

Measurement and Evaluations of Environmental Noise at Agbara Market, Ogun State, Nigeria

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Abstract

Noise is an undesirable sound that is considered to be unpleasant, loud, or disruptive to hearing. Noise has been observed to increase daily with increasing human activities in our environment. This is because of the increase in population, social and commercial activities, as well as improvements in industrial engagements. The aim of this study is to measure and evaluate the noise level and its effects on human at Agbara market, Ogun state in Nigeria using five different locations which were carefully selected based on commercial activities around the metropolitan. The measurement of sound level (dB) and temperature was carried out using a TM840M model noise meter. The mean noise level was obtained from the instrument which was analyzed to give the noise level equivalent (L_{eq}) of each selected location. The results were compared with the noise quality description to ascertain whether the noise level at Agbara market is suitable for human hearing or not. The results showed that morning time noise quality of no market days were satisfactory with a noise level equivalent (L_{eq}) of 61.00 dBA. The noise level equivalent (L_{eq}) in the afternoon and evening were unsatisfactory with a value of 82.60 dBA and 75.40 dBA respectively which was recorded within a temperature range between 25°C and 31°C. The same variations were also observed on Market days with a value of 65.80 dBA in the morning (satisfactory) while it recorded a value of 84.80 dBA in the afternoon (unsatisfactory) and 78.20 dBA in the evening (unsatisfactory). The morning hours during the weekends show good quality with a value of 59.80 dBA. The afternoon was unsatisfactory with a value of 82.00 dBA meanwhile evening noise level equivalent (L_{eq}) was satisfactory with a value of 68.20 dBA which was also within the same temperature range. These values were higher than the Federal Environmental Protection Agency (FEPA) and World Health Organization (WHO) standard limits for outdoor environment which is 65.00 dBA and becomes harmful when it exceeds 75.00 dBA. Therefore, Agbara market area should be decongested through proper planning by government to reduce the noise level in the environment in order to safeguard the physical and mental health of its inhabitants and users.

Keywords: Noise quality, Pollution, Environment, Noise Level Equivalent, Temperature

1. Introduction

Noise pollution is one of several environmental pollutions across the world. Noise pollution is rarely studied compared with other forms of pollution such as water, air (Obi et al. 2021; Arora et al. 2020). The pollution contributed by noise in the environment has become a major concern that calls for checks and balances daily (Garcia Ruiz and Bragdon, 2019). This is because there is an increase in noise levels daily due to an increase in population, and improvement in commercial, industrial, and social activities (Themann and Masterson, 2019). This assertion was also buttressed by many researchers that automobiles, commercial motorcycles, music recording houses, and the use of electricity generators have been responsible for most of the noise experienced in Nigeria (Anomohanran et al. 2008; Yesufu, 2012; Salami, 2021; Obi et al. 2021; Awosusi, and Akindutire, 2014). Also, Olayinka and Abdullahi, 2008 in their study observed that the population growth of the city which increased exponentially was partly responsible for the rise in noise pollution. It was also affirmed that road traffic is the predominant and most

generalized noise source in Nigeria. The development and improvements are good for the economy of every developed country but have to be regulated in order not to harm our health (Ikioda, 2016).

The ear drum as an organ in the body has the remarkable ability to handle an enormous range of sound (Leeds, 2010; Tomatis, 2005; Wever, 2015; Royster et al. 2003). However, it becomes uncomfortable when an irregular or unpleasant frequency from sound source interferes with our activities such as reading, worship, recreation, or during our leisure period which as a result becomes noise to the hearing. The hearing mechanism in the ear responds to variations of sound from sound sources in a relative manner. Therefore, logarithmic scale called the decibel (dB) is used to measure sound pressure level (Burkard, 1984; Royster et al. 2003; Anomohanran et al. 2008). This is a measure that describes pressure in the sound whether suitable or not for hearing and also deduces if it is a pleasant sound or noise. Research has shown that noise can have very dangerous effects on human health and therefore the need for proper understanding of the system (Skanberg and Ohrstrom, 2002; Bragdon, 2016). Noise pollution have been recognized as a major threat confronting the world today. World Health Organization (2005) reveals that noise is a dangerous agent which affects human health and the environment. However, people do not pay significant attention to the harmful effects of noise pollution and its dangerous environmental consequences on humans. Noise pollution affects both health and physical behavior which can lead to hearing loss, stress and high blood pressure and other health related problems (Švec, and Granqvist, 2018). The most common health related issues caused by noise pollution is the Noise Induced Hearing Loss (NIHL). There are some countries around the world where necessary actions have been put in place to control and regulate noise pollution in order to make their environment noise-free. Recently, Nigerian government has made some efforts to curb the effects of noise pollution, but commercial activities have dominated every part of our daily life which has been stated to be the major source of environmental pollutants (Anomohanran and Osemeikhian, 2006; Burkard, 1984).

The impact of Noise-Induced Hearing Loss (NIHL) in Nigeria is arguably higher compare to some other African countries. Considering Nigeria's increasing population of over 220 million people, many cities in Nigeria have been highly commercialized due to improvements in the economic status of the country. In recent times, markets are located in an environment without considering the environmental noise pollution it will pose to the residents of the area. Lately, some markets were located in residential areas in some parts of Lagos and Ogun state. An example of this is Agbara market which is located along Lagos-Badagry expressway. Agbara is a town in southwest Nigeria. It is located in the popular Ado-Odo/Ota Local Government Area of Ogun State. Agbara is located in Ogun state but shares a close boundary with Lagos State with longitude 3.0927° and latitude 6.5102° . It has a landmass area of 878 km² and a population of over 526,565 according to the 2006 census, which houses the highest number of companies in the state. Agbara is known for its high concentration of industrial estates and being a major manufacturing hub in Nigeria. The land mass given to the market initially could no longer house the marketers as they began to extend to residential areas in carrying out trading activities. The five-day interval at which the market normally holds could no longer be recognized as commercial activities have increased due to population of the area. Therefore, the noise pollution in this environment cannot be avoided as no regulation is seen to be operating in the area. This research will assess and evaluate the noise level in this area and some selected markets and in turn suggest possible ways of curbing the noise pollution to the Nigerian government in order to mitigate noise-induced hearing loss.

2. Data and Method of Analysis

2.1 Location

In this present research, we carried out the noise level measurements in five (5) different locations around the Agbara environment (Latitude 6.51° N and Longitude 3.09° E). Different locations were carefully mapped out for the measurements to give a good coverage of the market. Areas that are known to accommodate a high concentration of activities were also considered in the choice of the locations. These areas include Roundabout, Station, Agoro Street, Palace Road, and Main Market.

2.2 Materials

The measurements of the sound level were carried out using a TM840M model noise meter which is an integrated sound level meter consisting of a microphone, electronic circuit and a display screen was used to measure the noise level and the temperature of the environment. The microphone serves to detect subtle changes in air pressure corresponding to sound, which are then converted into electrical signals. The device’s electronic circuitry processes and presents these signals as the measured noise level in decibels (dB). The digital sound level meter captures instantaneous Sound Pressure Levels (SPL) when it is positioned in a specific location. This meter is purposefully designed to fulfill the sound level requirements of technicians, engineers, health and quality control personnel in diverse environments, including schools, offices, and homes. This instrument is very suitable for environmental noise surveys.



Figure 1: A TM840M Model Noise Meter (Salami, 2021)

2.3 Sources of Data

The data used for the study were obtained by mounting the instrument at a height of 1m above the ground level for all the locations for consistency of measurement with the antenna pointing to the sound source. The instrument was set to obtain the equivalent noise level (L_{eq}) which is the constant noise level that expands the same amount of energy over the same period and was measured for the various locations.

2.4 Method of Analysis

The instrument gives the mean noise level for each point using Equation (1) as stated in the work of Majidi et al. (2019).

$$X_m = \frac{\sum_{i=1}^n x_i f_i}{\sum_{i=1}^n f_i} \tag{1}$$

where x_i is the mean sound pressure and f_i is the percentage frequency of the data. Equivalent sound level (L_{eq}) is obtained using Equation (2)

$$L_{eq} = 10 \log \left[\frac{1}{\sum_{i=1}^n f_i} \sum_{i=1}^n 10 \frac{L_{pt}}{10} \times f_i \right] \tag{2}$$

where L_{pt} represents X_m of the location.

This measurement process was carried out at the locations at three different times of the day which are: 9:45 am-10:00 am, 1:30-1:45 pm, and 6:30-6:45 pm using three days which include Market-day, No market-day, and Weekends that does not fall on market days. A period of three months was used for obtaining the data. The readings were taken twice a month for the required days to obtain the data after which an average of each day was determined for analysis. The instrument was set to an automatic mode to run continuously for fifteen minutes. This is because the instrument authentically follows all the fluctuations and stores them in its memory. The instrument gives the average energy recorded in decibels (dBA).

3. Results and Discussion

3.1 Results

The result is compared with the standard noise quality description shown in Table 1 to determine whether the noise level at Agbara is suitable or not which was adopted from Anomohanran (2013).

Table 1: Noise Quality Description (WHO, 2005)

Leq (dBA)	Noise Quality Description (Day Time)
0-30	Excellent Quality
31-40	Very Good Quality
41-60	Good Quality
61-75	Satisfactory Quality
76-90	Unsatisfactory
91-110	Hazardous Quality
>111	Not allowed

Table 1 shows the noise quality description which clearly depicts that the equivalent noise level is of good quality between 0-75 dBA. Also, it was stated from the same table that the equivalent noise level between 75-110 dBA is unsatisfactory and hazardous to the health while the equivalent noise level greater than 111 dBA is classified as a level not allowed in our environment.

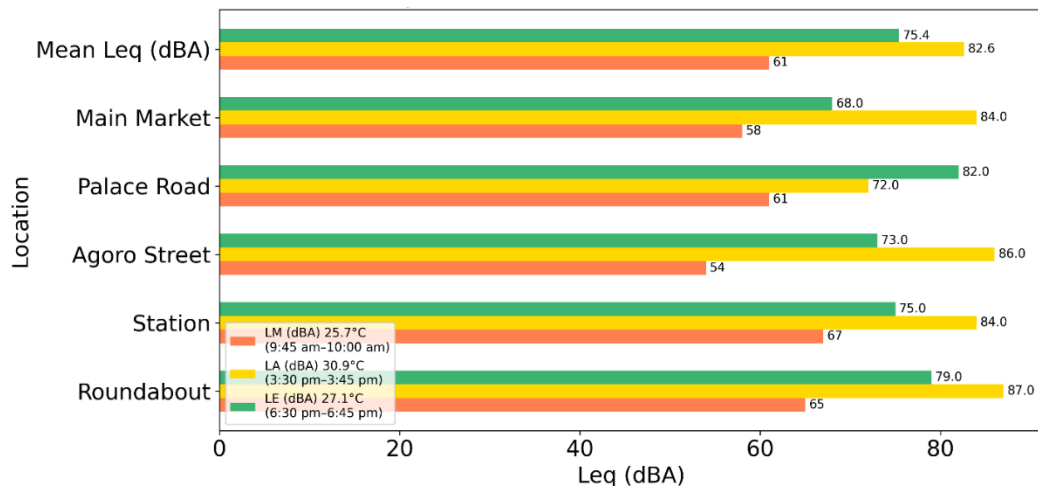


Figure 2: Equivalent Noise Level of different location on No Market day

Figure 2 presents the results of No market day in Agbara recorded between 9:45 am to 10:00 am at 25.7°C shows that station has the highest morning time noise level of 67.00 dBA in the market, followed by Roundabout having the noise level of 65.00 dBA. This high level is attributed to the fact that they are areas of larger crowd and activities.

Agoro street also have the morning noise level to be 54.00 dBA which is the least of the morning noise level because Palace Road has 61.00 dBA and the Main market also have its noise level to be 58.00 dBA.

The afternoon peak hour which was recorded between 3:30 pm to 3:45 pm at 30.9°C shows that Roundabout possesses the highest afternoon time noise level of 87.00 dBA. After which is Agoro street having its afternoon noise level to be 86.00 dBA followed by Station and Main market which are of same noise level of 84.00 dBA and the least which is Palace Road with noise level 72.00 dBA. The evening noise level was measured at exactly 6:30 pm to 6:45 pm at 27.1°C and was recorded to have palace road as the one with the highest evening time noise level of 82.00 dBA with others ranging from 79.00 dBA to 68.00 dBA.

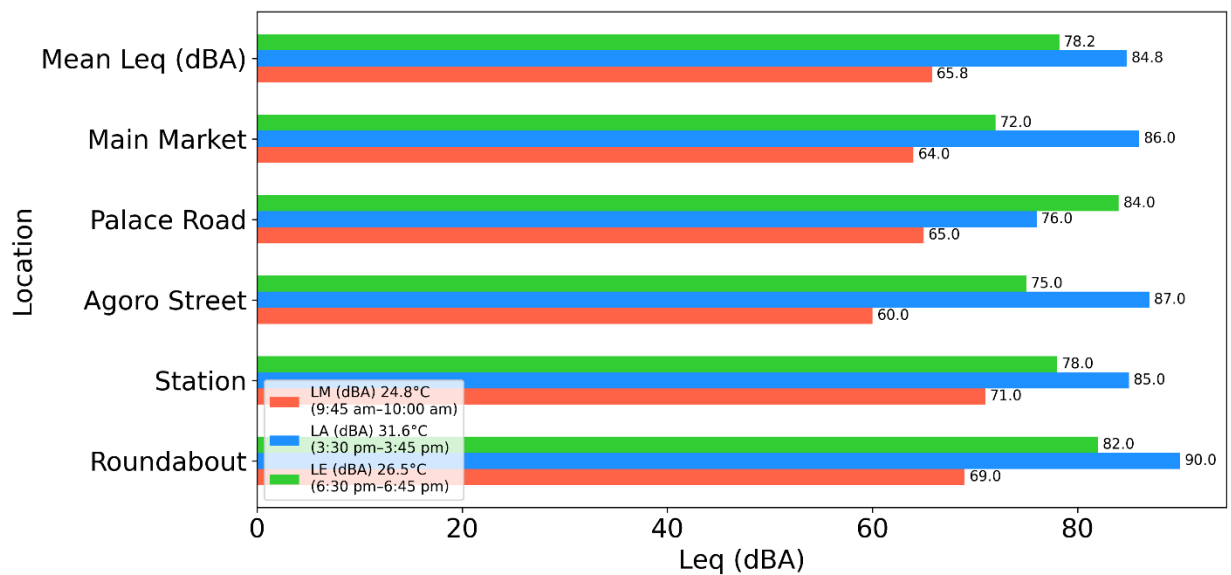


Figure 3: Equivalent Noise Level of different location on Normal Market Day

Figure 3 shows the result a market day recorded between 9:45 am to 10:00 am at 24.8°C. It was observed that station has the highest morning time noise level of 71.00 dBA in the market followed by Roundabout having the noise level of 69.00 dBA. This high level is attributed to the fact that these areas contain a larger population of residents and many commercial activities is carried out alongside. Agoro street also have the morning noise level to be 60.00 dBA which is the least of the morning noise level. Palace road recorded a noise level of 65.00 dBA and the Main market has its noise level to be 64.00 dBA during the same period of time.

The afternoon peak hour which was recorded between 3:30 pm to 3:45 pm at 31.6°C shows that Roundabout possesses the highest afternoon time noise level of 90.00 dBA. After which Agoro street recorded its afternoon noise level to be 87.00 dBA followed by Station and Main market which record their noise level to be 85.00 dBA and 86.00 dBA respectively. The least noise level was recorded at Palace Road with a value of 76.00 dBA. The evening noise level was measured at exactly 6:30 pm to 6:45 pm at 26.5°C and was observed to have Palace road as the one with the highest evening time noise level of 84.00 dBA followed by Roundabout which recorded its evening time noise level to be 82.00 dBA. The noise level at Station, Agoro Street and Main market were recorded as 78.00 dBA, 75.00 dBA and 72.00 dBA respectively.

Table 2: Equivalent Noise Level of different location on weekends (From the TM840M Model Noise Meter)

Time	9:45 am–10:00 am	3:30 pm–3:45 pm	6:30 pm–6:45 pm
Temperature(°C)	27.3°C	30.9°C	26.4°C
Location	L_{eqM} (dBA)	L_{eqA} (dBA)	L_{eqE} (dBA)
Roundabout	53.00	80.00	80.00
Station	61.00	82.00	74.00
Agoro Street	62.00	83.00	73.00
Palace Road	63.00	84.00	71.00
Main Market	60.00	81.00	73.00
Mean L_{eq} (dBA)	59.80	82.00	68.20

Note: Equivalent Noise Level in the Morning (L_{eqM}), Afternoon (L_{eqA}) and Evening (L_{eqE})

Table 2 reveals the results of Equivalent Noise Level in the Morning (L_{eqM}), Equivalent Noise Level in the Afternoon (L_{eqA}) and Equivalent Noise Level in the Evening (L_{eqE}) during the weekend at Agbara. The results recorded between 9:45 am to 10:00 am at 27.3°C shows that Palace Road has the highest morning time noise level of 63.00 dBA in the Main market, followed by Agoro street having the noise level of 62.00 dBA. This high level is attributed to the fact that these areas housed churches which activeness are mostly during the weekends. Roundabout also has noise level to be 53.00 dBA which is the least of the morning noise level. This is can be attributed to the fact that less commercial activities were experienced during the weekend in this area. Station has its morning noise level to be 61.00 dBA while the Main market record it noise level to be 60.00 dBA. The afternoon peak hours which were recorded between 3:30 pm to 3:45 pm at 30.9°C shows that the noise level in the market at this point is very high in all 5 locations. Although Palace Road was observed to be having the highest Afternoon time noise level of 84.00 dBA, the remaining location ranges between 80.00 dBA to 83.00 dBA. The afternoon time noise range is quite higher in all the locations. This is attributed to a high trading activities in the market during the afternoon period than other periods in the market domain. The Evening noise level was measured at 6:30 pm to 6:45 pm at 26.4°C and the highest noise level was recorded at Roundabout with a value of 80.00 dBA followed by Station with noise level 74.00 dBA after which we have Agoro street and main market with the same noise level of 73.00 dBA and the least which is Palace Road which recorded a noise level of 71.00 dBA.

Table 3: The Mean Equivalent Noise (Mean L_{eq}) Morning time, Afternoon time, and Evening time noise levels of the market (From the TM840M Model Noise Meter)

DAYS	Morning Time		Afternoon Time		Evening Time	
	L_{eq} (dBA)	NQD	L_{eq} (dBA)	NQD	L_{eq} (dBA)	NQD
No Market days	61.00	Satisfactory	82.60	Unsatisfactory	75.40	Unsatisfactory
Normal Market Days	65.80	Satisfactory	84.80	Unsatisfactory	78.20	Unsatisfactory
Weekends	59.80	Good Quality	82.00	Unsatisfactory	68.20	Satisfactory

Note: NQD - Noise Quality Description

Table 3 shows the Mean Equivalent Noise (Mean L_{eq}) during the Morning, Afternoon, and Evening time noise levels of the market. Checking the quality level of all equivalent noise levels, it was observed that shows that in the morning on No market days the noise level was satisfactory with a value of 61.00d BA while afternoon and evening is unsatisfactory with values of 82.60 dBA and 75.40 dBA respectively. The same description was also observed on Market days with 65.80 dBA in the morning which was satisfactory, 84.80 dBA in the afternoon which was unsatisfactory and 78.20 dBA in the evening which was also unsatisfactory. Weekends in the morning show good quality with 59.80 dBA, afternoon was unsatisfactory with 82.00 dBA and evening satisfactory with 68.20 dBA.

3.2 Discussion

Analysis of Figure 2 using the model in Table 1 shows that the Market Day has the highest morning time equivalent noise value of 65.80 dBA in the market. This high value is attributed to the fact that the area has the most frequent physical activities during the morning time. The volume of vehicles plying the network of roads in the area is very high being along federal ECOWAS road coupled with the high business activities going on in this area daily. This result agrees with the finding of Essandoh and Armah, 2011 that most environmental noise results from road traffic and commercial activities. This point is also supported by the work of Anomohanran et al. (2008); Sisman, and Unver, (2011). The morning time equivalent noise level of No market day with a value of 61.00 dBA is also characterized by commencement of traffic built up, commercial and business activities. The weekend has less commercial and business activities hence their daytime mean equivalent noise level has a comparatively lower value of 59.80dBA. The afternoon time mean equivalent noise measurement shows that the Normal market day possesses the highest value of 84.80 dBA followed by the No market day with a value of 82.60 dBA and weekend with a value of 82.00 dBA. The reason for these high values could be attributed to commercial activities at its peak at this time.

The Morning time, afternoon time and Evening time mean noise level of the market shows that the morning time noise quality of No market day and Market Day is satisfactory with a lower temperature while afternoon and evening are unsatisfactory at slightly high temperature. This is not healthy for hearing system as continuous exposure to this kind of noise without a corresponding period of recouping will certainly lead to one of the health-related effect of noise as suggested by Agarwal and Swami, (2010); Welch et al. (2013); Zambrano-Monserrate and Ruano, (2019).

4. Conclusion

The equivalent noise level of Agbara has been measured and evaluated. It was observed that there is satisfactory noise in the morning and of good quality. Afternoon time is observed to be the period of unsatisfactory noise quality level. This period is when the commercial activities are at its peak. From the result of our analysis, we observed that the morning time noise quality of No Market Day, Market Day, and weekend evening is satisfactory. Weekend evening has good noise level while that of afternoon and evening period on weekdays is unsatisfactory. The time for an unsatisfactory noise is more than the time for satisfactory noise. The analysis of our results also showed that there is a strong relationship between temperature and noise level. We concluded from our result that temperature increases with noise level of the environment but with slight variations during the evening period. The slight increase in noise equivalent level during this period compared to the morning hour is as a result of large number of people that are engaged with leisure activities during the weekends in the area despite the low temperature as compared to the morning hours when people are relaxed in their various homes. Continuous exposure to unsatisfactory noise will certainly lead to one of the health-related effects of noise as suggested by Agarwal et al. (2010); Themann and Masterson, (2019); Schmidt and Klokker, (2014). The period for the unsatisfactory noise is hazardous to the health as environmental noise pollution will most likely affect the hearing system of the people residing in this area. Considering this unhealthy situation, the area should be decongested through a proper planning by government, as the location is too small to hold the kind of commercial activities going on there.

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