, $p<0.05$) as presented in Table 3, using the confidence level of 95% . The outcome of this finding is in affirmation with a related study conducted in the Ilorin metropolis in Kwara state Nigeria, where there was a significance difference between L_{10} and L_{90} (Oyedepo and Saadu, 2009).

Table 3: Single factor ANOVA for Noise percentile For all the intervals of time

Source of Variation	SS	Df	MS	F	P-value	F crit	Remarks
Between Groups	3966.45	1	3966.44	130.12	1.26E-17	3.98	P<0.05 There is a significant difference
Within Groups	2133.86	70	30.48				
Total	6100.3	71					

The Single Factor ANOVA for the Noise Diurna Parameters

The single factor ANOVA between the traffic noise index (TNI) and Noise pollution level (L_{NP}) from different surveyed sites revealed that $f(1, 70) = 1.35$, $P > 0.05$, using the confidence level of 95%. Therefore, there is no significant difference between the Traffic Noise Index (TNI) and the Noise pollution level (L_{NP}).

In a related analysis conducted by Oyedepo and Saadu, (2009) in Ilorin Nigeria observed that there was no significance difference between the Traffic Noise Index (TNI), and the Noise Pollution Level (L_{NP}) as reaffirmed in this study.

Table 4: Summary of the Single Factor ANOVA for the Noise Diurna Parameters

Source of Variation	SS	df	MS	F	P-value	F crit	Remark
Between Groups	73.21	1	73.21	1.35	0.25	3.98	P>0.05 There is no
Within Groups	3792.04	70	54.17				Significance difference
Total	3865.25	71					

Conclusion

The outcome of the findings revealed that the noise level were unsatisfactory in all the Nine (9) selected study sites. The $L_{(A)Day}$, $L_{(A)evening}$ and $L_{(A)night}$, and $L_{(A)DEN}$ diurnal noise levels exceeded the WHO and NESREA standards with maximum to a minimum value at Kwangila site (1) to ABU site (2). The Traffic Noise Index (TNI), and Noise pollution Level (L_{NP}) exceeded all the intersections with the maximum to a minimum value at Kwangila site (1) to Emanto and MTD. For the single factor ANOVA, there was a significant difference between L_{10} and L_{90} as $P < 0.05$, while for the noise parameters there was no significant difference between TNI and L_{NP} as $P > 0.05$ using the confidence level of 95%. The Marchants, commuters, hawkers, transport operators, and road traffic warders could be predisposed to the health effect of noise pollution.

Recommendation

The recipients of this noise pollution could be predisposed to the effects of noise pollution which could range from physiological to psychological effects. Therefore, there is a need for routine noise monitoring, strategic plan by government and concerned individuals in providing ear protective devices, public awareness, maintenance of vehicle silencers suspensions to decrease rolling stocks in urban and peri-urban areas.

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