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Research Article

Evaluation of Noise Pollution Level in Selected Sawmill Factories in Port Harcourt and Environs, Rivers State, Nigeria

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Abstract

Evaluation of noise pollution level has been carried out in in some selected Sawmill factories in Port Harcourt and environs using noise level and frequency meters in seven locations. The mean values of maximum and minimum sound levels in Mile2, Mile3, Marine base, Oluwood were 81.98±0.43 and 79.28±2.00, 82.450±0.66 and 80.28±0.80, 81.50±4.73 and 74.75±1.10, 81.40±0.40 and 78.03±2.02 respectively. Also the mean values of maximum and minimum sound levels at Igwuruta, Rumosi, Rumuji were found to be 82.00±0.64 and 79.40±2.00, 81.53±0.60 and 78.66±1.63, 81.78±0.40 and 77.95±1.86 respectively. The average noise equivalent (Leq) ranged from 77.20 to 82.25 dB whereas the average noise pollution level (Lnp) ranged from 96.13 to 101.23 dB. Therefore, the indication is that the Sawmill at Igwuruta has the highest average Lnp whereas Rumuosi has the least average when compared with the recommend permissible value by the Nigerian Federal Ministry of Environment (FMEnv). This study has determined the noise level generated in study area through set objectives which included but not limited to measuring the sound level, investigating noise some meters away from the source and of course comparing results with best known standards. The results therefore suggested that the noise level is high at the saw mills and the day exposure to this unwanted sound could threaten the health of the factory workers and the residents at proximity to the noise sources.

Keywords

Evaluation, Health Effect, Noise, Pollution Level, Sawmill

1. Introduction

Noise has been defined as every kind of unwanted and disturbing sound that threatens our physical, psychological and social well-being [1]. The frequency range of 20 Hz to 20 kHz is conventionally referred to as the human audible range. Exposure to High frequency HF noise (frequencies above 20 kHz) for long period of time can cause hearing damage. In developing country like Nigeria with considerable growth in the area of industrialization, the residents of cities are experiencing severe environmental problems that results from heavy-duty industrial machines and tools. Industrial noise is one of the major sources of environmental pollution and it has detrimental effects on human beings.

Studies published in a British medical bulletin showed that high frequency sounds can cause a range of ill health effect

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such as stress and anxiety. Conventionally, Infra-sounds typically below very low frequency of 20 Hz are usually too low to be picked by human ear [2]. Sound can be generated by loud-speaker, industrial machineries, power generators, etc., and can cause sicknesses like migraine, fatigue, nausea, tinnitus and general headache. Noise can cause presbycusis, a common age-related hearing loss especially high frequency sounds [3]. It is a gradual loss that slowly happens over time and affects both ears equally. Human beings affected by this disease are usually not aware that their hearing capability is diminishing. It is estimated that presbycusis appears from the age of 30 years onward and becomes noticeable after the age of 40 years [3]. Exposures to guns, industrial machinery and very loud music contribute significantly to presbycusis. The hearing loss can usually be corrected with a hearing aid. Another hearing ill health is tinnitus which is condition that causes a form of hearing impairment that the affected persons respond to the sound at frequency that can be heard by their ears only [4]. It is commonly caused by constant exposure to high frequency sounds and can also be corrected by hearing aid.

Noise produces direct and cumulative adverse effects that impair health and degrade residential, social, working environments with corresponding impact on economic and human well-being [5]. Noise can startle, annoy and disrupt concentration, sleep and relaxation, interfere with speech communication, and as a consequence interfere with job performance and safety, as well as physiological effect such as noise-induced loss of hearing or aural pains [6]. Annoyance is associated with both environmental noise level and psychological symptoms [7].

Hearing loss may be temporary or permanent. Prolonged exposure to high noise levels leads to permanent deafness. Human beings when exposed to noise level of 90dB and above may develop auditory fatigue which is a condition of hearing impairment. Noise control or noise mitigation is a set of strategies to reduce noise pollution or to reduce the impact of that noise, whether outdoors or indoors [8]. Noise control in specific regions can be backed up by laws, for instance, the US Noise Control Act in 1972. These are intended to give legal direction towards the abatement of noise on a nationwide basis. With particular reference to Nigeria, a number of State Governments have evolved noise control laws [9]. The main areas of noise control are in: transportation noise control, structural or noise in wall control, and workplace noise control. Roadway noise and aircraft noise are the most pervasive sources of environmental noise. Social activities may generate noise levels that consistently affect the health of residents in such areas. Hence, it is imperative for religious bodies, schools and other social groups to minimize environmental noise by strictly adhering to these noise control laws.

The World health organization recommends that noise level for residential area should not exceed 55dB in the day time and 45 dB at night. Also FMev set a standard for Nigeria that within eight (8) hours of the day the environmental level should not exceed 90dB. Noise of 90 dB(A) or above which is considered as noise pollution by FMev has been proven in the industry and in the laboratory to reduce working efficiency and increase the liability to make mistakes and thus resulting to decrease in productivity through increment in loss of man-hours [7]. Environmental noise in some areas of Port Harcourt metropolis has been studied previously as recorded by [7]. The study collaborated sound levels and environmental pollution of aircrafts noise impact on the host communities. Physical/acoustic measurements of the airport were carried out through the use of a BK Precision digital sound level meter. In order to validate the field measurements, they used optimization model with a symbolic computational software package (Maple). Previous study carried out by [6] determined the environmental sound quality of some selected flow stations in the Niger Delta of Nigeria. The results obtained showed an average of 81.72dB(A) and 84.74dB(A) for East and West of the Niger Delta respectively. The intensification of industrial production and the concurrent increase in machine operation speeds has led to the rise in the intensity of noise generated in most workplaces [10]. The city of Port Harcourt is one of the Nigerian cities where uncontrollable noises exist with a major source of the noise being Sawmill. Many residents and Sawmills occupational workers are ignorant of the noise level of sawmills in their area. This therefore necessitated the study on evaluation of the noise level of selected Sawmills to ascertain the matrix of relationship between local and international permissible values to ascertain how the levels are related to the local and international permissible values.

2. Study Area

The study area is within Port Harcourt the capital city of Rivers State of Nigeria and environs. Rivers state lies within Niger Delta region and the Niger Delta is located in southern Nigeria, between latitude 4^{o} and 6^{o} N and longitude 3^{o} and 9^{o} E. It is bounded in the west by the Benin Flank and in the east by the Calabar Flank, to the south by the Gulf of Guinea (extending offshore to the Atlantic) and to the north by older Cretaceous tectonic elements, such as the Abakaliki Anticlinorium and the Afikpo syncline [11].

The Sawmills investigated were: Mile 2 sawmill factory located at Illoabuchi, Diobu. Mile 3 sawmill factory located at Mile 3, Diobu. Orlu woods and furniture sawmill factory located at Eliozu. Marine Base sawmill factory located at Marine-base. Igwuruta sawmill factory located at Igwuruta. Rumousi sawmill factory located at Rumousi. Rumuji Sawmill factory located at Rumuji as shown in Figure 1.

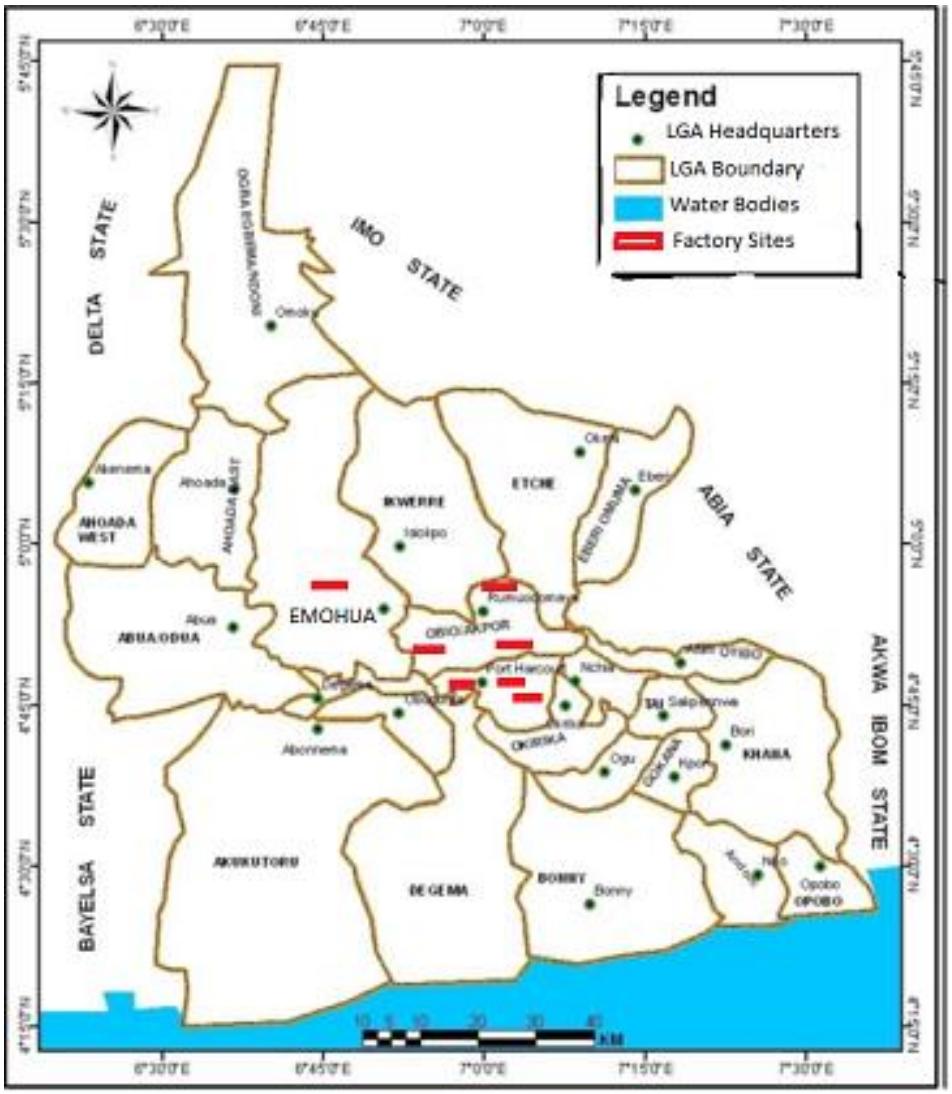

Figure 1. Map of Rivers State showing the LGAs and factory sites.

3. Materials and Method

3.1. Materials

This research involved the measurement of noise levels of sawmills selected at random in Port Harcourt metropolis and environs using Digital Sound Level Meter and Stop watch. The noise levels were measured *in situ* on the different workshoptools (machines) at a distance of 3 meters from the sources, using a Bruel and Kjaer (B&K) precision digital sound level meter (IEC651 TYPE II) set on the weighting scale and slow response. A stop watch was used to monitor measurement duration. The noise measurements were taken at 10 second intervals for 5 minutes.

3.2. Method

Measurements were taken when the machine was put on (machine noise) and when wood was sawed (operational noise) and then the nature of the wood sawed was noted. The sound meter measured directly the equivalent continuous sound level (leq) as digital numerical read out, which stabilized after about five minutes. During measurement, the meter microphone was directed towards the noise sources and the meter held away from the body. Six readings were taken at each spot when the machine was in operation and the average value recorded.

This process was repeated for the different machines in the factory and the background noise level obtained at an average distance of 50 meters from factory and the adjoining residential house walls, which is a contribution to both the sound reflection from the wall and the floor of the buildings. The noise pollution level Lnp was computed using the expression $Lnp = Leq + K\sigma$ [12]; where K is a constant with a value of 2.565 for this kind of environment and σ is the standard deviation which has values of 7.4 (dB) for (A) weighted level of range [6].

The matrics of noise were calculated using the relations

below.

Equivalent Continuous Level (Leq)

$$Leq = 10Log\ 10(1T\ \Sigma 100.1Li\ ni\ i=0\ x\ ti) \quad (1)$$

The n-Percent Exceeded Level, Ln (L10, L50 and L90)

$$((n+1))*100/ \quad (2)$$

Noise Climate (NC) NC = L10−L90 (3)

Traffic Noise Index (TNI)

$$TNI = 4(L\ 10 - L\ 90) + L\ 90 - 30dB\ (A) \quad (4)$$

TNI is expressed in dBA.
Where;
T=total observation time
ti=duration of individual sound level sampled
Li=noise level of ith sample
m = rank number
n = total number of data available.
L10 = Sound pressure level exceeded 10% of the time
L90 = Sound pressure level exceeded 90% of the time [13]

4. Results and Discussions

The result of measurements are presented in Tables 1–7 showing the Max/Min sound levels, Leq noise levels and the computed Lnp levels for Mile 2, Mile 3, Marine base, Orluwoods, Igwuruta, Rumousi and Rumuji sawmills respectively, while Table 8 is the background noise level also showing the mean at each factory. Figure 2 showed the comparison between the calculated mean values (Lnp) and the recommended value whereas Figure 3 showed the variation of the maximum and minimum Lnp from the recommended value of 55dB during the day for occupational workers.

Table 1. Mile 2 Timber Sawmill Noise Level.

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Planer machine	82.40	81.60	82.00	100.38
3	Big Stenner machine	80.80	73.60	77.20	96.18
4	Small Stenner machine	81.90	80.60	81.25	100.23
5	Calving machine	82.80	81.30	82.05	101.03
6	MEAN	81.98±0.43	79.28±2.00	80.63±1.16	99.46±61.16

Table 2. MILE 3 TIMBER SAWMILL NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Planer machine	82.70	81.70	82.20	101.18
3	Patterning machine	82.80	81.30	82.05	101.03
4	Sawing machine	83.70	79.90	81.80	100.78
5	Perkins generator	80.60	78.20	79.40	98.38
6	MEAN	82.45±0.66	80.28±0.80	81.36±1.14	100.34±0.65

Table 3. MARINE BASE TIMBER SAWMILL NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Circular machine	81.00	76.20	78.60	97.58

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
3	Table machine	82.60	81.60	82.10	101.08
4	Planer machine	81.60	62.60	82.10	101.08
5	Perkins generator	80.80	78.60	79.60	98.68
6	MEAN:	81.50±4.73	74.75±1.10	80.60±0.89	99.61±0.85

Table 4. ORLU WOOD AND FURNITURES NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Circular Machine	81.00	76.40	79.10	97.08
3	Table Machine	82.40	81.60	82.00	100.98
4	Calving Machine	81.30	80.60	81.10	101.08
5	Generator	80.90	73.50	77.20	98.18
6	MEAN:	81.40±0.40	78.03±2.02	79.85±1.07	99.33±1.01

Table 5. IGWURUTA SAWMILL NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Circular Machine	81.90	80.60	79.10	100.23
3	Big Stenner	82.40	81.90	82.00	101.13
4	Sharpening Machine	82.90	81.60	81.10	101.23
5	Calving machine	80.80	73.50	77.50	96.13
6	MEAN:	82.00±0.64	79.40±2.00	79.93±2.04	99.68±1.20

Table 6. RUMOUSI TIMBER SAWMILL NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Table saw	82.60	81.30	81.95	100.93
3	Stenner machine	80.40	78.35	79.35	98.38
4	Planer machine	82.50	81.20	81.85	100.18
5	Perkins Generator	80.60	73.80	77.20	96.18
6	MEAN:	81.53±0.60	78.66±1.63	80.09±1.13	98.92 ±1.08

Table 7. RUMUJI TIMBER SAWMILL NOISE LEVEL (dBA).

S/N	EQUIPMENT	SOUND METER LEVEL (dBA)		Leq (dBA)	Lnp (dBA)
1		MAXIMUM	MINIMUM		
2	Sharpening machine	80.90	73.60	77.25	96.23
3	Planer machine	81.80	80.40	81.10	100.08
4	Circular machine	82.60	81.90	82.25	101.23
5	Calving machine	81.80	75.90	78.83	97.83
6	MEAN:	81.78±0.40	77.95±1.86	79.86±1.12	98.84 ±2.51

Table 8. Mean values of the Equivalent Noise level and Noise Pollution.

S/N	LOCATION	(dBA)	
		Av. Leq	Av. Lnp
1	Mile 2	80.63±1.16	99.46±1.16
2	Mile 3	81.36±1.14	100.34±0.65
3	Marine base	80.60±0.89	99.61±0.85
4	Orlu wood & furniture	79.85±1.07	98.33±1.01
5	Igwuruta	79.93.70±2.04	99.68±1.20
6	Rumuosi	80.09±1.13	98.92±1.08
7	Rumuji	79.86±1.12	98.84±2.51

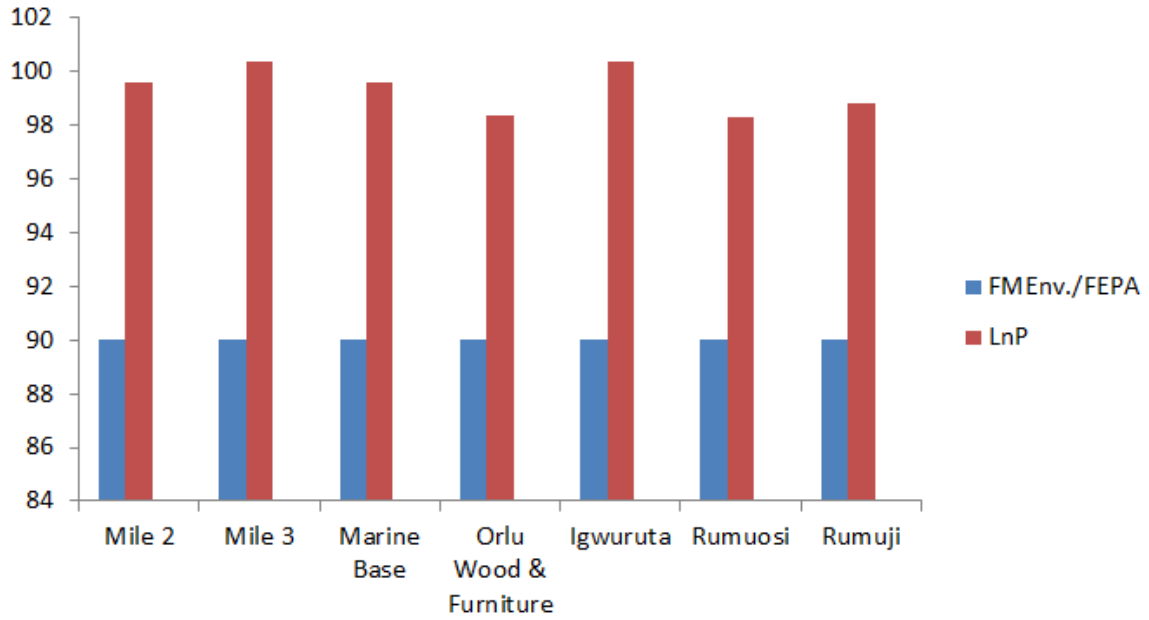

Figure 2. Comparison of measured Lnp with recommended value.

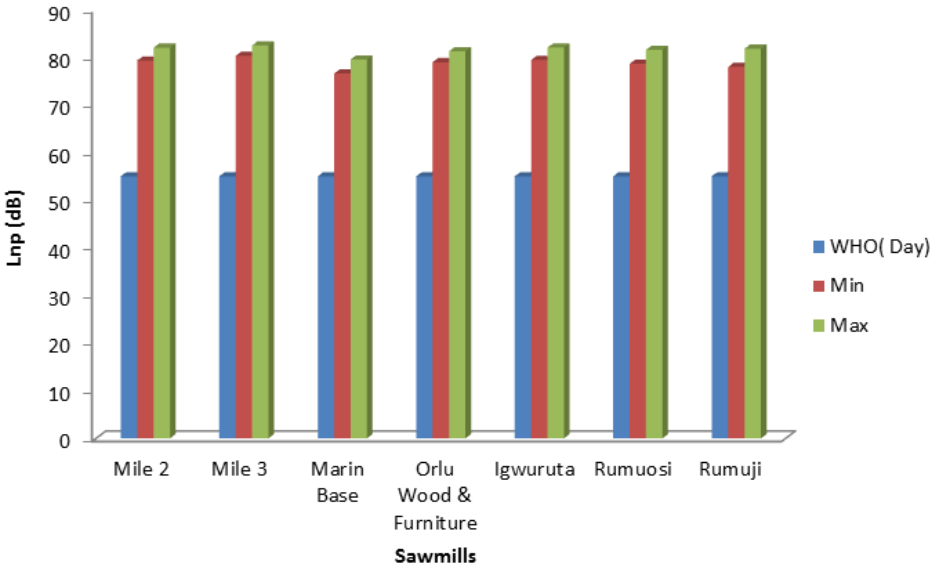

Figure 3. *Comparison of recommended noise pollution level during the day with the minimum and maximum values at the factories.*

5. Discussion and Conclusion

5.1. Discussion

The results of the background noise levels in the Sawmills, showed that Orlu woods and furniture produced the minimum value of 79.85 dB while Igwuruta had the maximum value of 100.35 dB. The Orluwood is the smallest while Igwuruta sawmill is the largest with many machine that generate more noise. The results of noise from individual machines ranged from 96.18dB (big Stenner) at Mile 2 sawmill to 101.23dB (circular machine) at Rumuji sawmill with an average of 98.71dBA which is higher than the values obtained for the Niger Delta by [6]. The values are higher than the recommendation by FMEnv. The implication is that the workers are daily exposed to high noise that can cause hearing loss and threshold shift. It may also cause anxiety, stress, nervousness, nausea, headache, emotional instability, argumentativeness, annoyance. This level of noise may equally affect human pulse rate, and blood pressure. Table 8 Showed the mean of the minimum and maximum noise level values obtained from the various equipment present at each of the sawmill locations. However, the saw mill factories produced noises above the standard in consideration of permissible limit for eight (8) hours continuous exposure in a day as recommended by [14].

5.2. Conclusion

Evaluation of Noise Pollution Level in selected Sawmill Factories in Port Harcourt and Environs has been made in seven sawmill factories. The physical measurements showed that the values of background noise level are above the FMEnv and FEPA recommended limit for normal environment, meaning that the average Lnp exceeded 90dB at all the sawmills under investigation. The permissible noise level of 55dB during the day for industries was also exceeded. Therefore, the noise generated from these factories has every likelihood to have negative impact on the sawmill workers and resident at proximity to the factories. This could lead to hearing impairment for anyone who stays in that environment overtime. It was observed that the older the machine in the factories the noisier the machine and also that when hard woods were being processed the noise produced became more than when soft woods were on the machine either for planning or cutting. In general, great noise was generated at all the factories, so all workers should wear ear muff, very old machines should be changed and residential building very close should be relocated or converted to warehouses.

Conflicts of Interest

The authors declare no conflicts of interest.

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