

Determination of Ambient Noise Levels of Some Selected Commercial Areas of Bauchi Metropolis, Nigeria

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Abstract: Noise is the product of human activities most especially urbanization, development of transport industries as well as commercial activities. World Health Organisation has considered noise in big cities to be the third most hazardous pollution type, right after air and water. In comparison with other pollutant, the control of environmental noise has been distracted by insufficient knowledge of its effect on human and lack of sufficient data. Noise pollution is described as an unwanted sound introduced into the environment without regard to the adverse effects. Therefore, this study intends to measure the noise pollution levels in some commercial areas of Bauchi metropolis. Sound level meter (AR524) was used to measure the noise level in the study areas. Results from the measurement shows that a significant difference exists between the noise level measured and the WHO recommended noise level for commercial areas. The noise level range at Yankari motor park is 78.7-91.2 dB (A), while that of Bauchi central market is 79.6-91.1 dB (A) and that of Muda Lawal is 76.5-93.5 dB (A). Conclusively, limits on the noise emission in the study area be controlled by the relevant authorities. Noise level in the study areas were above the maximum threshold recommended by international regulatory agencies (WHO) by values of 1–17 dB (A). This makes imperative for the regulatory authorities to enforce compliance on noise.

Key words: Ambient Noise, Noise pollution, Commercial areas, WHO standard, Bauchi- Nigeria.

1 Introduction

Sound is defined as any variation in pressure that be detectable by ear, from the lowest sounds to levels which can result in hearing damage (Foreman, 2012). Different people are affected differently by the same sound. However, in different situations and on various occasions, every day sound can commonly interfere with routine activities, in this case sound become noise. (Parisara, 2005).

Nausea is the word from which noise was derived, which implies 'unwanted sound'. It originates as a result of human activities most especially urbanization, development of transport industries and as well commercial activities (Valentine, Margarate and Tamunobereton-ari, 2010). The unwanted sounds should be eliminated as far as possible, while the wanted sounds should be adjusted for comfortable hearing. Sound is a form of energy and energy cannot be destroyed. To eliminate sound, therefore, requires a transformation to some other form of energy, ultimately heat. Thus, sound waves impinging on a porous structure are absorbed when they set up a friction between thin layers of air and the adjacent solid material to which the layer adheres, with a consequent creation of heat (Christensen, 1992) & (Cavanaugh, Tocci and Wilkes 2010). Sound as energy is also used up when it generate" vibrations in windows, doors, partitions etc. The fraction of energy in sound is so small, that an average voice has only about one-millionth of the required energy to set ordinary electric lamp into function which means that little heat is generated when sound is absorbed (GÜL, 2015). This noise may also radiate through rigid floor/ceiling assemblies and framing that extend between living/working/common and service areas (Tate, 1994).

Environmental noise has been defined as an unwanted or harmful outdoor sound created by human activities. This includes noise emitted by means of transport and from sites of industrial activities (Paul & Fredrick, 2011)

Noise pollution contributes to environmental degradation and poses a threat to human and terrestrial lives. (Ibekwe et al., 2016). Noise pollution (community and industrial) ranks third as the most hazardous form of pollution behind air and water pollution (WHO, 2005). It is generally agreed by many that the trend of noise pollution is on increase in magnitude and severity with more widespread reach, due to population growth, technological advancement and urbanization. (Goines & Hagler, 2007). Inadequate attention was paid to noise as a form of pollution with the earlier widespread cliché being that noise differs from other forms of pollution in that, once abated, noise leaves no residual accumulation in the environment or the human body (Lai, 1996). Noise pollution has been proven to aggravate chronic illnesses like hypertension and other cardiopulmonarydiseases (Sobotova, Jurkovicova & Stefanikova, 2010). Consequently, some studies have summarily referred to noise pollution as a modern plague (Clark, 1992).

Noise control measures as part of an architectural plan can efficiently prevent noise by considering noise reduction in the architectural design of a building. To reduce noise conveyance, living areas can be planned at a distance from noise sources, and

efficient sound insulation can be incorporated, including sound-proof structures and the use of special noise absorbing construction materials. Noise prevention can then be achieved from an architectural aspect. Noise damage can be huge in buildings parallel to roads, because sound is reverberated, and therefore, a building needs to be built in a vertical direction or by maintaining a proper angle with respect to roads. Bricks with a rough surface can be used as a lining to prevent noise reverberation and absorb noise. This method can be very efficient because sound-proof measures can be established in advance when preparing the architectural plan.

When noise control measures are implemented in existing housing a much quieter environment can be enjoyed, even with slight improvements. Some simple measures to prevent noise can be implemented by installing materials such as curtains or carpets to absorb sound. Carpets are generally better than other floor materials at absorbing sounds, and are excellent sound-proofing materials for indoor spaces. Social measures should be adopted, such as keeping the volume of appliances (e.g., radios) at moderate levels.

2 Methodology

The location covers an area of 3,687 km² and had a population of 493,810 at the time of the 2006 Census (Ade, Sulaiman & Isa, 2013). The areas includes Bauchi Central market, Yankari Motor Park and Muda Lawal (Both Park and Market).

Commonly, the sound level meter or sound meter, an instrument that measures sound pressure level, is used in noise pollution studies for the quantification of different classes of noise including industrial, aircraft and other environmental forms. The unit of measurement is in decibel (dB) which is a logarithmic mode of quantifying sound loudness, intensity and pressure. The A-weighted variety of sound wave measurement is used for the quantification of the environmental noise in dB (A) units. An increase in 10dB is equivalent to doubling the loudness of sound, while increase by 6dB and 3dB doubles the Sound Pressure Level (SPL) and Intensity of the sound respectively.

This study was basically to evaluate the noise dB (A) pattern (levels, places and time) in our environment. Hence, the prime objective of this investigation is to carryout comprehensive assessment of the noise levels in the city.

A sound level meter is an instrument used for measuring the pressure levels of sound. Not all sounds are not detectable by human ears, as such weighing systems for internal frequency were incorporated in most sound level meters to help with equivalent readings. The designated weighting systems are A, B and C. The mostly used weightings today are A and C. The A weighting is used most frequently because it yields sound measurements that most closely reflect how humans actually hear and therefore AR524 Sound Level Meter was used.

The experimental setup includes Sound level meter, Digital timer and Tripod stand. The instrument was mounted on tripod stand at a height of 1 m above the ground for all the locations for consistency of measurement with the antenna pointing to the sound source. This measurement process was carried out for the locations at three different times of the day which are: 8.00-9.00am, 12.00-1.00pm and 5.00-6.00pm (Anomohanran, 2013). The Digital timer was used in measuring the measurement's period. Three measurement were conducted at each time of the day.

Only day time readings were obtained from the markets because the premises remained closed by 6pm with zero activities till next day.

The result from the experiment was presented in table as well. SPSS statistical software was used in conducting the analysis for the obtained information from the experiment.

3 Results and Discussions

Measurement

The average morning, afternoon and evening noise level in Yankari Motor Park were found to be 85.9, 88.2 and 83.9 respectively with daily average of 86.0dB. This is shown Table 1.

Table1: Average Noise Level of Yankari Motor Park

Blocks	Measured Average Noise Level (dB)			
	Morning	Afternoon	Evening	Daily Average
Block1	86.3	88.3	84.2	86.3
Block2	89.0	91.1	87.9	89.3
Block3	87.9	90.2	81.7	86.6
Block4	89.3	91.2	85.2	88.6
Block5	84.2	89.0	82.3	85.2
Block6	78.7	79.6	80.0	79.4
Average	85.9	88.2	83.9	86.0

Table 2 shows that the Noise level in Bauchi Central Market for Morning, Afternoon and Evening were found to be 85.6, 88.4 and 84.2dB respectively. Daily average was also found to be 86.1dB.

Table 2: Average Noise Level of Bauchi Central Market

Blocks	Measured Average Noise Level (dB)			
	Morning	Afternoon	Evening	Daily Average
Block 1	88.9	90.2	85.8	88.3
Block2	82.7	86.3	81.7	83.6
Block3	84.6	84.6	80.4	83.2
Block4	88.6	89.7	83.8	87.4
Block5	87.6	91.1	83.8	87.5
Block6	83.6	83.6	79.6	82.3
Block7	82.4	86.2	81.3	83.3
Block8	84.4	90.4	86.6	87.1
Block9	88.4	89.0	86.1	87.8
Block10	85.9	88.4	89.5	87.9
Block11	84.2	88.3	83.2	85.2
Block12	85.9	93.3	88.3	89.2
Average	85.6	88.4	84.2	86.1

Table 3 indicated that the daily average noise level was found to be 87.0dB at Muda Lawal while for the respective morning, afternoon and evening were as well found to be 86.9, 90.0 and 84.0dB.

Table 3: Average Noise Level of Muda Lawal Market

Blocks	Measured Average Noise Level (dB)			
	Morning	Afternoon	Evening	Daily Average
Block1	90.7	93.5	83.3	89.2
Block2	84.6	89.3	86.5	86.8
Block3	84.0	90.5	82.5	85.7
Block4	85.3	91.3	81.6	86.1
Block5	86.6	94.4	83.6	88.2
Block6	76.5	79.0	77.3	77.6
Block7	88.1	88.0	86.4	87.5
Block8	91.0	88.9	84.8	88.2
Block9	90.1	88.0	83.2	87.1
Block10	81.3	86.6	83.5	83.8
Block11	85.1	88.9	79.3	84.4
Block12	84.1	88.9	83.8	85.6
Block13	86.6	89.0	86.8	87.5
Block14	89.5	90.7	86.2	88.8
Block15	86.9	92.0	84.2	87.7
Block16	91.0	89.0	86.7	88.9
Block17	87.6	90.1	83.6	87.1
Block18	87.9	91.1	83.6	87.5
Block19	84.8	89.6	84.1	86.2
Block20	87.8	89.1	84.3	87.1
Average	86.9	90.0	84.0	87.0

Table 4 indicated that the average noise level for commercial areas is significantly higher than WHO noise level standard (70dB). This is due to the fact that after comparing the WHO standard with the obtained noise levels in the study areas, it appears to vary significantly (.000) from the column of Sig (2-tailed)

Table 4: WHO Standard (70dB) against measured noise in the respective locations

Test Value = 70dBb						
Location	N	Mean	Mean Diff.	Sig(2-tailed)	t-value	Df
CM	12	86.0667	16.06667	.000	23.263	11
YMP	6	85.9000	15.90000	.000	11.039	5
ML	20	86.5500	16.55000	.000	29.174	19

CM: Central Market

YMO: Yankari Motor Park

ML: Muda Lawal

The first hypothesis was tested using a t-test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that if the $p\text{-value} > 0.05$, the hypothesis is accepted but if the $p\text{-value} \leq 0.05$, the hypothesis is rejected.

It could also be seen from Table 15 below that the Central market noise level when compared to the average noise level in Muda Lawal does not varied significantly ($p\text{-value}$ of .437).

Table 15: Test of Hypothesis 1

Central		Test Value = 86.1dB					
Location	N	Mean	Mean Diff.	Sig(2-tailed)	t-value	Df	Decision
ML	20	86.5500	.45000	.437	.793	19	Accepted

ML: Muda Lawal

The second hypothesis was also tested using a t-test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that if the $p\text{-value} > 0.05$, the hypothesis is accepted but if the $p\text{-value} \leq 0.05$, the hypothesis is rejected.

Similarly, the p-value of .334 from Table 16 above shows that there is no significant difference between the noise level in Yankari Motor Park and Muda Lawal.

Table 16: Test of Hypothesis 2

Yankari		Test Value = 86dB					
Location	N	Mean	Mean Diff.	Sig(2-tailed)	t-value	Df	Decision
ML	20	86.5500	.55000	.334	.970	19	Accepted

ML: Muda Lawal

The third hypothesis was equally tested using a t-test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that if the $p\text{-value} > 0.05$, the hypothesis is accepted but if the $p\text{-value} \leq 0.05$, the hypothesis is rejected.

In this case i.e Table 17, the cumulative average noise level of Central Market and Yankari are compared against the average noise level in Muda Lawal. The result (.000) indicated that there is significant difference between them, with cumulative average being of greater value than that of Muda Lawal.

Table 17: Test of Hypothesis 3

Central-Yankari		Test Value = 89dB					
Location	N	Mean	Mean Diff.	Sig(2-tailed)	t-value	Df	Decision
ML	20	86.5500	-2.45000	.000	-4.319	19	Rejected

ML: Muda Lawal

4 Conclusion and Recommendation

The 86.4dB noise level in the study areas is above the 70dB maximum threshold recommended by World Health Organisation by values of 1–17 dB which was believed to be annoying. Thus, there need for improvement through adequate building design and materials choice. Treatment techniques used in reducing the noise level in the study area from various noise sources, should be checked regularly by market officials to ensure that it doesn't exceed the prescribed allowable standard.

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