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ANALYSIS OF NOISE ASSOCIATED WITH MARKETS ALONG MAJOR AND MINOR ROUTES IN SELECTED AREAS OF RIVERS STATE, NIGERIA

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Abstract: **This study investigated noise associated with markets along major and minor routes in selected areas of Rivers State. The continuous equivalent noise level (L_{eq}), the Noise Pollution level (L_{NP}), the background noise level (L_{90}) and the peak noise level (L_{10}) were used as the indices to determine the level of noise in the study areas. Field instruments used to for the study include noise Meter GM 1351, Kestrel Pocket Weather Tracker 4500, Newsmy Z600 GPS, Trumeter Measurement Roller and Stop Watch. The results obtained indicated that Nchia, Bori, Mile one, Kibangha and oil mill market route for L_{10} were 82.25dBA, 78.5dBA, 93.75dBA, 74.5dBA and 82dBA; while L_{90} were 67.25dBA, 69.5dBA, 82dBA, 62.5dBA and 69.25dBA for non-market days respectively. Also, Nchia, Bori, Mile one, Kibangha and Oil mill market route L_{10} were 97.5dBA, 106dBA, 102.5dBA, 100.9dBA and 82dBA; while L_{90} was 76.5dBA, 88.25dBA, 82.5dBA, 83.5dBA and 69.25dBA for market days respectively. A Regresit software was used to develop a model $N= A +BTe + CTe^2+ Dt + Et^2+ Fw + Gw^2$, which was calibrated and validated. A correlation of 65%, 55%, 62%,74% and 83% for non market days and 67%, 73%, 83%, 76% and 86% for market days respectively were indicated. The noise level in study route exceeded the maximum permissible noise limit for public places. This may constitute adverse health risk to people living and doing business along these routes. The study recommended public awareness and passage of public health laws by the authorities to checkmate the high level of noise being generated.**

Keywords: **Regresit, calibrated, validated, correlation noise model, permissible, health risk, public health, noise.**

1. INTRODUCTION

Man's ability of making and detecting sound gives him the opportunity of receiving and communicating valuable information from and within the environment. Noise is an unwanted or undesirable sound that is heard or experienced by people or person(s) at a particular place at a particular point in time,[1]. The quality of life in cities or urban centre is dependent largely on some factors which are related to noise level to which the urban population is being exposed,[2]. ooNoise pollution has been discovered to give rise to public health related and environmental problems in 21th century. Several impediments caused by noise pollution can be seen in commercial traffic routes or roadside and urban areas; the degree of noise pollution throughout the city is caused by several factors, the quantification of the noise effect on the population being a major challenge, [3].

Economic growth, social development, increased human population, industries, transport routes and vicinity connection are considered to have resulted to an increase in the volume of noise generated in a locality or city, [4]. In the face of unplanned traffic route control, there is an increase in density of traffic which invariably results in rise of noise level in an area. Noise pollution effects urban population, small towns and villages along vehicular routes; and workers in the industries are also victims of noise pollution..

The study is important because noise is an environmental nuisance, a pollutant that is rapidly increasing as a result of the activities of man which include; improvement in commercial, industrial and social activities. [5]. Noise pollution is a serious public health issue today leading to some health challenges such as hypertension sleep disruption and hinders cognitive development in children, temporal and permanent deafness, permanent loss of memory and a psychiatric disorder [6].Noise elevates blood pressure, causes heart attack and fatigue; disturb sleep, increases frustration and anxiety in concentration (U.S. Environmental Protection Agency [7]; [8]. Noise is considered a growing threat, [9] and if left unchecked could result to hazardous condition. It is a silent, slow and subtle killer; and itis hazardous to the quality of life all over the world, yet very little efforts have been made to reduce its effects [10]. Generation of noise can be at a peak at proximity to airport and transport routes especially at T-junctions and bus-stops along major transport routes.Vehicles, Musical instruments, Small industries, Urbanization and human activities are the main sources of noise pollution [11].

The logarithmic scale called the decibel (dB) is used to measure sound pressure level. This is so because the human hearing mechanism rather than responding to the change(s) in sound pressure in an absolute manner, does so in a relative manner. The weakest sound detectable by the human ear is known as the threshold of hearing which corresponds to zero decibels (0dBA). On the other hand, the sound pressure level capable of causing pain to the ear is referred to as the threshold of pain and it corresponds to 120dBA [12]. A change of 3dBA in sound level is just enough to make such a change, noticeable, [13]. However, an increase of 10dB is perceived as doubling the loudness of the sound [14]. The measurement of noise is made using an A-weighted scale (dBA) for environmental purposes because the scale measures sound level almost the same way as the human ear.

The developing countries and Nigeria in particular has some factors responsible for most noise experienced today. These include automobiles, commercial motorcycles, electricity generators, commercial activities etc. These are in addition to population growth and vehicular traffic.

Generation of noise in a metropolitan is often escalated by poor city planning, disorderliness in the face of urban growth and rapid increase in number of vehicular traffic. Therefore, modern city planning and development must incorporate noise control capacity [15]. Abatement plans for noise generated within an areas such as those around major transport facilities (at bus-stops along traffic routes); major and minor market areas are needed. Most capital cities in Nigeria are characterized by residential land use, social, industrial and commercial activities. All of these activities put together result to the high incidence of noise pollution that is predominant in these areas/cities. Since noise is an integral part of civilization, therefore definite steps must be taken to reduce the present inordinate level of noise in the urban areas and communities; so that many people will not have auditory impediment.

This study therefore monitored the continuous equivalent noise level (L_{eq}), and noise pollution level (L_{NP}) along major and minor routes of selected areas in Rivers State. The model showing the relationship between the noise level with respect to time, temperature and wind speed was determined. It further investigated and provided information on the harmful effects of noise and necessary precautionary measures taken required to tackle or reduce it drastically.

2. METHODOLOGY

2.1 Study Area:

i. The study concentrated on some major market routes such as Oil Mill Market, and Mile one market in Port Harcourt; and the minor market routes including Nchieta Eleme Market route and Kibangha Gokana Market routes

A.	**Case study market routes**	**Market coordinates**
B.	**Major Market routes**	**Coordinates**
i.	Mile one market route	N4.792706^o; E6.996256^o
ii.	Oil mill market route	N4.855708^o; E7.064826^o
iii.	Bori market route	N4.673357^o; E7.368028^o
C.	**Minor Market Routes**	
iv.	Nchia market route	N4.798819^o; E7.121612^o
v.	Kibangha market route	N4.655481^o; E7.285873^o

2.2 Materials/Instruments:

The instruments used for field sampling include digital sound level meter, Kestrel Pocket Weather Tracker 4500 for sampling wind speed and temperature; Newsmy Z600 GPS; Trumeter Measurement Roller to determine linear distances between points and Stop Watch to measure time interval which the noise level measurement was taken.

2.3 Procedure for Noise Measurements:

In this work, measurement of noise pressure level was made using a sound level meter.The noise level measuring instrument was mounted at a height of one and half metres (1.5m) above the ground level for all selected routes. The instrument was set at the A-weighting network and the equivalent noise level (L_{eq}) which is the constant noise level that will expand the same amount of energy over the period of measurement was determined.

Measurement was carried out at each route by recording the noise pressure level at an interval of ten minutes (10min); equal number of readings was made. Readings were made morning, afternoon and evening on both market days and non-market days along the selected routes. The morning, afternoon and evening readings were taken within the hours of 6.30am-10am, 11.30am-3pm and 3.30pm-7pm respectively.

The various field parameters were determined including noise level, wind speed and temperature (^oC), linear distances between points and the time intervalat which the noise level measurement was taken, using standard instruments. .

2.4 Mathematical Methods:

The data obtained from the field study was analysed using the following equations:

i. Noise Level (L)

$L= 10\log_{10}(10^{L1/10}+10+^{L2/10}\ldots.+10^{Ln/10})$. Eqn1

ii. Equivalent Noise Level (L_{EQ})

$$L_{EQ} = 10\log\left(\frac{i}{T}\sum_{i=1}^{n} 10^{0.1L_i} \times t_i\right)$$ Eqn.2

Where;

T= the total observed time.

L_i= Noise level in the ith sample

t_i= the fraction of total time.

n = number of samples

iii. Noise Pollution Level (L_{NP})

$L_{NP} = L_{EQ} + \sigma K$. Eqn.3

Where;

K = 2.56 (best fit from subjective response to noise)

σ= Standard deviation of the time varying sound level over sampling time.

L_{EQ}= equivalent noise level

iv. Standard Deviation (σ)

$$\sigma = \sqrt{\frac{\sum(x-m)^2}{n-1}}$$ Eqn4

x = individual noise sample measured

m = mean of individual noise measured

n = total number of samples

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2.5 Model Derivation:

The model concept of the form presented in equation 5 was formulated.

Noise (N) = f (time, temperature, wind speed).

The model of the form presented in equation 5 was formulated and validated,

$N= A +BTe + CTe^2 + Dt + Et^2 + Fw + Gw^2$ Eqn.5

Where; Te = temperature, t = time and w = wind speed, whereas A, B, C, D, E, F and G are constants, while A is the intercept. The quadratic model as presented in Equation 5 was adopted and the correlation coefficient (R^2) values of the various market routes under study were obtained.

3. RESULTS

3.1 Noise Equivalent Level:

The values for the equivalent noise level for the various market routes were obtained using equation 2 and are presented in Table 1.

Table 1: Noise Equivalent Level for the various market routes

Market route	Week 1		Week 2		Week 3	
	Nmkt days	Mkt days	Nmkt days	Mkt days	Nmkt days	Mkt days
Nchia	85.8dBA	106.3dBA	87.2dBA	106.4dBA	81.2dBA	102.2dBA
Bori	79.1dBA	104.6dBA	80.2dBA	105.3dBA	80.7dBA	101.4dBA
Mile One	86.0dBA	99.1dBA	82.4dBA	102.5dBA	81.5dBA	101.1dBA
Kibangha	76.5dBA	104.3dBA	75.8dBA	100.4dBA	75.2dBA	94.9dBA
Oil Mill	82.6dBA	101.8dBA	79.6dBA	101.5dBA	81.0dBA	101.4dBA

The noise pollution level for all the market routes for non-market and market days are presented in Figure one and two.

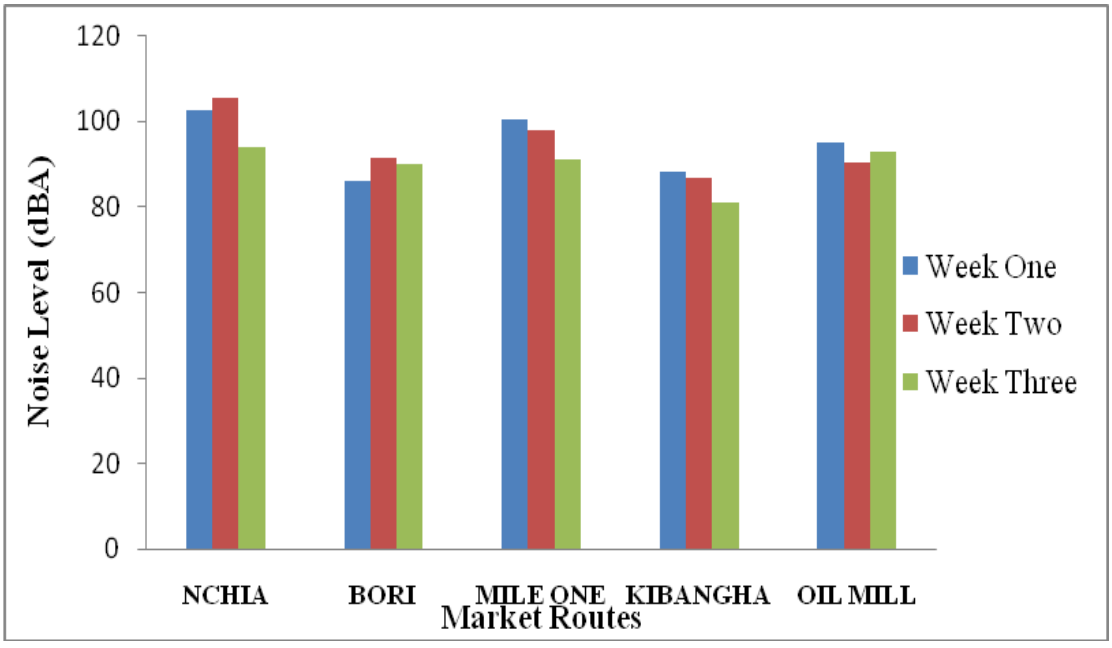

Figure 1: Noise Pollution Level for all the market routes for non-market days

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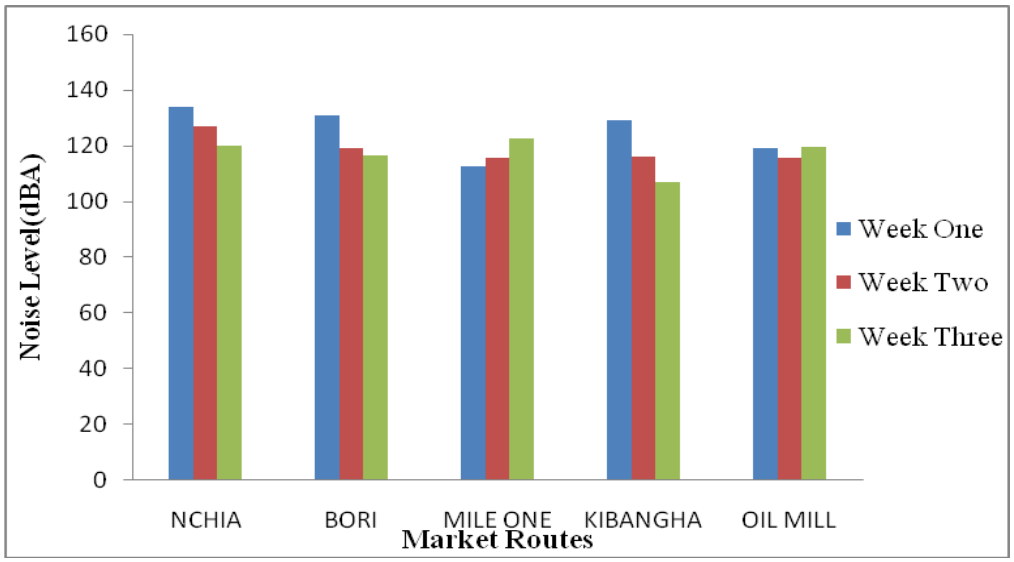

Figure 2: Noise Pollution Level for all the market routes for market days

The noise exceedence trend of the study market routes for non-market and market days were indicated in figure three to figure twelve.

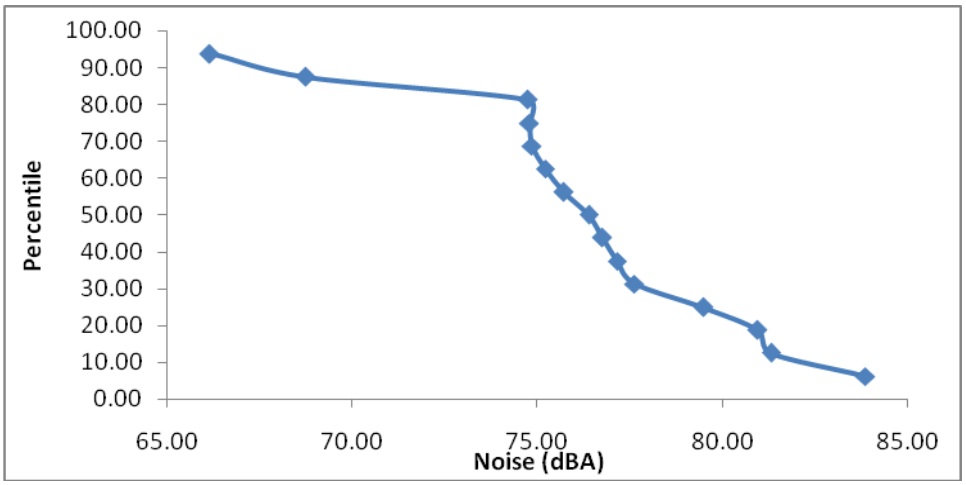

Figure 3: Noise exceedence trend level for Nchia market route for non-market days

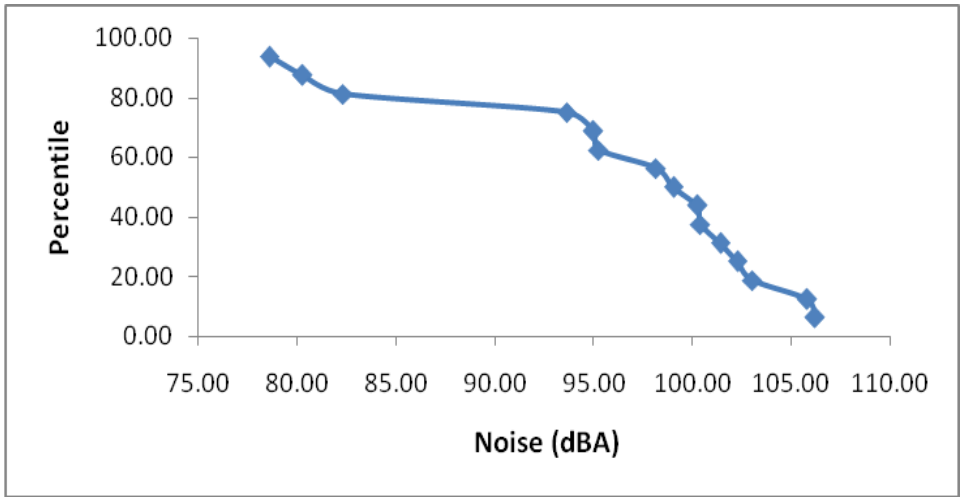

Figure 4: Noise exceedence trend for Nchia market route for market days

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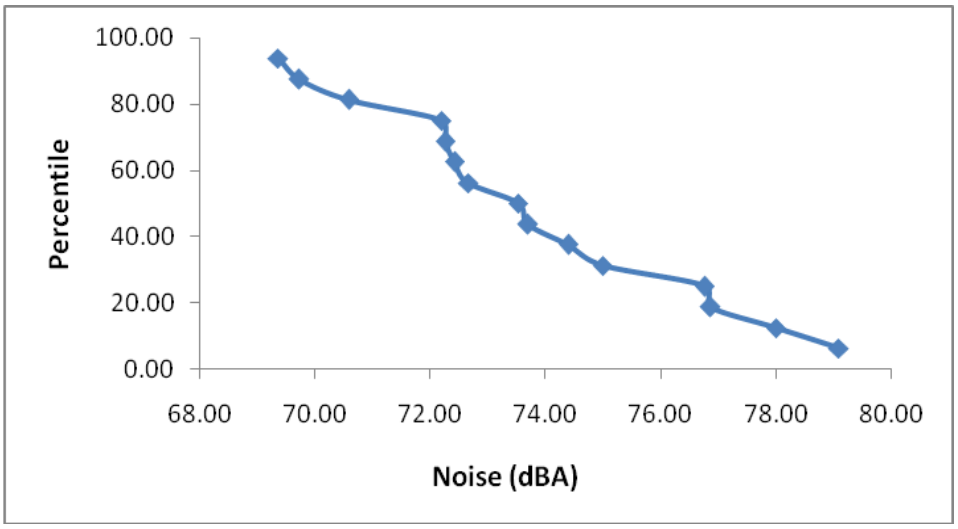

Figure 5: Noise exceedence trend for Bori market route for non-market days.

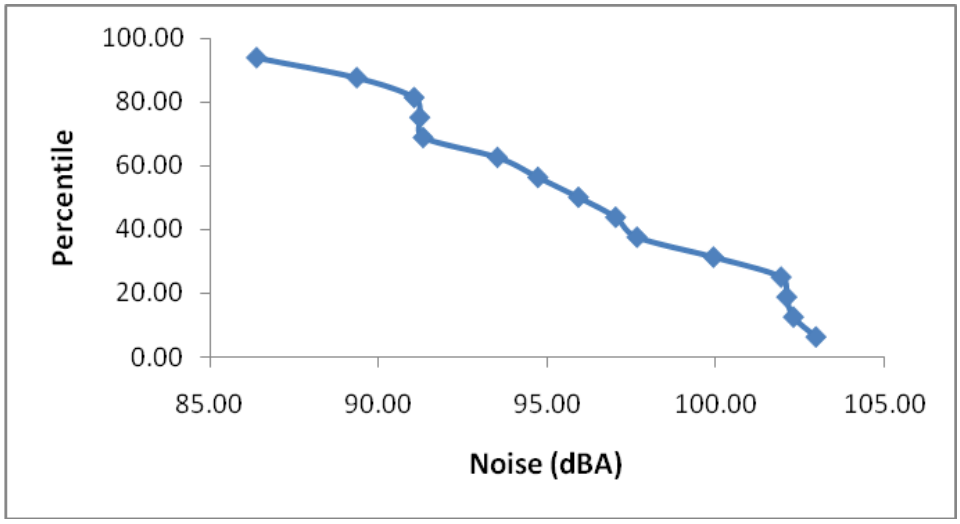

Figure 6: Noise exceedence trend for Bori market route for market days

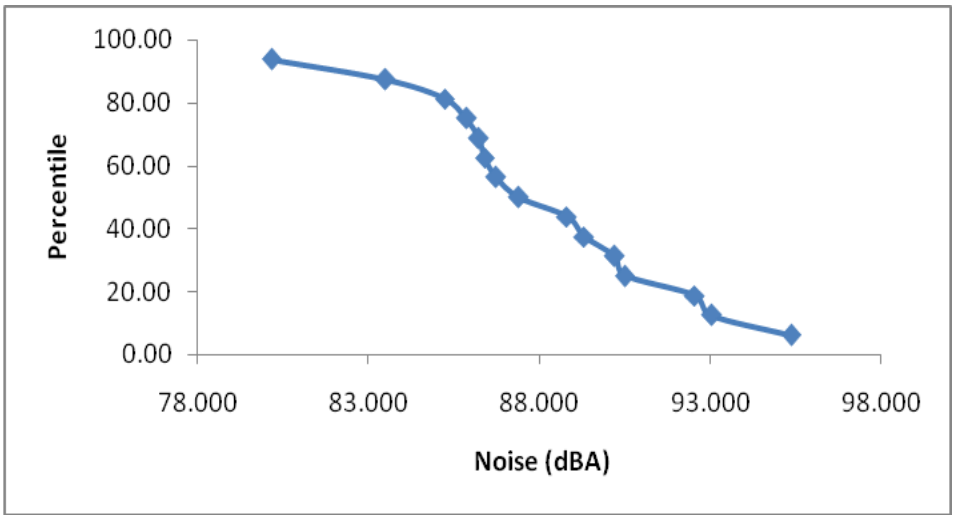

Figure 7, Noiseexceedencetrend for Mile One Market Route for non-market days

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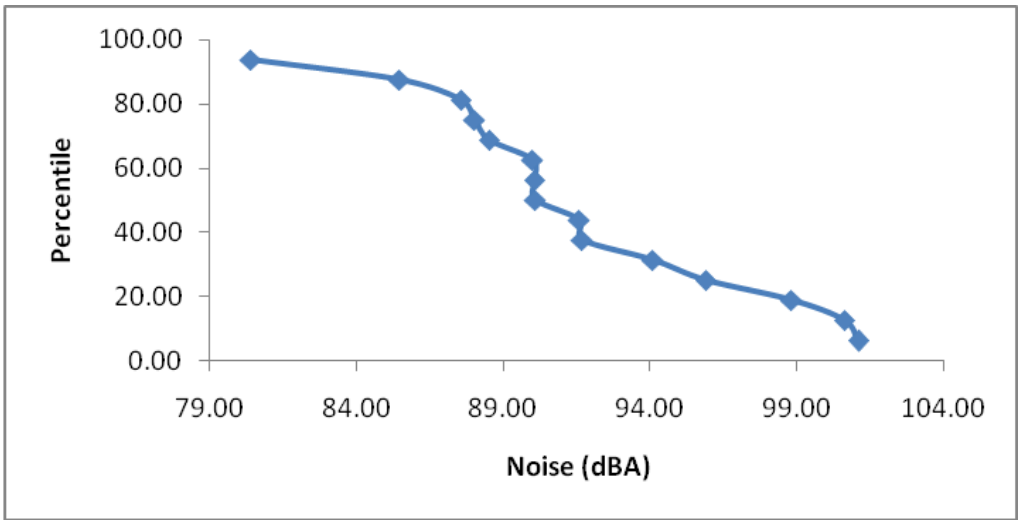

Figure 8: Noise exceedence trend for Mile One Market Route for market days

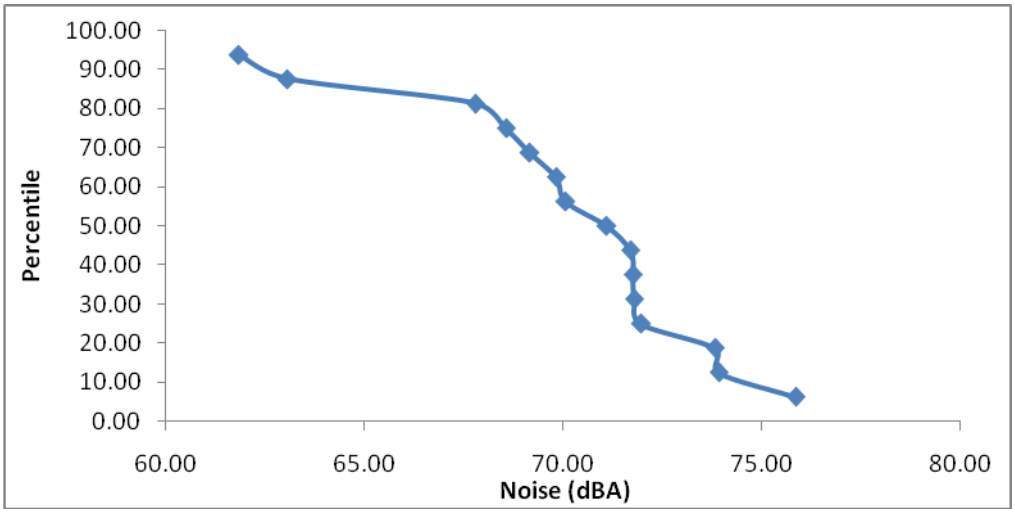

Figure 9: Noise of exceedencetrend forKibangha Market Route for non-market days

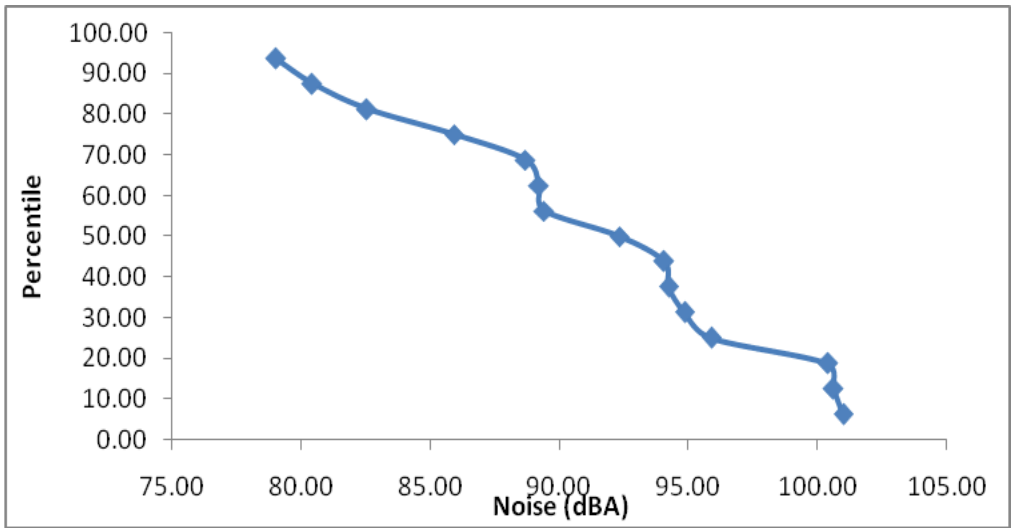

Figure 10: Noise of exceedencetrend for Kibangha Market Route for market days

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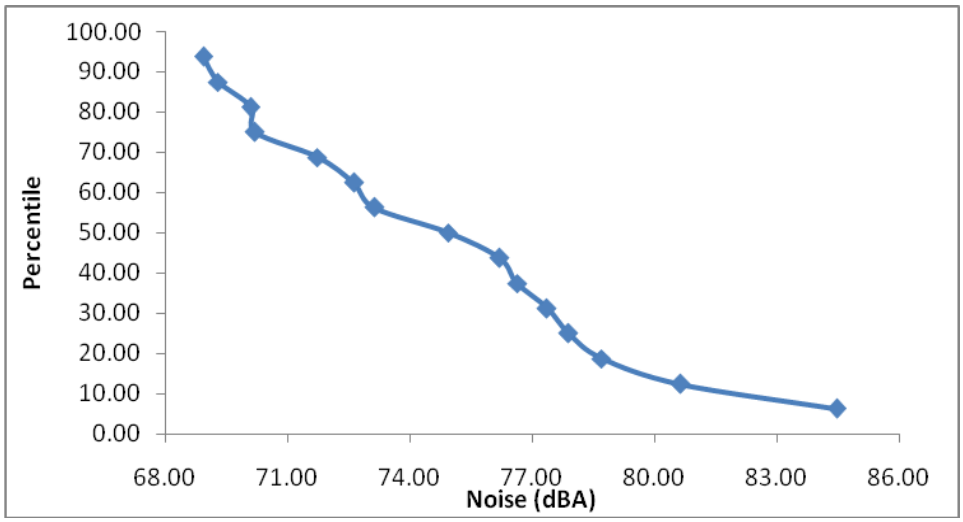

Figure 11: Noiseexceedencetrend level for Oil Mill Market route for non-market days.

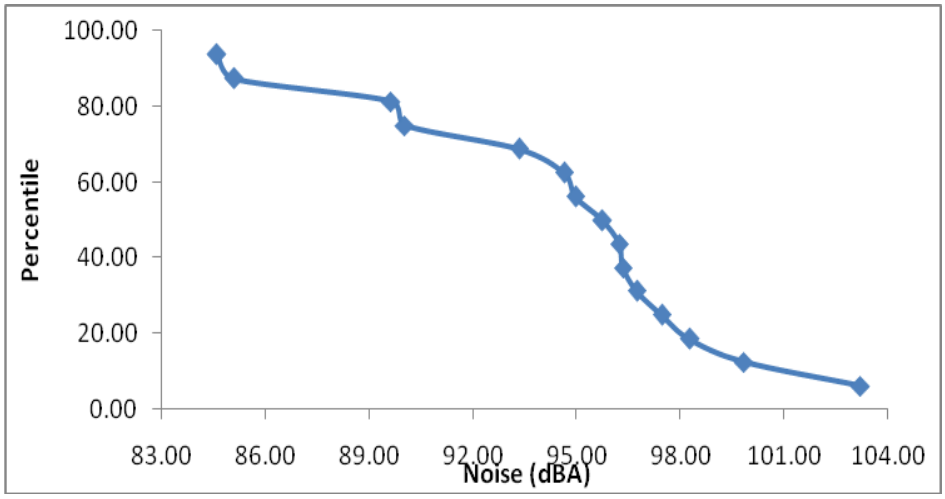

Figure 12: Noise exceedencetrend for Oil Mill Market route for market days

4. DISCUSSION

4.1 Equivalent Noise Level, Leq:

It was observed that the maximum equivalent noise level was recorded along Nchia market route for both market and non-market days (see table 1). It recorded 106.4dBA for market days and 87.2dBA for non-market days respectively in week two. In Bori market route, the equivalent noise level was 105.3dBA for market day and 80.7dBA for non-market day respectively. In Mile One market route, the maximum equivalent noise level observed was 102.5dBA and 86.0dBA for week two market and week one non-market days respectively. The Kibangha Market route recorded its maximum equivalent noise level in week one with 104.3dBA for market days and 76.5dBA for non-market days respectively, while the maximum equivalent noise level for Oil Mill market droute were 101.8dBA and 82.6dBA in week one for market days and non-market days respectively.

4.2 Noise Pollution Level for Non-Market Days:

The Nchiamarket route Noise Pollution Level (NPL) for week one for non-market days as indicated in figure1 showed that the noise pollution level for week one, two and three were 102.6dBA, 105.5dBA and 94.2dBA respectively. It is observed therefore that the Noise Pollution Level at the Nchia Market Route for non-market days was high as the maximum noise permissible limit was exceeded for both residential and industrial environment. The noise pollution level for Borimarket route for non-market days for week one, two and three were 86.3dBA, 91.5dBA and 90.1dBA

respectively. This indicated a high level of noise pollution. The Mile One Market route environment suffers noise pollution with the Noise Pollution Level week one; two and three shown were 100.5dBA, 98dBA and 91dBA respectively. The study indicated that Kibangha market route environment suffers noise pollution with the Noise Pollution Level in week one, two and three were 88.3dBA, 86.7dBA and 81.1dBA respectively. The Oil Mill market route environment suffers noise pollution with the pollution level in week one, two and were 95.1dBA, 90.3dBA and 92.9dBA respectively.

4.3 Noise Pollution Level for Market Days:

The noise pollution level for the various market routes for market days indicated that, the maximum noise pollution level occurred in week one at the Nchia market route having 133.9dBA. The result of the Noise Pollution Level for Nchia market route for market days as shown in figure 2 indicated that the value of Nchia market route noise pollution level for week one, two and three were 133.9dBA, 126.9dBA and 120.0dBA respectively. Figure 2, indicated that there was high prevalence of noise pollution. Findings from study indicated also that the value of Bori market route Noise pollution level for week one, two and three were 130.9dBA, 119.1dBA and 116.6dBA respectively. This indicated that there was prevalence of noise pollution on these days.

Findings from the Mile One market route showed that week three; two and one were 122.8dBA, 115.6dBA and 112.7dBA respectively. The Kibangha market route environment suffers indicated Noise Pollution Level in week one, two and three as 129dBA, 116.3dBA and 107.1dBA respectively. The Oil Mill market route indicated Noise Pollution Level in week three, two and one as 119.7dBA, 115.7dBA and 119.2dBA.

Figure 3 indicated L_{10} value for Nchia market route for non-market days as 82.25dBA; L90 value was 67.25dBA. Figure 4 indicated that L_{10} value for Nchia market route for market days was 106dBA while the L_{90} value was 79.5dBA.

Figure 5, showed that the peak noise level, $L_{10}$was 78.5dBA, while the background noise L_{90} was 69.5dBA. Figure 6 indicated that the L_{10} value for Bori market route for market days is 102.5dBA while the L_{90} value for market days is 88.25dBA

Figure 7 indicated that the L_{10} value for Mile One market route non-market days was 93.75dBA and L_{90} was 82dBA. Figure 8 showed that the L_{10} value for Mile One market days was 100.9dBA and L_{90} was 83.5dBA.

Figure 9indicated that the L_{10} value for Kibanghanon-market days was74.5dBA and that of the L_{90} was 62.5dBA. Figure 10 indicated that the peak noise level (L_{10}) was 100.75dBA for Kibangha non-market days; and the background noise (L_{90}) was 79.75dBA.

The noise exceedence level from the Figure 11indicated that, the peak noise level (L_{10}) value was 82dBA for Oil Mill market route for non-market day and the background noise level (L_{90}) was 69.25dBA. The noise exceedence level from the Figure 12 showed that, the peak noise level (L_{10}) value was 82dBA for Oil Mill market route for market daysand the background noise level (L_{90}) was 69.25dBA.

5. CONCLUSION

The comparative analysis of noise associated with markets along major and minor routes in selected areas of Rivers State were investigated. In the analysis of noise associated with markets along major and minor routes in selected areas in Rivers State, noise indices such as the equivalent noise level (L_{eq}), the background noise (L_{90}), the peak noise level (L_{10}), the combined noise level (L) and the Noise pollution level (L_{NP}) were used as parameters to determine the extent of noise generated within the areas of study and to determine its acceptability by its comparison with the standard widely recognised and acceptable. The model for the prediction of noise for the areas of study was developed, calibrated and validated.

The result from study indicated that the noise generated by human and vehicular activities in the areas covered in this research work exceeded the standard set by regulatory guide line for the control of noise which is 55dBA for residential and educational institution; and 70dBA for industrial and commercial exposures. The implication is that individuals residing or doing business in these areas were at risk of serious health impairment if action is not urgently taken to mitigate the high level of noise generated. The study recommended proper road, urban area and market design; proper traffic control, vehicular integrity, continuous noise monitoring by regulatory agencies and public awareness as lasting measures to reduce exposures and effects on the public.

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