

## **Evaluation of noise levels in Kara market Sokoto, Sokoto state, Nigeria.**

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**Abstract:** *Noise generated in public places has become a matter of public concern to the Government, traders, merchants and other close residents. Exposure to excessive noise has the ability to cause both physiological and psychological effects in humans. In this research systematic noise evaluation survey was conducted at different strategic locations within Kara market Sokoto, Sokoto state Nigeria. A cumulative noise level of 90.55 dBA was obtained at the grains market; while the wood market showed cumulative noise level of 78.15dBA. The iron work market, onion market and Motor Park showed cumulative noise levels of 72.42dBA, 62.52dBA and 80.88dBA respectively. Minimum and maximum noise levels were compared with the WHO noise standards. Findings of the research indicated that the use of grinding engines, wood cutting machines and public address systems generated most of the noise levels in the market. The findings of the research further show that High noise pollution is generated within the market environment with potential health effects on traders and the public. The state and local government should carry out extensive awareness campaigns among traders on the effects of noise on their health.*

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### **I. Introduction**

Sound is a common part of everyday human life. The sound can be pleasant (wanted) or unpleasant (unwanted). When it is unpleasant to the human ear, it is known as noise. Noise can be defined as “disagreeable or undesired sound” or other disturbance. From the acoustic point of view, sound and noise constitute the same phenomenon of atmospheric pressure fluctuations about the mean atmospheric pressure. The differentiation is greatly subjective, what is sound to one person can very well be noise to somebody else. Noise is one of the most common environmental pollutions often associated with anthropogenic activities such as industrial, commercial, institutional and recreational activities. Noise pollution constitutes environmental hazards and poses a threat to public health and the environment. Noise pollution is rated among the most hazardous form of pollutions in many metropolitan cities of the world after air and water pollution. Noise has been broadly categorized into residential, commercial and industrial type and regulated according to WHO. Residential noise also known as domestic noise is generated at homes, commercial noise from business environments such as shops and market places, while industrial noise are generated within industrial environment through the use of equipment and machineries. Commercial activities including buying and selling are important aspects of human endeavors and play central roles in the economic and social advancement of the people. However, commercial activities in market places in developing countries are associated with a lot of health and environmental issues including noise pollution. Noise in market places can be a matter of public health concern especially for merchants engaged in commercial activities within market places and residents. Noise emanating from market places is considered as commercial noise and capable of affecting the general public. Prolonged exposure to excessive noise has the ability to cause adverse health effects in humans. Health effects associated with noise pollution can be classified into auditory (physiological) and non-auditory (psychological/sociological) effects. Research has shown that people exposed to noise level above 90 decibels are at risk of hearing loss. Non-auditory or psychological/sociological effects of noise include cardiovascular disorder, hypertension, release of adrenaline, mental health, interference with speech communication, sleep disturbance, interference with learning process and annoyance. Several studies have been carried out to assess and investigate noise levels in industrial areas, road traffic and construction areas, but little has been done to assess noise levels in market places.

### **II. Materials**

The materials used to carry out this research includes:

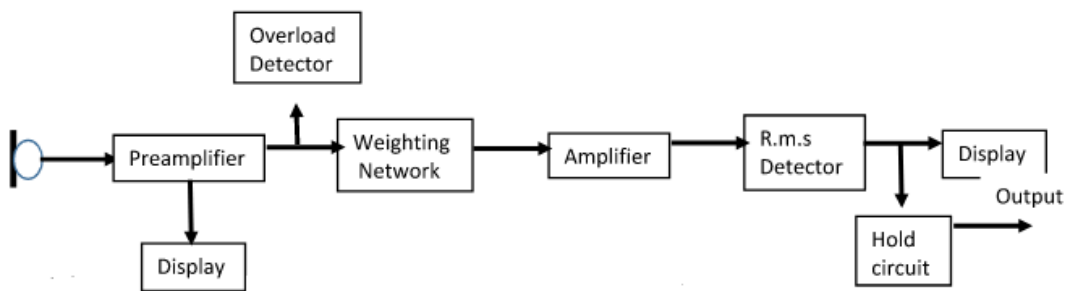
#### **SOUND LEVEL METER**

The sound level meter provides measurement of sound pressure level and displays it in units of decibel (dB). The block diagram of a sound level meter is shown in fig.2. the input of the instrument is the microphone

which converts sound signal to an electrical signal. The sensitivity of the microphone determinates the measurement precision. There are four types of microphone which can be used in sound level meters; piezoelectric, condenser, electret and dynamic types.



**Figure 1. Simple Digital Sound Level Meter**



**Figure 2. Bloc Diagram of the Sound Level Meter**

### **III. Methodology**

The methodology adopted to carry out this research is the ISO 1913 Acoustic-Attenuation of sound during propagation outdoors: - this standard method was last reviewed and confirmed in 2017 (ISO1913). This method describes a method for calculating the attenuation of sound during propagation outdoors in to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A- weighted sound pressure level under meteorological conditions.

#### **DECIBEL SCALE**

The decibel scale dB is the unit used to measure the intensity of a sound. The decibel scale is a little odd because the human ear is incredibly sensitive. The human ears can hear everything from your fingertips brushing highly over a surface to a loud jet engine. On the decibel scale, the smallest audible sound (near total silence) is 0dB. A sound 100 times more powerful than total silence is 20dB, a sound 1000 times more powerful than near total silence is 30dB. The following definition gives the level of sound pressure  $p$  in decibels (Patrick N. et al. 2006)

$$SPL = 10 \log_{10} \left[ \frac{P^2}{P_{ref}^2} \right] dB \tag{1}$$

Where SPL is the sound pressure level in dB

$P^2$  = the sound pressure fluctuation (Above or below atmosphere pressure)

$P_{ref}^2$  = 20 micro Pascal ( $2 \times 10^{-5}$ Pa) which is approximately the threshold of hearing.

The threshold of human hearing varies with frequency; it is most sensitive to middle frequencies and less sensitive to lower and higher frequencies. To analyze noise, both frequency and amplitude need to be taken into account, the sound and noise level measurement are made using A-weighted filter and the measurement unit is A-weight decibels, dBA. Here are some common sounds and their decibel ratings (Patrick N. et al. 2016)

- Near total silence – 0dB
- A whisper – 15dB
- Normal conversation – 60dB
- A lawnmower – 90dB
- A car horn – 110dB
- A rock concert/ jet engine – 120dB
- A gunshot/firecracker – 140dB

Any sound above 85dB can cause hearing loss and the loss is related both to the power of the sound as well as the length of exposure. Since sound pressure levels are based on a log scale, they cannot be added directly i.e.

$$80dB + 80dB \neq 160dB$$

$$SPL = 10 \log \left[ \sum_{i=1}^n 10^{\left[ \frac{SPL_i}{10} \right]} \right] \tag{2}$$

Where SPL = total sound pressure

SPL<sub>i</sub> = is the *i*th sound pressure to be summed

### STUDY AREA

The kara market is a daily market located at sokoto north region of sokoto town in sokoto state. The daily market attracts merchants and traders from all over the north western region (kebbi state, zamfara state and katsina state) the market attracts traders of diverse goods which are mostly farmed/produce/processed in the North West. Products like grains, onions, vegetables etc. are being processed right there in the market. The location where grains are grinded with machines constitute the noisiest part of the market followed by the wood market. The location where metal work and blacksmithing is carried out is the third noisiest part of the market. On a daily basis, human traffic produces noise nuisance along the major road where some traders display their goods. The location of the market has put people living around the market at risk of noise pollution due to the influx of people.

### DATA COLLECTION

Field measurement of noise levels at different locations around Kara market was conducted. A systematic monitoring of noise level was carried out at each location within the market area using a simple digital sound level meter which gives instant real time readings according to regulatory noise measurement standards. Measurement of noise levels was carried out for 30mins with 1 hour intervals for a period of 5 days. The instrument was placed in close proximity to the source of the noise about 3 to 5 meters above ground level in accordance with ISO 9613 noise measurement procedure. 5 sets of data was obtain from 5 different strategic locations in the market area and a total of 30 data set were obtained for the study

## IV. Results

**Table 1:** Field Measurements of Noise Level in Kara-Market

Day	Time	Location	L <sub>min</sub> (dBA)	L <sub>max</sub> (dBA)
1	11:00am-11:30pm	Grains market	60.5	85.4
	12:00pm-12:30pm	(where grains are processed)	75.6	86.6
	02:00pm-02:30pm		75.8	85.2
2	10:30am-11:00am	Wood market	60.0	75.7
	12:00pm-12:30pm	(saw-mill)	65.2	70.3
	01:00pm-01:30pm		61.8	72.4
3	11:00am-11:30pm	Iron work market	49.3	67.1
	12:00pm-12:30pm	(blacksmithing)	50.5	68.0
	01:00pm-01:30pm		50.2	67.8
4	10:00am-10:30pm	Onion market	47.7	55.7
	11:00am-11:30pm		26.6	56.2
	01:00pm-01:30pm		39.9	60.0

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5	10:30am-11:00am	Motor park	42.8	78.9
	12:00pm-12:30pm		39.8	68.5
	01:30pm-02:00pm		56.0	75.8

**Table 2: Nigeria Noise Exposure Limit**

Time/duration(dBA)	8	6	4	3	2	1.5	1	0.5	0.25 or less
Permissible exposure limits (dBA)	90	92	95	97	100	102	105	110	115

Source: FEPA. Guidelines and standards for environmental pollution control in Nigeria.1991.

**Table 3: WHO Noise Level Guidelines.**

Receptor	One hour $L_{Aeq}$ (dBA)	
	Daytime	Nighttime
	07:00am-10:00pm	10:00pm-07:00am
Residential	55	45
Institutional	55	45
Educational	55	45
Industrial	70	70
Commercial	70	70

Source: IFC. Environmental health and safety (EHS) guidelines.2007

**INTERPRETATION OF RESULTS**

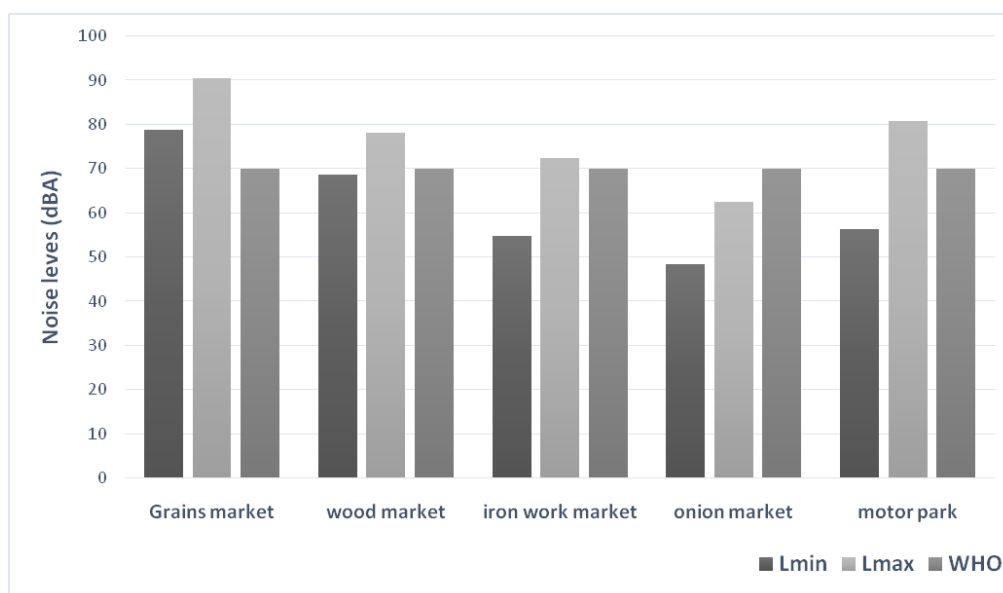
The results of the field measurements were carried out and the aggregate of the minimum and maximum noise level for each day were calculated using the equation 2.

**Table 4: Interpretation of Field Measurement.**

Day	Location	$L_{min}$ (decibels)	$L_{max}$ (decibels)
1	Grains market	78.77	90.55
2	Wood market	68.70	78.15
3	Iron work market	54.80	72.42
4	Onion market	48.39	62.52
5	Motor park	56.30	80.88

**Table 5: Cumulative Noise Levels In Comparison With Standard Limits**

Day	Location	$L_{min}$ (dBA)	$L_{max}$ (dBA)	WHO limit	NESREA Limit	Noise rating
1	Grains market	78.77	90.55	70	75	Very high
2	Wood market	68.70	78.15	70	75	Very high
3	Iron work market	54.80	72.42	70	75	High
4	Onion market	48.39	62.52	70	75	Low
5	Motor park	56.30	80.88	70	75	Very high



**Figure 3. Minimum and Maximum Level of Noise Level with Comparison with WHO Standards**

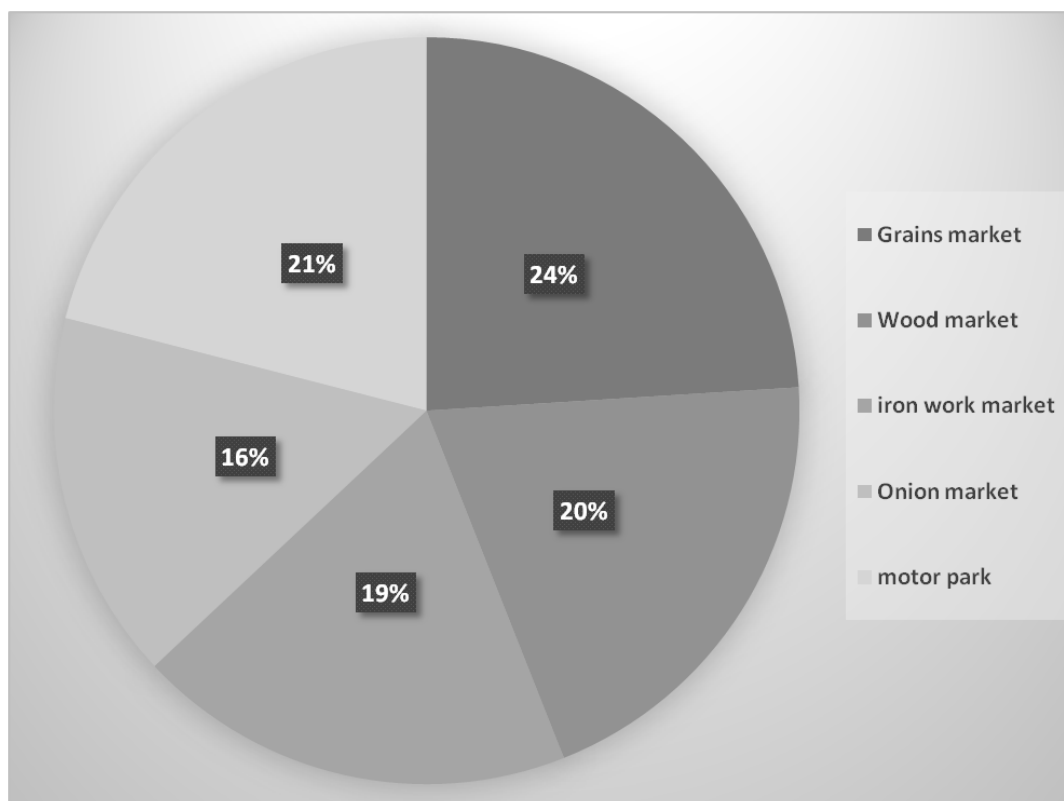


Figure 4: Percentage of Noise Generated in the Market

## V. Discussion

Noise levels measured during the field measurements were generally high except the onion market which is lower than the standard permissible noise exposure levels. The other 4 locations showed generally high noise levels and potentially hazardous to human health.

Looking at Table 1 shows the minimum and maximum noise levels measured in all the five locations. It can be seen that all the noise levels were measured three times in each location, and a range of noise levels were observed, for example in the grains market, all the noise levels measured are all in the range of 60-75 decibels for the minimum noise levels and a range of 80-86 decibels for maximum noise level for that location which constitute the most noisiest part of the market. The same pattern is also noticed in all the remaining locations.

Taking a thorough look at Table 2 and 3 shows the permissible noise limits in Nigeria and the WHO (World Health Organization) and the duration of exposure, WHO recommended that for a commercial environment, a noise level of 70 dBA is the highest level to be exposed to for a duration of 14 hours. Exposure to a higher level is hazardous to human health.

Results shown in Table 5 enumerate noise exceedance factors computed for each of the 4 locations. High noise ratings with significant health impacts. The high noise levels obtained in the market could constitute serious health hazards such as hypertension, hearing acuity, tinnitus, annoyance, vasoconstriction and cardiovascular diseases among merchants. Continuous exposure to noise at levels up to 75dB to 78dB at the iron and wood market can cause acute annoyance over the years which might lead to hearing loss over the years. Noise levels of 80dB to 90dB obtained around the grain market and Motor Park which are located in very close proximity to each other, can affect the performance level of pupils in the Arabic schools located close to the market area. Continuous or prolonged exposure to such noise can raise the levels of cortisol (stress hormone) in pupils which will eventually affect their learning process resulting in poor performance among them. Also residents living close to the Kara market area for a long time need to be aware that they may be at risk of noise-related health problems such as stress, hypertension, anxiety and annoyance. Some groups of people in the market which are at risk of the above problems impacting on their lives include children and elderly (60 years and above) and youths who are susceptible or sensitive to high noise levels.

## VI. Conclusion

The competitive nature of commercial activities among merchants in the Kara market generates an enormous amount of noise. Noise is a common characteristic among merchants in the market and serves as a key factor attracting customer's attention. Shouting and use of public address systems (mobile and fixed) are

used as means to attract customers. Field result of measurement and data evaluation indicated that very high noise levels prevailed in the Kara market. Computed  $L_{\min}$  and  $L_{\max}$  noise levels showed very high noise values that exceeded regulatory standards and are hazardous to human health. Traders and merchants doing business in the market are therefore exposed to high noise pollution with significant risk of noise related health diseases such as hearing loss, hypertension, hearing acuity, tinnitus, annoyance, vasoconstriction and cardiovascular diseases as well as other physiological and psychological noise effects. This implies that environmental noise in kara market is mainly caused by a combination of human activities (such as grinding and use of public address systems by mobile sellers) to vehicular traffic. Local by-laws which discourage the use of public address systems within the market can be used to reduce environmental noise within the market. The provision of steady public power supply in the market can reduce the use of generators in the market.

## **VII. Recommendations**

In view of the findings in this research, it has been established that high levels of noise is generated in the Kara market which is dangerous to the traders, merchants and people living around the market area who are in constant exposure to the noise. It is therefore recommended:

- State or local government should carry out extensive awareness and campaigns among traders, merchants and people living around the market on the adverse health effects of noise on their health.
- Noise control by-laws or regulations should be enforced so as to regulate the activities of mobile sellers who use public address systems
- Traders who spend more than 2 hours in the market should be encouraged to use ear protection devices. These devices can be provided by the local government or non-governmental organizations on humanitarian bases
- Health assessments should be conducted by the government or non-governmental organizations on traders, merchants and people living around the market area to test and detect signs of noise related illness and affordable treatment should be giving to them
- Traders using grinding machines and generators should create enclosures around their machines to reduce the noise generated by the machines
- Further research study is recommended to investigate the auditory and non-auditory health effects from environmental noise exposure among traders and merchants in the market.

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