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Assessment of Noise Pollution Levels of Selected Sawmills Activities in Ogbia Local Government Area of Bayelsa State, Nigeria.

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Abstract

Sawmill industries generate high levels of sound to the residential, commercial industrial environments which may be hazardous to human health. The high sound (noise) can affect workers and residents psychologically as well as physiologically. This paper presents the findings of a baseline research undertaken to evaluate the sound level at sawmill workstations in Ogbia Local Government Area of Bayelsa State, Nigeria using a digital sound level meter of model TES – 1350A and global positioning system. A total of fifteen sawmill workstations in seven towns of the L.G.A were assessed after a reconnaissance survey. The average measured noise level for the fifteen sawmill workstations ranged from 80.50 dBA in Imiringi (labelled - OBG10) to 100.40 dBA in Imiringi (tagged – OGB9). Apart from the average noise level of 84.30 dBA in Elebele and 80.550 dBA in Imiringi, all other values exceed Occupational Safety and Health Acts (2002) and World Health Organization (2004) recommended standard limit of 85.0 dBA 8-hour workstation for industry. The estimated noise pollution level for the fifteen sawmill workstations ranged from 96.91 dBA in location in OGB10 location to 116.81 dBA in OGB9 location. All the estimated noise pollution levels are higher than the OSHA and WHO permissible limit of 85.0 dBA. The results of the accumulated dose in percentage exposure for 8-hour workday period of exposure indicate that sawmill workstations OGB1 and OGB10 situated at Elebele and Imiringi Towns with percentage accumulated dose of 43.48% and 28.67% exhibit lower percentage dose. The noise quality indices such as Leq, Lnp, and accumulated dose in percentage exposure values of the thirteen out of the fifteen sawmill workstations indicate unhealthy noise levels. These values can affect the auditory system and the health of industry workers.
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Keyword: Noise pollution level, Sawmill, Health effects, Occupational safety, Industrial noise exposure, Environmental monitoring, Noise regulation compliance.

INTRODUCTION

Woodwork plays dominant roles and has been useful to human societies from time immemorial as wood products are increasingly demanded in the world (FPL, 2010). The wood industry has also experienced tremendous growth as the building construction industry utilizes wood from logs as a major construction material through the activities of sawmills. Sawmill activities through the operation of machines, sawing and cutting could create an appreciable amount of noise daily for a long-time frame. Sawmill workers are exposed to this degree of acoustic environment.
According to the World Health Organization report (WHO, 2005; Mojisola, 2018), after air and water pollution, noise is the third most harmful type of pollution. Noise is an unwanted, undesirable, unpleasant sound from industrial equipment sources that create or give rise to nuisance, stress, annoyance, sleeplessness, decreased intellectual ability, loss of concentration, increased blood pressure and other health and psychological effects to the environment and human life (Choudhari *et al*., 2011). Some of this hazardous industrial equipment includes generators, sewing machines, heavy-duty machines, aircraft, musical instruments, among others (Avwiri and Nte, 2003; Parzych, 2004).

An increase in noise pollution because of rapid industrialization through urbanization causes excessive noise, and without proper noise pollution assessment and prevention measures, could culminate in hearing loss among wood millers and copper smiths (WHO and OHSA, 2005). Therefore, it is pertinent to regulate industrial noise globally as the challenges are enormous (WHO, 2015). Several studies revealed the danger of unchecked exposure of industry workers to very high levels of noise that may contribute to hearing impairment and other health challenges (Akpan, 2018). According to the World Health Organization (WHO, 2005), approximately 328 million adults and 32 million children worldwide, representing about 5% of the world's population, undergo hearing loss. This disability is due to exposure to excessive noise in the workplace. People residing near these industrial areas are indirectly or directly affected by the noise pollution from the sawmill machine and other components (Asit *et al*., 2016). Today, noise pollution is one of the environmental and physical variables affecting human health. Environmental noise pollution increases in cities and urban areas due to increased commercial and industrial activities that elevate noise pollution exposure level.

According to Peippo *et al*. (2000), the lamentation of the public regarding unwanted sound is frequently increasing as excessive noise can damage physiological health. The effect of noise pollution increases beyond human beings, but damage ecosystem and wildlife thereby cutting short migration patterns and breaking off natural behaviors. Noise pollution, a distributive and much underrated environmental unit, has been widely studied and its adverse effects underscored by the World Health Organization (WHO) to include sleep disruption, cardiovascular ailments, among others (WHO, 2018). Therefore, for the health safety of every organism, especially the industrial workers, the NESREA (2007) and OSHA (2002) recommended exposure limits of 85dBA continues sound pressure level for 8 hours. WHO (2004) justified these regulatory standards due to the adverse effects of excessive noise on human health. The World Health Organization pointed out that noise must be recognized as a major threat to human wellbeing (WHO, 2018).

The issue of noise pollution among policymakers and the public remains an increasing menace as Guidelines Development Group strongly advocates minimizing noise levels produced sawmills industry to 70dBA for average noise exposure (WHO, 2018). Ogbia snuggled in the ecological susceptible Niger Delta region, presents persuasive case study due to its collocation of rural and urban landscape where industrial development merge with traditional lifestyles and these distinction presents an opportunity for empirical exploration. Taking sawmill activities as a case study, this study seeks to unravel the intricate relationship existing among industrial noise emissions, environmental stability and community resilience. Inasmuch as industrial noise pollution has been a subject of investigation, limited attention has been given to it within the Bayelsa State specific socio-environmental context.

Measuring and analysing noise levels in different sawmill locations will facilitate a nuanced

understanding of the sources and propagation patterns of noise pollution as the study's findings bear the potential to illuminate multifaceted dimensions. These findings could be complemented with the attitudes and perceptions of the stakeholders and that will contribute to a holistic understanding of the community perceptions on noise pollution. Ultimately, the study endeavour aligns with broader sustainability goals by offering empirical evidence that can guide policy formulation and operational adjustments. The research output may lead to targeted interventions like spatial planning regulations, noise reduction strategies and engaging community initiatives. This study presents the assessment of noise pollution levels of selected sawmills activities in Ogbia local government area of Bayelsa state, Nigeria. The research objectives were to determine noise pollution levels caused by sawmill workstation, evaluate the impact of the noise to industrial workers and general public. It aims to create a cordial relationship and coexistence between the well-being, environmental conservation and the industrial advancement of Ogbia Local Government inhabitants.

MATERIALS AND METHODS

The research is a combination of both experimental and computational approaches to comprehensively assess noise pollution arising from sawmill activities in Ogbia Local Government Area, Bayelsa State, Nigeria (Table 1). This hybrid approach is tailored to address the multifaceted nature of the research questions and act as a baseline for reference purposes. Reconnaissance surveys were carried out to enumerate the sawmill locations and their operational activities for easy accessibility. Fifteen sawmills were eventually selected in seven towns (Elebele – two locations, Emeyal – four locations, Ewoi – one location, Imiringi – four locations, Kolo – one location, Onuebum – one location, and Otuoke – two locations) of Ogbia. A high precision digital quality handheld Sound Level Meter (TES – 1350A Sound Level Meter) and digital Global Positioning System were used to measure the machine's noise levels in dBA and its longitude and latitude corresponding coordinates for the various sawmill locations. Figure 1 shows the map of the study area where data collection and measurement were taken.

Figure 1: Map of Ogbia L.G.A. showing the study area.

The sound level meter and the global positioning system are shown in Figures 2 and 3. The sound meter (TES -1350A) model has three major components such as a display screen, a microphone and electric circuit; with a frequency range of 30Hz to 12kHz and capable of measuring A-weighting system which is the focus of this research (soundExperts 821). The Noise Level Meter antenna was strategically positioned within each selected sawmill 1 meter above ground level. The ambient sound level in various sawmill workstations was noted before the machine was put on operation. Three readings were taken at each workstation of the sawmill industry with the machines in operation and the average value recorded as noise level in decibel. The global positioning system (GPS) are used to determine accurate locations for field sampling sites, recording the spherical coordinates expressed as latitudes and longitudes (geographical coordinates). Datums are recorded in degrees, minutes and seconds of arc. The Universal Transverse Mercator (UTM) projection coordinates are written using eastings and northings. A GPS unit can produce accurate, precise and reliable positional data (Garmin, 2000; TNL, 2002).
The noise pollution level was evaluated using equation (1) (Avwiri and Nte, 2003).

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

Where: Lnp is the noise pollution level, Leq is the sound level equivalent, K is a constant value = 2.56

and σ is the standard deviation of the acquired Leq values.

$$\sigma \text{ of ungroup data} = \sqrt{\frac{\sum(Leqi - Leq(m))*2}{N-1}} \quad (2)$$

Leq is the individual sound level equivalent, Leq(m) is the average sound level equivalent, N is the total number of measured data.

$$\text{Mean (Leq(m)} = \frac{\sum Leqi}{N} \quad (3)$$

Accumulated dose in percentage exposure can be expressed using equation (4)

$$D = \left(\frac{C_1}{T_1}\right) \times 100 \quad (4)$$

Where: C1 is the total length/ period of exposure and T1 is the reference duration for the particular noise level.

Figure 2: Digital sound level meter

Figure 3: global positioning system

RSULTS AND DISCUSSION

The results of the research the assessment of sound level generated by various sawmill workstation in Ogbia Local Government Area of Bayelsa State, Nigeria and comparing the measured sound level with worldwide permissible limit to ascertain its impact on human. Measurements were taken in fifteen sawmill locations and the average values recorded as shown in Table 2. Table 3 shows the calculated noise pollution level, while table 4 presents the estimated percentage accumulated dose level exposure. Figures 4 and 5 shows the noise pollution level (dBA) against location and percentage accumulated dose exposure against location respectively. The results obtained from this study are similar to other related research works such as (Prasanth *et al*., 2022) where all the results are above 80 – 85dBA which is the occupational exposure limits of National ambient sound quality index recommended by OSHA, but results obtained by (Betul and Nuray, 2021) shows a range of 41-72 dBA for traffic, school and hospital noise environment which are lower than the sawmill environment.

Table 1: Location of the sawmill sites

S/N	Site Code	Coordinates		Environment
1	OGB1	N4^{0}51’0.8.8627”	E6^{0}20’52.3457”	Commercial
2	OGB2	N4^{0}51’36.8558”	E6^{0}20’47.3471”	Administration
3	OGB3	N4^{0}50’08.8283”	E6^{0}21’01.3517”	Commercial
4	OGB4	N4^{0}50’08.8284”	E6^{0}21’01.3041”	Commercial
5	OGB5	N4^{0}50’28.7849”	E6^{0}21’09.3084”	Commercial
6	OGB6	N4^{0}50’28.8261”	E6^{0}21’09.3478”	Commercial
7	OGB7	N4^{0}47’14.0244”	E6^{0}18’8.3025”	Residential
8	OGB8	N4^{0}51’12.8419”	E6^{0}22’33.3522”	Residential
9	OGB9	N4^{0}52’31.8410”	E6^{0}22’41.30840”	Administration
10	OGB10	N4^{0}52’31.8594”	E6^{0}22’41.37607”	Residential
11	OGB11	N4^{0}51’12.8753”	E6^{0}22’33.3471”	Residential
12	OGB12	N4^{0}47’51.8566”	E6^{0}22’35.1470”	Commercial
13	OGB13	N4^{0}47’4.2832”	E6^{0}18’7.2937”	Administration
14	OGB14	N4^{0}47’24.5918”	E6^{0}18’50.7336”	Commercial
15	OGB15	N4^{0}47’26.50704”	E6^{0}18’53.29504”	Commercial

Table 2: Noise Levels at Sawmill Sites

Site Code	Locations	Noise Level (dB)
OGB1	Elebele	84.3
OGB2	Elebele	93.8
OGB3	Emeyal 1	97.3
OGB4	Emeyal 1	99.6
OGB5	Emeyal 2	100.4
OGB6	Emeyal 2	95.2
OGB7	Ewoi	98.0
OGB8	Imiringi	92.3
OGB9	Imiringi	100.4
OGB10	Imiringi	80.5
OGB11	Imiringi	99.2
OGB12	Kolo	99.2
OGB13	Onuebum	99.6
OGB14	Otuoke	96.7
OGB15	Otuoke	85.6

Table 3: Locations of the Selected Sites and their Noise pollution level (dB)

Site Code	Coordinates		Noise level (dB) Leg	Noise Pollution level
OGB1	N4^{0}51’0.8.8627”	E6^{0}20’52.3457”	84.3	100.71
OGB2	N4^{0}51’36.8558”	E6^{0}20’47.3471”	93.8	110.21
OGB3	N4^{0}50’08.8283”	E6^{0}21’01.3517”	97.3	113.71
OGB4	N4^{0}50’08.8284”	E6^{0}21’01.3041”	99.6	116.01
OGB5	N4^{0}50’28.7849”	E6^{0}21’09.3084”	100.4	116.81
OGB6	N4^{0}50’28.8261”	E6^{0}21’09.3478”	95.2	111,69
OGB7	N4^{0}47’14.0244”	E6^{0}18’8.3025”	98.0	115.21
OGB8	N4^{0}51’12.8419”	E6^{0}22’33.3522”	92.3	108.41
OGB9	N4^{0}52’31.8410”	E6^{0}22’41.30840”	100.4	116.81
OGB10	N4^{0}52’31.8594”	E6^{0}22’41.37607”	80.5	96.91
OGB11	N4^{0}51’12.8753”	E6^{0}22’33.3471”	99.2	115.61
OGB12	N4^{0}47’51.8566”	E6^{0}22’35.1470”	99.2	115.61
OGB13	N4^{0}47’4.2832”	E6^{0}18’7.2937”	99.6	116.01
OGB14	N4^{0}47’24.5918”	E6^{0}18’50.7336”	96.7	113.11
OGB15	N4^{0}47’26.50704”	E6^{0}18’53.29504”	85.6	102.01

Table 4: Accumulated Dose in Percentage Exposure

SITE	NL (dBA)	C_1 (hr)	T_1 (hr)	D (%)
OGB1	84.3	8	18.4	43.48
OGB2	93.8	8	4.6	173.91
OGB3	97.3	8	3.0	266.67
OGB4	99.6	8	2.0	400.00
OGB5	100.4	8	2.0	400.00
OGB6	95.2	8	4.0	200.00
OGB7	98.0	8	2.6	307.00
OGB8	92.3	8	6.1	131.15
OGB9	100.4	8	2.0	400.00
OGB10	80.5	8	27.9	28.67
OGB11	99.2	8	2.3	347.83
OGB12	99.2	8	2.3	347.83
OGB13	99.6	8	2.0	400.00
OGB14	96.7	8	3.0	266.67
OGB15	85.6	8	13.9	57.55

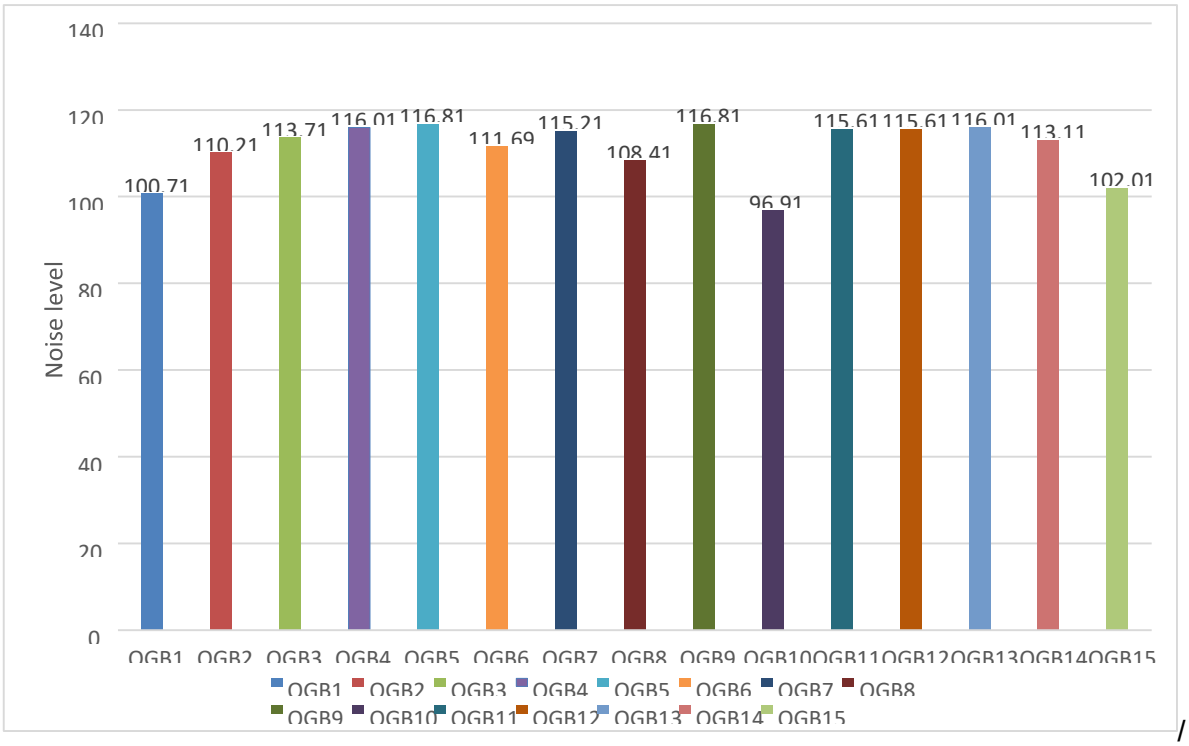

Figure 4: Noise pollution level against site

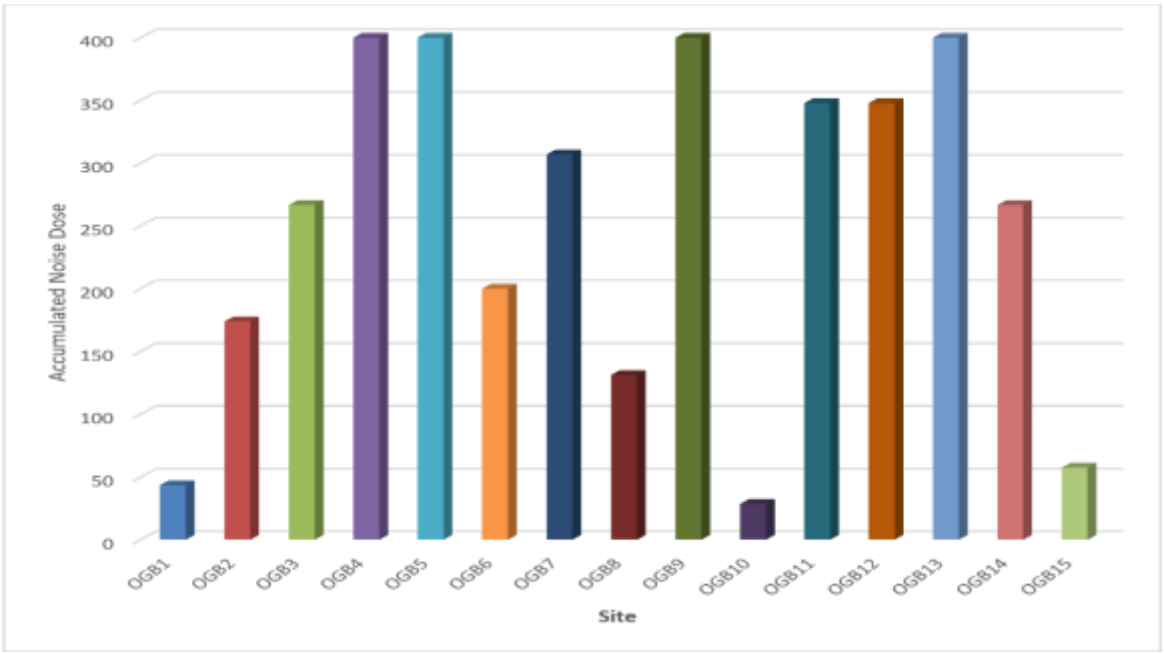

Figure 5: Accumulated dose in percentage exposure against location

The average measured noise level for the fifteen sawmill workstations ranged from 80.50 dBA in Imiringi (labelled - OBG10) to 100.40 dBA in Imiringi (tagged – OGB9). Apart from the average noise level of 84.30 dBA in Elebele and 80.550 dBA in Imiringi, all other values exceed Occupational Safety and Health Acts (2002) and World Health Organization (2004) recommended standard limit of 85.0 dBA 8-hour workstation for industry. The estimated noise pollution level for the fifteen sawmill workstations ranged from 96.91 dBA in location in OGB10 location to 116.81 dBA in OGB9 location. All the estimated noise pollution levels are higher than the OSHA and WHO permissible limit of 85.0 dBA. Table 4 shows the accumulated dose in percentage exposure for 8-hour workday period of exposure. The result obtained indicate that sawmill workstations OGB1 and OGB10 situated at Elebele and Imiringi Towns with percentage accumulated dose of 43.48% and 28.67% exhibit lower percentage dose. The noise quality indices such as Leq, Lnp and accumulated dose in percentage exposure values of the thirteen out of the fifteen sawmill workstations indicates unhealthy noise level. These values can affect the auditory system and health of industry workers. The high noise level recorded may be because of the obsolete machines that no longer have sound guard or soundproof. Noise as one of the types of pollution is not given its expected attention in society, thereby endangering the health and auditory system of factory workers. It is advisable that surveillance and medical tests ought to be performed regularly to industry workers to save future auditory health impact causes by sawmill noise pollution.

CONCLUSIONS

According to the present research findings, the noise levels measured in thirteen out of the fifteen sawmill workstations evaluated exceed the recommended occupational exposure limit of sound quality of 85.0 dBA as reported by OSHA (2002). Unlike the two sawmill workstations with lower noise level than the recommended limit of 85.0 dBA, the other machines are old and obsolete and demand urgent services and overhauling. Proper wearing of hearing protection equipment while operating the sawmill machine should be adhere to as none of the workers were wearing any personal protective equipment, thereby exposed to such high noise level for a longer period. Noise level between 90 dBA to 120 dBA as evaluated in this study may result to major communication problem and cause chronic hearing loss. This research work validates the relationship between hearing impairment of sawmill industry workers and sawmill workstation machine noise. Based on the findings of this study and OSHA recommendations: awareness and training should be organized regularly to educate and train workers, noise identification, assessment and prevention. Data from this study are useful baseline data for reference purposes and policy regulations and implementation. The sawmill industries should be located and established far away from residential areas and workers protected. In other words, more research should be conducted on other sawmill workstations within the state.

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