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Investigation of Noise Pollution in Ifo Market, Ogun State, Southwestern Nigeria

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Abstract

Due to economic expansion, industrialization, and unplanned urbanization, noise pollution is one of the most serious issues confronting the modern world. High levels of noise pollution have physiological (auditory) and psychological consequences. The project's goal is to determine the spatial and temporal variation of the noise levels in Ifo Market, Ogun State, Nigeria. A reconnaissance study was conducted across the Ifo market to map out sampling points of the areas. Residential views and perceptions of the presence of the market in the location were determined using 100 questionnaires and social surveys across the market. Statistical Package for Social Science (SPSS) software was used to analyze the data at a 95% confidence interval. The environmental equivalent noise levels (Leq) were measured at five (5) randomly selected spots within the market in the morning and afternoon between September and October 2022 using an SW-524 LCD digital sound level meter. The meter was held at about 1.5 meters above ground levels and 3m from the noise source around each spot for 25 minutes before readings were taken to ensure good area coverage, stability, and uniformity in measurement. The average noise pollution level (L_{np}) was calculated using a standard equation. The Standard deviation of the affected area by noise pollution ranged from 0.2010 to 0.4521, respectively. The equivalent noise level in the market at the 5 selected points for working days ranged between 70 - 97 dBA, respectively. The noise level generated is slightly above the permissible level which is dangerous to human health. The obtained data can serve as a piece of baseline information for noise pollution modeling and control.

Keywords: Noise level, Noise pollution, Physiological, Spatial, Temporal

1 Introduction

Noise pollution is one of the most widespread forms of pollution in the environment, and it is frequently related to anthropogenic activities such as industrial, commercial, institutional, and recreational activities. Noise pollution is a serious environmental problem that endangers people's health and the environment. After air and water pollution, noise pollution is regarded as one of the most dangerous forms of pollution in many major cities throughout the world.

Residential, commercial, and industrial noise has been comprehensively classified and regulated according to WHO and NESREA.[1]

Noise is defined as a loud, unpleasant, or unexpected sound that has the potential to negatively impact a man's quality of life. It is divided into three categories: industrial, residential, and commercial. Many people suffer from phonophobia or lygophobia, which is a fear of noise. Industrial noise is mostly generated by industrial equipment, whereas residential noise is primarily generated by municipal and household sources, which include noise from all electrical and mechanical appliances in the home. Industrial noise pollution can be defined as an unwanted sound emitted by industrial machines or equipment that poses a threat to people and the environment. Commercial activities, such as purchasing and selling, are crucial. aspects of human endeavors and play central roles in the economic and social advancement of the [2] Its numerous physiological (auditory) and psychological (non-auditory) effects, on the other hand, may have an impact on firm people as well as the ecosystem of the host environment. Auditory or physiological noise consequences include hearing loss and other effects such as noise-induced hearing loss and presbycusis. According to a study, people who are exposed to noise levels greater than 90 dB are at risk of hearing damage. Cardiovascular illness, hypertension, adrenaline release, mental health, speech and communication interference, sleep disturbance, learning process interference, and aggravation are some of the non-auditory or psychological/sociological effects of noise.

Furthermore, the environment plays a major role in the developmental processes of man. Any little distortion of the environment can lead to dangerous consequences that the world

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will find difficult to come out from I3, 2]. One of the environmental problems, which required the attention of both the public and the government, is noise pollution in urban and rural communities of developing countries. Urbanization and industrialization have been driving people to develop areas of the communities for economic activities, thereby increasing human activities that have also resulted in noise pollution. Most of the commercial centers such as markets are operated in open places and this creates a serious environmental problem as they transact their commercial businesses. Some vendors go to the extent of shouting and using loudspeakers in an attempt to advertise their products or catch the attention of the passerby, which results in unimaginable noise pollution.[1,4].

Regardless of how significant or beautiful a sound is, it can be considered noise if it becomes intolerable owing to its volume. Noise is described by the Environmental Protection Agency as an "unwanted or annoying sound." Sound becomes unsettling when it disturbs or reduces one's quality of life by interfering with routine activities such as sleeping or conversing [5]. Because it cannot be seen, tasted, or smelled, it has gotten less attention than other types of pollution like air pollution or water pollution. Even though the air around us is continuously filled with sounds, most of us would not describe ourselves as being surrounded by noise. Though for some, the persistent and escalating sources of sound can often be considered an annoyance. This “annoyance” can have major consequences, primarily to one’s overall health. [6,7]

2 Materials and Methods

2.1 Description of the Study Area

This study was conducted in September-October, 2021 at some selected points within Ifo Market, Ifo. Although, the population, according to 2006 census figures consists of 698,837 people of which inhabitants are mostly Yoruba. Ifo Division has a large industrial area containing several factories. The town of Ifo itself is home to branches of several established Nigerian banks. Ifo is the fastest-growing part-market of the Ogun metropolis, owing in part to increasing influxes of people from Ifo's surrounding towns and villages who are attracted by the town's proximity to Ogun.

Most of the foodstuffs are raw and locally converted farm produce which include; yam tubers, yam flour, maize, millet, fruits, rice, pepper, tomatoes, vegetable oil, onions, melon seed cassava tubers, cowpeas, etc. Most of the sellers at the market are women, though men help out with labor-intensive jobs. The ifo market is daily (both night and day), the distribution pattern of the market is on-street trading, and the nature of growth is organic. The base map of the Ifo Area in Ifo with each local government area in Ifo is presented in Figure 1.

The noise level was measured with the SW-524 LCD Digital Sound Level Meter, which includes a 6mm polarization capacitance microphone, electronic circuitry, a readout display, and a power supply (3 pieces AAA battery). Small air pressure differences associated with sound are detected by the microphone and converted into electrical impulses. The electronic circuitry of the device subsequently processes these signals. The sound level is displayed in decibels on the readout. The Sound Level Meter measures the sound pressure level in a specific location at a certain time.

It meets the requirements for laboratory-grade meters set forth by the International Committee IEC 651 Type 2 and the American International Standard ANSI 1.4 Type 2. The noise meter measures noise levels in the range of 30 – 130 dBA with accuracy up to ±1.5dB.

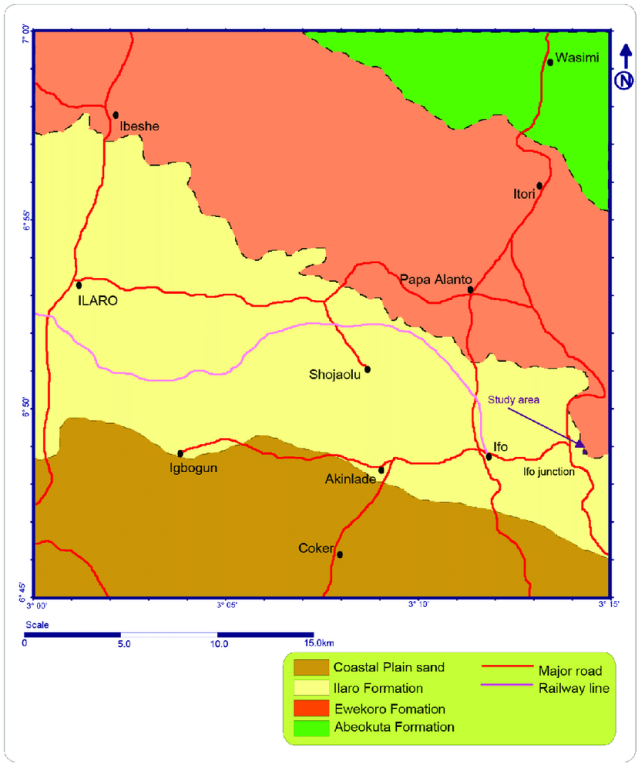

Figure 1: Base Map of Ifo Measuring Equipment

2.2 Social Survey

One hundred (100) questionnaires were distributed to the residents and workers of the study area. This was done to have in-depth knowledge about the operations and activities performed in the area. The data collected includes the age range, job identification, average hour spent in the market per day and condition, resident perception, and business of residents within the vicinity of the market location. Oral interviews on the other hand were carried out to collect more information about the environment. A hand-delivery method was adopted to distribute the questionnaires.

2.3 Field Investigation

This was done to verify the responses in the questionnaire in a bid to know if the residents are biased or not. Their responses and field investigation were compared together. This method is reliable and convenient but time-consuming. Data collection was achieved through social surveys and Field studies The field measurement includes the measurement of physical transient noise levels.

2.4 Physical Transient Noise Level Measurement

There was no record of any previous noise pollution study in the study area, thus a preliminary field survey became necessary. The preliminary survey involves site visitation, initiation of noise measurement modalities, and interaction/interview of officers and workers in the study area. The noise levels were measured in situ

at the different locations inside the market at a height of about 1.5 m above the ground and a distance of about 3 meters from the sources, using an SW-524 LCD digital sound level meter set. The desired response of SLM was set at "fast" for conducting the noise survey and slow for taking the average measurement per time.

Figure 2: SW- 524 LCD Digital Sound Level Meter

The sound meter measured directly the equivalent continuous sound level as a digital numerical readout, which stabilized after about five minutes. During measurement, the meter microphone was directed toward the noise sources, and the meter was held away from the body. Five readings were taken at each spot when the machine was in operation and the average value was recorded. This was repeated at different measuring spots in the market. The noise pollution level Lnp was computed using equation 1.

$$Lnp = leq + K\sigma \quad (1)$$

where: K is a constant with a value of 2.565 for this kind of environment
σ is the standard deviation of the obtained L_{eq} values

3 Results and Discussions

3.1 Site Assessment

The noise level changes with the days and the hour of the day, according to the reconnaissance survey based on both social interaction and on-the-spot measurements over one week. The average noise level across the study is presented in Table 1. As indicated in the Table below the largest level of noise is generated on market day (Wednesday). The noise level varies depending on the number of buyers and sellers in the market at any given time. Based on this, noise measurements were performed at twelve different locations on Saturday, Sunday, and Monday to accurately depict the maximum and lowest levels of noise during the working day and weekend. However, the noise sources were majorly from grinding machines, the presence of loudspeakers within the market, commercial activities within the market, a religious house situated close to the market, from the expressway opposite it due to high traffic and vehicular movement, and nature of trading at the point (on-street trading).

Table 1: Average Noise Level during Reconnaissance Study across Ifo Market

	Vegetable	Meat	Trad.	Foodstuff	Wear
Monday	80.7	88.2	91.5	80.7	75.6
Tuesday	74.2	83.4	77.5	90.9	73.0
Wednesday	76.7	75.6	80.1	83.8	148.3
Thursday	75.6	82.1	76.3	84.1	78.5
Friday	73.3	83.4	77.5	81.5	85.3
Saturday	71.3	80.7	72.5	81.9	83.3

3.2 Temporal and Spatial Variation of Noise Level Around Ifo Market

The environmental equivalent noise levels (Leq in dBA) were measured at 5 randomly selected spots and average readings were taken within the same locality in the morning time and the afternoon. The SND Way sound level meter was used to obtain synchronous values averaged at different locations. The meter was held at about 1.5 meters above ground levels and 3m from the noise source around each spot for ¼ of an hour before readings were taken to ensure good area coverage, stability, and uniformity in measurements. The measurements were performed on a workday Monday to Friday. These days were chosen because they reflect the true picture of the market noise levels as detected from both social interaction with people and the on-spot measurement readings during the reconnaissance survey.

The mean noise level measured at the 5 selected points, is represented in Figure 2 and Table 2. It was revealed that day 3 (wears section) had the highest mean noise level of (148±1.5 dB). This was closely followed by market day 2 (foodstuff) and market day 3 (foodstuff) with an average noise level value of 90±1.5 dB and 88±1.5 dB, respectively. There was a high correlation in the recorded values because the locations have nearly the same features. The noise level was due to noise from grinding machines, the presence of loudspeakers within the market, commercial activities within the market, a religious house situated close to the market, from the expressway opposite it due to high traffic and vehicular movement and the nature of trading at the point. The majority of the traders in the vegetable and spices line engaged in on-street trading as presented in Plates 1 and 2.

The average noise level, L_{eq}, was obtained on the working day and weekend, respectively for the morning and afternoon time, The L_{eq} values are compared with the WHO Standards for both the working day and weekend and are presented together in Figure 2.

Table 2: Noise Variations Across Ifo Market

MARKET DAY		1				
Time	FS	Vg	M	T	W	WHO Std.
1-2pm	78.5	91.5	87.3	80.7	75.6	70
2-3pm	86.3	90.2	91.2	82.2	83.3	70
3-4pm	79.3	80.2	86.2	72.7	76.5	70
4-5pm	78.7	77.9	88.3	76.1	78.5	70
MARKET DAY		2				
Time	FS	Vg	M	T	W	WHO Std.
8-9pm	93.6	77.2	88.4	79.7	76.5	70
9-10pm	94.1	79.5	82.3	81.2	78.2	70
10-11pm	91.4	80.6	81.7	83.4	77.6	70
11-12pm	92.7	78.2	87.2	80.9	71.4	70
12-1pm	89.7	72.7	84.9	78.7	73.2	70
1-2pm	92.5	76.8	83.6	72.4	70.3	70
2-3pm	93.8	72.3	88.7	76.4	75.3	70
3-4pm	90.7	64.5	87.8	74.1	69.8	70
4-5pm	88.7	68.9	78.2	77.8	70.2	70
5-6pm	82.1	71.8	71.8	70.8	67.5	70
MARKET DAY		3				
Time	FS	Vg	M	T	W	WHO Std.
8-9pm	80.4	82.3	90.3	80	77.7	70
9-10pm	83.1	82.3	85.4	90.2	83.9	70
10-11pm	92.8	79.9	91.2	79.4	72.2	70
11-12pm	92.7	78.2	101.2	82.9	75.6	70
12-1pm	81.9	71.4	87.1	74.6	71.1	70
1-2pm	79.8	86.1	82.1	82.3	81.7	70
2-3pm	88.1	74.6	84.5	71.9	802	70
3-4pm	78.2	71.9	82.6	88.9	79.6	70
4-5pm	82.1	69.8	78.9	72.6	70.3	70
5-6pm	79.6	70.6	72.6	78	69.1	70
MARKET DAY4						
Time	FS	Vg	M	T	W	WHO Std.
8-9pm	71.6	79.8	82.4	79.1	76.6	70
9-10pm	85.2	71.4	71.8	73.5	81.2	70
10-11pm	88.1	89.1		81.7	80.9	70
11-12pm	78.4	80.2	85.1	80.5	78.8	70
12-1pm	90.2	72.9	89.6	70.4	82.1	70
1-2pm	88.8	68.9	91.1	80.2	78.4	70
2-3pm	79.1	71.5	81.9	85.8	79.1	70
3-4pm	92.2	76.9	79.8	74.4	80.1	70
4-5pm	86.4	77.1	81.9	68.5	77.6	70
5-6pm	84.1	68.1	75.3	69.1	71.7	70
MARKET DAY		5				
Time	F	Vg	M	T	W	WHO Std.
8-9pm	70.6	71.2	92.6	81.9	79.6	70
9-10pm	88.6	80.4	98.1	85.4	91.1	70
10-11pm	83.1	75.2	89.6	78.9	89.6	70
11-12pm	70.6	81.9	90.2	72.2	90.2	70
12-1pm	84.3	71.6	98.8	80.4	91.8	70
1-2pm	86.9	72.4	83.9	74.6	88.9	70
2-3pm	81.1	69.6	75.1	78.6	75.1	70
3-4pm	89.5	71.2	82.6	80.1	82.6	70
4-5pm	81.2	71.4	45.2	74.2	85.2	70
5-6pm	79.6	68.8	78.6	68.8	78.6	70

Note: FS -Food Stuff, Vg – Vegetables, M Meat, Std-standard
T- Traditional materials, W- Wears

The noise level varies at various selected points across the market based on the product being marketed. The sampling point includes Food Stuff (FS), Vegetables (Vg), Meat (M), Traditional Materials (T), and Wears. The level of noise generated was also affected by some factors such as closeness to the major road or religious house, and the nature of trading at a particular point and hour of the day. In the afternoon; the market population increased greatly causing an increase in noise pollution level. The market women rely on canopy to provide shade for them in the afternoon while some of them even stay under the sun throughout the day. The majority of them also believe the noise pollution level is high but claimed to have adapted to it majorly due to their ignorance about its adverse effects.

The observed noise level across the market are compared with other studies carried out in different parts of Nigeria as presented in Table 2. It was found that other urban areas also faced a similar trend of noise pollution. Thus, there is a need to create awareness among the people and educate the citizens about the rising noise pollution and its health effects. It is important to note that control of noise at the individual level will reduce the effects of noise pollution. There are many legal provisions to control or check noise pollution. Many laws and acts have been amended to prevent noise pollution but none of these laws is implemented in Nigeria.

Plate 1: Commercial Activities at the Early Hour of the Day at the Vegetable Line

The noise pollution level values obtained in this research work agree with the findings of [2, 7] which indicated that the market is the noisiest place in the Abuja cosmopolitan and classified the noise pollution level as unsatisfactory.

3.3 Questionnaire Survey

A social survey was also conducted in the case study of nearby residents and the workers in the market as part of the overall assessment, using questionnaires. The questionnaire was designed for coverage, of job identification, the average hour spent in the market per day and condition, resident perception, and business of residents within the vicinity of the market location. From the social interaction, it was concluded that the majority of residents were also workers in the market. The majority of the houses within the axes of the market are old structures and up to 80 percent of the houses had been converted to shops and warehouses to harbor goods being sold in the market. About 76% of the market workers agreed to the presence of noise in the market, while 22% disagreed and 2% were not even aware of the noise pollution around them.

Plate 2: Commercial Activities in the Afternoon at the Meat Line

Table 2: Comparison of Noise Level with Related studies in Nigeria

City name	Minimum Noise Level (dB)	Maximum Noise Level (dB)
Ariaria Market, Aba	63.9	92.3
Oil Mill Market, Port Harcourt	98.9	109±3
Oju Ore, Ota	78.0	102.9
Oja Ota, Lagos State	68.5	95.6
Rumuosi sawmill, Port Harcourt	90.4	94.1
Ifo Market, Ifo	70.0±1.5	107.0±1.5

The majority of the residents considered the noise level from the market as bearable since they are not usually at home during the day and that the siting of the market in the area has brought employment opportunities to them and a positive impact in general while very few numbers people considered it annoying. However, about 66% of the respondent with the market to be more established to reduce the impact of noise pollution and traffic

congestion along the axes. A total of 100 questionnaires were shared, completed, and returned, which form the basic data analysis. From the social survey descriptive statistics in Table 3, it was deduced that an average worker spent at least 8 hours per day in the market. This implies that the majority of them are exposed to noise levels above 80dBA per day which has a great adverse effect on their health. Also, based on the administered questionnaires, none of the workers is using any form of the protective device nor had any gone for an auditory checkup before this time.

Table 3: Social Survey Descriptive Statistics

Variable	N	Min	Max	Mean	Std. Dev
S/N	100	1.00	100.00	51.5000	27.01549
Age range	100	0.00	3.00	1.9600	1.34716
Duration of service	100	0.00	3.00	1.4500	0.95733
Shift market system	100	0.00	0.00	0.0000	0.00000
Hours spent per day	100	0.00	1.00	0.8800	0.38815
Areas affected by noise Pollution	100	0.00	1.00	0.9500	0.45897
Use of a Protective device	100	0.00	0.00	0.0000	0.00000
The convenience of using a protective device	100	0.00	0.00	0.0000	0.00000
Disease due to noise pollution	100	2.00	4.00	4.1800	0.20000
Do auditory checkup	100	0.00	0.00	0.0000	0.00000

4 Conclusions and Recommendations

4.1 Conclusions

Based on the findings of this investigation, the following conclusions were drawn.

(i) According to a reconnaissance assessment, grinding activities produce a lot of noise.

(ii) The noise level in the Ifo market was effectively monitored during working days. The trend increases from morning till 4 pm and then drops. The noise level rises in this order: grinding, vegetable/spices line, and foodstuff line.

(iii) The greatest noise levels measured in the Ifo market exceed WHO recommendations (70 dBA for commercial environments).

(iv) The results of the oral interview revealed that individuals are unconcerned about noise pollution and its consequences.

4.2 Recommendation from the Study

The result from this study can serve as baseline information to model noise pollution studies in Ogun State. Government must create more awareness about Noise pollution and its adverse effects on people that are exposed to it.

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Ethical issue

Authors are aware of and comply with, best practices in publication ethics specifically about authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests, and compliance with policies on research ethics. Authors adhere to publication requirements that the submitted work is original and has not been published elsewhere in any language.

Competing interests

The authors declare that no conflict of interest would prejudice the impartiality of this scientific work.

Authors' contribution

All authors of this study have a complete contribution to data collection, data analyses, and manuscript writing.

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