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Assessment of Fluctuations in Traffic Noise Levels with Simultaneous Traffic Density at Kpakungu-Gidan Kwano Road

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ABSTRACT
Transportation is one of the important pillars of the nation's economic and overall growth. Despite its importance, it has its negative impacts on the environment as well as human health. One of its negative impacts is traffic noise pollution. This paper focuses on the relationship between traffic density and noise level. The study was conducted in Kpakungu area Minna city. The noise levels were monitored using the sound level meter and traffic count was done in the form of 2 wheelers, 3 wheelers, 4 wheelers, bus, and trucks. It was found that the average noise levels is 77dBA, which is higher than the permissible standards set by Nigeria environment standard and regulation enforcement agency. Also, the study indicates depends on traffic density and factors such as traffic flow, honking of horns, lane indiscipline, unauthorized parking, heterogeneity of vehicles in traffic. Lane indiscipline by vehicle users often result in traffic congestion and increase in honking of horns. Traffic noise levels are not always directly proportional to traffic count, but fluctuates randomly due to reasons enumerated above.
Keywords: *Traffic noise, Leq, Heterogeneous, Traffic flow, Noise level, Distance,*

1 INTRODUCTION

Noise is one of the pollutions that has always been an important environmental problem for human. It is characterized as 'undesirable sound', and it is seen as a natural stressor due to the annoyance from human daily activities [1]. The major form of noise is including transportation, industrial and neighborhood sector. Transportation noise can come from a variety of sources including motorcycles, vehicles, aircraft and rail transport. Road traffic has become an important factor in societal development and economic progress due to increasing number of vehicles [2]. Traffic noise has a tendency to be a dominant noise source in urban and rural environment, which has turned into a developing public concern. Based on the Report of World Health Organization, sound may cause hearing disability, sleep disturbance, performance loss, cardiovascular impacts, and interferences with social behaviour which are aggressiveness, protest and helpfulness.

Noise due to transport traffic becomes the benchmark of aggravation of disturbed people compared to others such as pollution or congestion. From research conducted in Montreal, there is a relationship between noise levels and disruption of highway traffic and total environmental noise [7]. Such noise is known to be influenced by several factors, one of which is the distance from the noise source. Distance to the main road and the type of road is a strong predictor of noise disturbance [8]. The noise level is significantly affected by the distance from the noise source and decreases as the constant tending of the noise level at an increased distance Traffic noise has also relates to the obstruction in speech communication and annoyance. Another perspective view on the economic consequences of these health impairments are property value. Loss in areas subjected to noise impact can bring down work performance of those influenced by noise [3] and medical expenses of improving the condition of health of those influenced by noise [4]. Its adverse effects on health and economy have forced communities to seek solutions to improve quality of life by reducing traffic noise. According to previous research [5] in figure 1, shows that 73% has pointed that traffic noise are the main source that contributes in urban area. Normally, the noise intensity is characterized by sound pressure level measured in decibels. The sound pressure level is a measure of the air vibrations that make up sound. All measured sound pressures are referenced to a

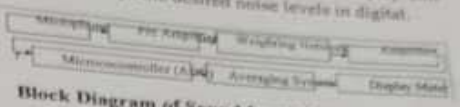
standard pressure that corresponds roughly to the threshold of hearing at 1000 Hz. Thus, the sound pressure level indicates how much greater the measured sound is than this threshold of hearing. The sound pressure levels of most noises vary with time. Consequently, in calculating some measures of noise, the instantaneous pressure fluctuations must be integrated over some time interval. To approximate the integration time of our hearing system, sound pressure meters have a standard Fast response time, which corresponds to a time constant of 0.125 sec. Thus, all measurements of sound pressure levels and their variation over time should be made using the Fast response time.

Figure 1. The histogram of road traffic noise in an urban setting

2 METHODOLOGY

Sound Level Meter

A sound level meter is a fundamental requirement for measuring the noise levels. It is designed to estimate the sensitivity level of loudness for the human ear and gives the desired, reproducible measurements for the sound pressure level. To determine the frequency range, spectral weighting of sound, along with the function of time constants, and computation of the equivalent continuous level the sound level meter does more complex work. The block diagram of sound level meter is shown in Figure 3.2 which consists of a micro phone which acts as a transducer to convert the sound into its equivalent electrical signal. The magnitude of the electrical signal is small which comes out of the microphone and then this low electrical signal is amplified by a pre amplifier and output of which is connected to a frequency weighting network "A" or "C" and the output of filter is again amplified and is then given to an microcontroller which has an analog to digital converter which converts the analog signal to digital and then the output is given to a averaging system for data storage facility and then we have display unit which displays the desired noise levels in digital.



Block Diagram of Sound Level Meter

In the present study an Environmental sound level meter 2001(DL03) of Baseline Technologies is used. It is used to measure the existing noise equivalent level (L_{eq}) dB (A) at the various intersections (locations). The battery operated instrument has a **microphone, amplifier "A" weighting network and an** indicating meter which gives a reading in dB relative to $2x10^{-5}$ N/m^2.The reading range is divided into three limits 0-50dB,50-100dB and 100-150 dB .The display is alphanumeric type. We have used this instrument according to given standard conditions.

Installation of sound level metre (SLM)

Methods

Traffic flow and noise measurements was conducted simultaneously within the timeframe from 07:30 AM - 07:30 PM with measurement intervals per 30 minutes.. The sound level meter was mounted at an 1.2 height close to the noise source) in order to reduce errors due to reflection of sound from the body of investigator and the instrument was kept at m away from the roadside. SLM indicate as sound pressure

level (SPL) meter, decibel (dB) meter, noise meter or noise dosimeter. SLM use a microphone to capture sound. The sound is then assessed within the device and sound measurement values are shown. The most common unit of sound measurement is decibel (Db).

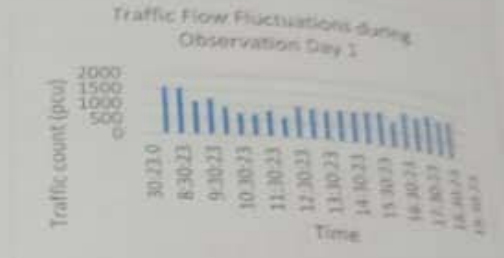
Location

Kpakungu is located on latitude 90 35'55.00" N and longitude 60 32' 00.00"E. Niger state is located between on latitude 80 10' N and 100 30' N and between longitude 30 30'E and 70 30' E. Kpakungu has a combination of dry and wet season, a hybrid of northern and southern Nigeria climate. Progressively it has a decreased in length and amount of rainfall from south to north with a mean annual rainfall between 110mm in the north to 1600mm in the south. The wet season has duration, which changes from 150 days in the north to 210 days in the south.

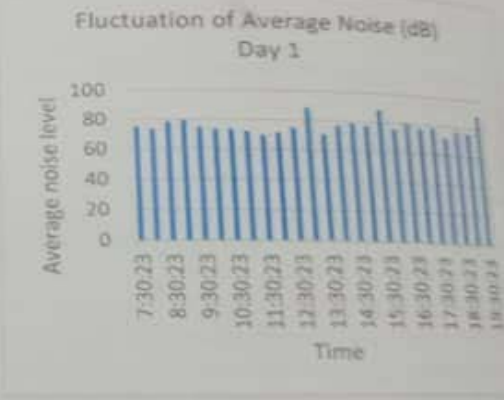
Air temperature in the area is fairly constant during seasonal variables and the mean temperature does not

RESULTS AND DISCUSSION

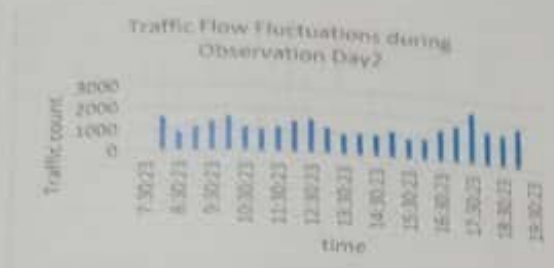
From the result of traffic survey and noise level conducted during 12 hours observation with normal weather conditions obtained the composition of car, motorcycle vehicle (MC), light vehicle (LV), and heavy vehicle (HV). Further traffic data is presented in pcu/hour and can be described fluctuations in traffic flow as shown in Figure 1



Trafic count against Time



Average Noise level against Time



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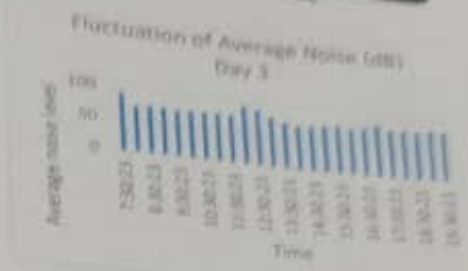

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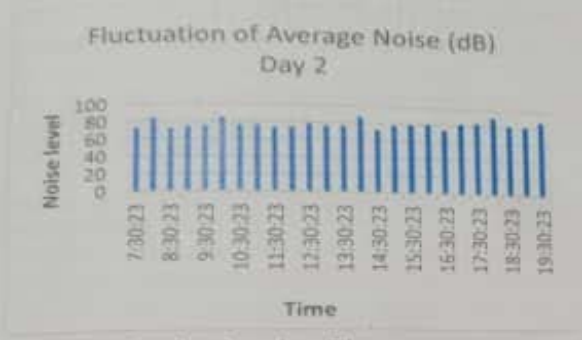

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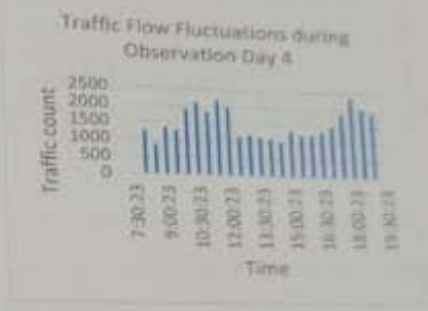

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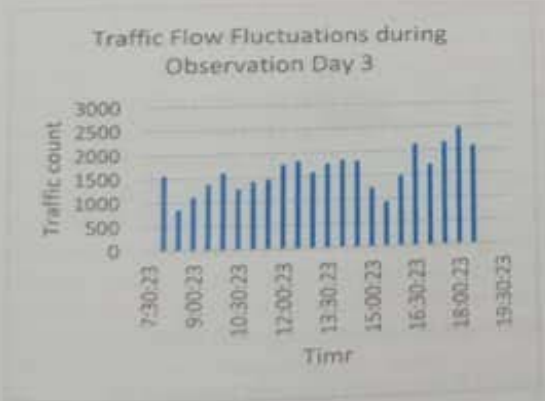

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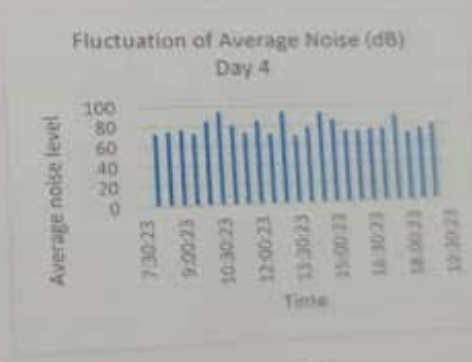
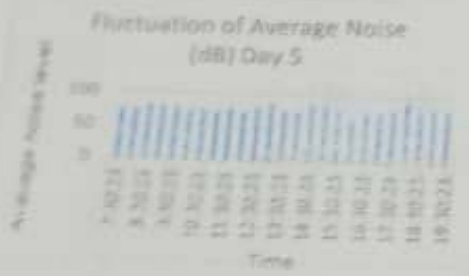


Average Noise level against Time

Trafic count against Time

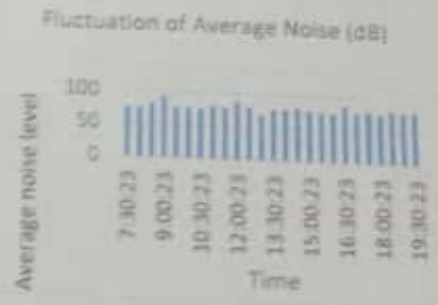
Average Noise level against Time



Average Noise level against Time

Trafic count against Time

Trafic count against Time



Average Noise level against Time

Figure.1 LAeq over 12 hour's period of sampling locations.

Fig 1. : Traffic count in all

Figure 1 displays hourly traffic changes for all 21 day from 7:30 a.m. to 7:30 p.m. While carrying out the analysis, it was observed that in any instance of time the Tricycle are high in because of the high number of Tricycles traffic flow is congested leads to horn honking, which raises noise levels in the area. The traffic composition in the area is heterogeneous. Two-wheelers share 68 to 70% and three-wheelers share 18 to 20% of total traffic, due to this heterogeneous nature of traffic and lane indiscipline by vehicle users, traffic often gets congested which results in honking of horns. This traffic congestion situation is very common in peak hours hence noise levels are high in peak hours. Also, a very important reason observed in the area for traffic congestion is unauthorized perking. People park their vehicles at the roadside which lowers the space available to free flow of ongoing vehicles which ultimately results in traffic congestion and horn honking.

Fluctuations in noise levels and simultaneous traffic density

figures 1 shows variations/ fluctuations in noise levels to its simultaneous traffic count on an 30min basis. The vehicle count is a normal integer scale, on the other hand, noise levels are in logarithmic scale. It means that if one or two decibels of noise is also increasing, it can be considered a significant change in noise level. The first observation from these figures implies it is not always necessary that, if the number of vehicles is increasing, simultaneous noise levels will also increase. As these figures are showing in a particular hour sometimes noise levels are simultaneously increasing with a respective traffic count of that particular hour, for example in day 2, at 9:30 AM and 11:30 AM, in day 3 at 11 AM-12:30pm, day 4 9:30-11:30 etc. On the other hand, most of the time, almost the same noise levels are appearing at different traffic counts of the respective hour, for example, in day 2 at 11:30 AM and 12:30 PM, day 3 at 11 AM and 11:30 AM, etc. Also, in some instances, noise levels are decreasing as traffic count is increasing, for example in day at 16:30 PM-9:30PM, in day 4 at 10:30 PM-12:00 PM, in day 6 16:30 PM – 17:30 etc. several reasons are observed for such fluctuations in noise levels, the primary reason is honking of horns. For instance, at a non-peak hour, due to unauthorized parking, sometimes the free flow of traffic gets disrupted and traffic congestion happens where people will start honking horns which will lead to an increase in noise levels at a lower number of vehicles also.

The second reason can be enlisted as lane indiscipline observed on the roads, for overtaking another vehicle, people may leave their respective lane of free flow and try to go by another lane at which already vehicles in motion are available, this also results in honking of horns that fluctuates noise levels.

Another important reason is the heterogeneity of traffic in India. Unlike in developed countries where traffic is homogenous i.e. mostly consisting of four-wheelers, in Indian conditions the number of two-wheelers and three-wheelers is higher than four-wheelers and the same was observed in the study area. Hence because of the lack of driving discipline of two-wheelers and three-wheelers also contribute to increasing in noise levels at lower traffic count.

CONCLUSION

A lot of previous researches, especially in developed countries indicates that as traffic count increases, respective noise levels also will increase. It is true for developed countries as the traffic is homogeneous as well as people follow lane discipline and won't honk horns until its necessary. But for Kpakungu-Gidan Kwano road conditions, it is not necessarily true due to several reasons. Heterogeneous nature of traffic in the area and lane indiscipline by vehicle users, traffic often gets congested which results in honking of horns. This traffic congestion situation is very common in peak hours hence noise levels are high in peak hours. Also, a very important reason observed in the area for traffic congestion is unauthorized perking. Due to these observed reasons in the study area, it can be concluded as traffic noise levels are not always directly proportional to traffic count, they may fluctuate very randomly, due to reasons enumerated above. For this season, an evolutionary computing tool-based noise prediction mathematical model may be developed for heterogeneous traffic conditions of developing countries like Nigeria

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