

Evaluation and Mapping of the Noise Levels in Oil Mill Market and its Environs, Port Harcourt, Nigeria

Abstract

Noise in market places can be a matter of public concern to traders and other close residents. Exposure to excessive noise has the ability to cause both physiological and psychological effects in humans. A systematic noise survey was conducted at different locations within Oil Mill Market and Eleme Junction in Port Harcourt, Rivers State, Nigeria. Modelling of noise levels within the market area is presented. A cumulative noise level of 108.6dB (A) was obtained along East-West Road between Oil mill market and Eleme junction; Eleme junction showed cumulative noise level of 105.4dB (A); also, Elelenwo by Oil-Mill market showed noise level of 103.8dB (A); while, Oil-Mill Market showed cumulative noise level of 108.2dB (A). Computed mean noise value is 109 ± 3 dB (A), computed Leq index is 123.6 ± 2.3 dB (A), while computed noise pollution level is 117.1dB (A). Findings showed that use of grinding machines and generators within the market accounted for 27% of noise within the market; mobile sellers contributed 26%; while vehicular movement along the East-West highway and Eleme junction constituted 19% of the noise produced in the area. High noise pollution prevails within the market environment with significant health effects on traders and the public. State and/or Local Governments should carry out awareness campaign among traders on the effects of noise on their health. Noise control by-laws or regulations should be enforced so as to regulate the activities of mobile advertisers or sellers.

Key words: Noise level, Oil Mill Market, Noise Pollution Levels, Cumulative noise, noise mapping

1. INTRODUCTION

Noise is one of the most common environmental pollutions often associated with anthropogenic activities [1] including industrial, commercial, institutional and recreational activities. Noise pollution constitutes environmental hazards and poses 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 [2]. Noise has been broadly categorized into residential, commercial and industrial type and regulated according to WHO and NESREA [3, 4]. Residential noise also known as domestic noise is generated at homes and residential environment, commercial noise are generated in business environment such as shops and market places, while industrial noise are generated within industrial environment through the use of equipment and machineries [5].

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 who are engaged in commercial activities within the market place and to residents located in close proximity to the market place. 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 (physiological, psychological and hearing loss) in humans [6]. People living at close proximity are sometimes disturbed by noise which originates from market places causing annoyance. Health effects associated with noise pollution can be classified into auditory (physiological) and non-auditory (psychological/sociological) effects [1, 7]. Auditory

or physiological noise effects include hearing impairment and other effects such as cardiovascular disorder, hypertension, release of adrenaline, mental health [8]. Research has shown that people exposed to noise level above 90 decibels are at risk of hearing loss [9]. Non-auditory or psychological/sociological effects of noise include Interference with speech communication, sleep disturbance, interference with learning process and annoyance [1, 7, 8, 10]. Individual's responses or reactions to noise are influenced by the susceptibility levels of the individual to sound level, frequency, duration of exposure and previous experience [7].

Several research studies have been carried out to assess and investigate noise levels in industrial areas[5, 11, 12, 13], road traffic [14, 15] and construction areas[6, 16], but little has been done to assess noise levels in market places. This study was therefore conducted to model and map noise levels in the Oil Mill Market and Environs in Port Harcourt, Rivers State, Nigeria; and to analyze its impacts on public health. There is inadequate research works on noise levels in market places in developing metropolitan city of Port Harcourt. It is based on this fact that this study was carried out on the popular Oil Mill market in Port Harcourt city order to evaluate and model noise levels within the market area and its environ. A study of noise levels in Abuja cosmopolitan in Nigeria has been carried out [10]; the study indicated that market place is the noisiest area in Abuja cosmopolitan and classified noise levels obtained in market places in Abuja as unsatisfactory.

2. MATERIALS AND METHODS

2.1 Study Area

Oil Mill market is a mid-week market located at Rumuchorlu Community in ObioAkor Local Government Area of Rivers State (Figures 1). The Oil Mill market is located within longitude E7° 03' 47.388'' and latitude N4° 51' 17.976''. The weekly market, which holds every Wednesday, attracts merchants from different parts of Rivers State and beyond [17]. Merchants from neighboring States such as Abia, Imo, Akwa Ibom and Anambra, also travel to the market to buy and sell goods [17]. The chaotic traffic jam the market causes every Wednesday constitute nuisance to free flow of traffic along the Aba/Port-Harcourt Road. The location of the market has also put the lives of merchants in the market at risk of noise pollution. On Market days, human traffic also creates noise nuisance along the flyover end of the popular Eleme Road where most of the merchants display their goods [17].



Figure 1: Map of Eleme Junction showing location of Oil Mill Market

Source: <http://wikimapia.org/9697092/Oil-Mill-Market>

2.2 Methods of Data Collection

Field measurement of noise levels at different locations around Oil Mill market and Eleme Junction was conducted on the 3rd, 7th, 10th and 11th of August 2016. A systematic monitoring of noise levels was carried out at each location within the market area. Monitoring was carried out at pre-determined locations within and outside the market and its environs using Smart Sensor (Model AR854) and TES (Model 1352H) sound pressure level meters which give instant, real time readings according to regulatory noise measurement standards. The instruments were set on the A-weighting scale and fast response. Measurement of sound pressure levels was carried out for 8 hours (15-minutes average sampling). Measurement instruments were placed between 3 to 10 high above the ground in accordance with ISO 9613 noise measurement procedure [18]. Values of sound pressure levels at each monitoring location were obtained and recorded. Four sets of readings were taken at each location to cover minimum and maximum values and a total of 112 data sets were obtained for the study. This forms the basis of noise levels evaluation, analysis and modeling/mapping presented in this paper. Traffic count was also carried out as part of the overall field survey. A method of visual counting was employed for traffic count of vehicular movements around the market area. Two directions of traffic flow were considered in the traffic count exercise to cover the entire intersect of the Oil mill market and Eleme junction (Figure 1). Measured noise levels within the market area and its environs were compared with Federal Ministry of Environment (FMEnv) stipulated permissible limit as contained in FEPA [19]. While, computed noise averages, Equivalent continuous equal energy level (Leq) and Noise pollution levels (Lnp) were compared with World Health Organization (WHO) and National Environmental Standards and Regulatory Enforcement Agency (NESREA) standards.

2.4 Regulatory Framework

2.4.1 National Regulatory Documents

Noise regulation in Nigeria is covered in National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35. The main objective of the provisions of this Regulation is to ensure tranquility of the human environment or surrounding and their psychological well-being by regulating noise levels (NESREA, 2009). Permissible noise exposure limits in Nigeria is shown in Table 1.

Table 1: Nigeria Noise Exposure Limits

Duration	Permissible Exposure Limit dB(A)
Day Hour	
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115
Source: FEPA, 1991	

Source: [20]

2.4.3 WHO Noise Guidelines

WHONoise Guidelines prescribe noise levels for the day and night periods are presented in Table 2.

Table 2: WHO Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 – 22:00	Nighttime 22:00 – 07:00
Residential; Institutional, Educationl	55	45
Industrial; Commercial	70	70

Source: [21]

3. RESULTS AND DISCUSSION

Result of field measurement on day 1 in comparison with FMEnv limit is shown in Figure 2. A minimum noise value of 75.1dB (A) was recorded around Elelenwo by Oil-Mill Junction area; while a maximum noise value of 105.1dB (A) was obtained around Oil-Mill Market Point 1 area. Result showed that maximum noise levels, L_{max} , for all monitoring points within the Oil mill market and Eleme junction exceeded FMEnv limit (Figure 2). The maximum noise level obtained during monitoring exceeded regulatory standard by 17%. Prolong exposure to this level of noise could lead to hearing impairment among merchants in the market.

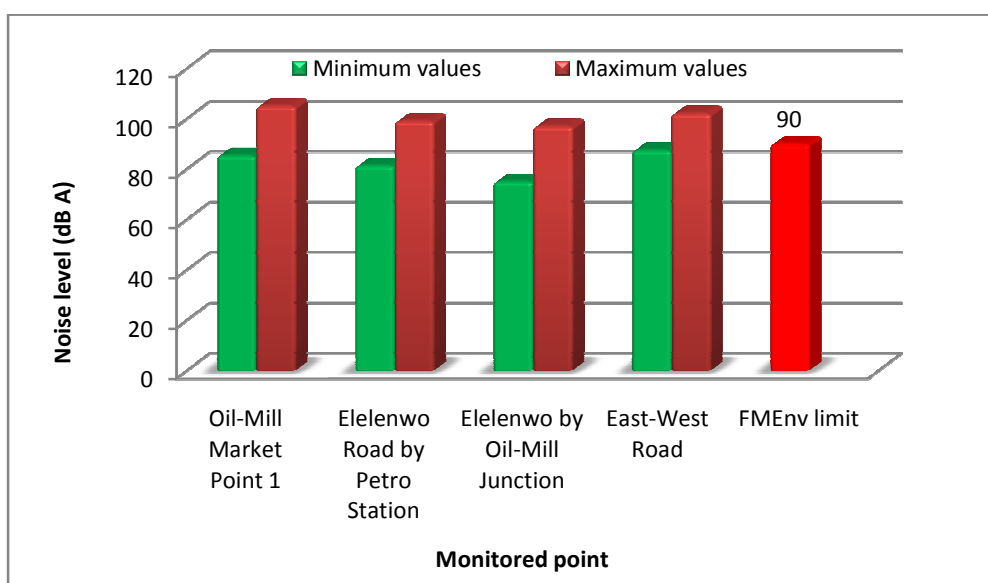


Figure 2: Minimum and maximum Noise levels on Day 1 in comparison with FMEnv limit

Noise levels measured on day 2 in comparison with FMEnv limit are shown in Figure 3. A minimum noise level of 73.5dB (A) was measured around Market Boundary with Rumukwurushi town; while a maximum level of 102.1dB (A) was recorded along East-West Road between Oil mill market and Eleme junction. Minimum noise levels, L_{min} are below FMEnv limit, while maximum noise levels exceeded FMEnv limit at all monitoring points within the market (Figure3). The maximum noise level obtained during monitoring exceeded

147 regulatory standard by 14%. This noise level may negatively affect the health of traders in the
 148 market who are exposed for a long period of time.
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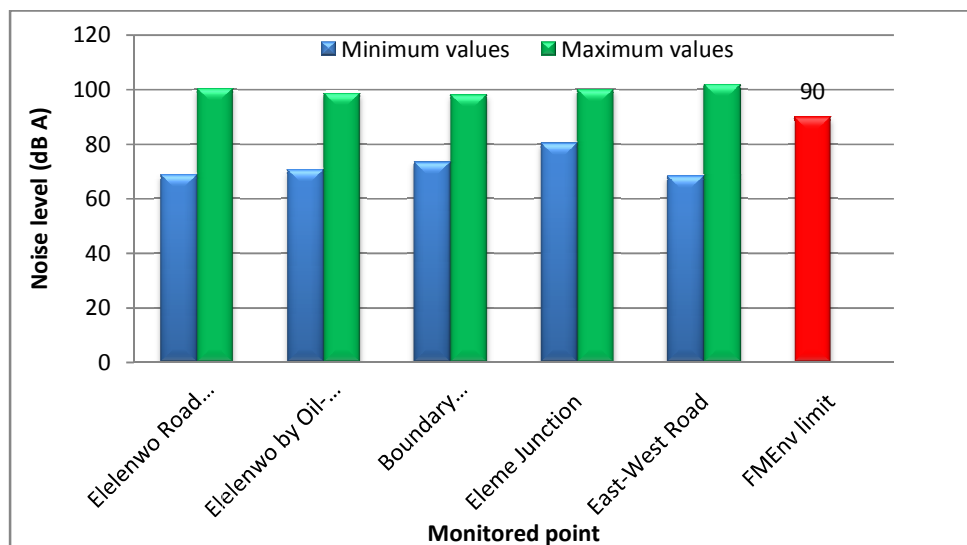


Figure 3: Minimum and maximum Noise levels on Day 2 in comparison with FMEnv limit

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 154 Results of noise levels monitored on day 3 in comparison with FMEnv limit are presented in
 155 Figure 4. A minimum noise value of 71.1dB (A) was obtained around Elenwo by Oil-Mill
 156 Junction area; while a maximum noise value of 108.3dB (A) was measured around Oil-Mill
 157 Market Point 2 area. Minimum noise value recorded at Oil Mill market point 2 was 93.5dB
 158 (A) and exceeded FMEnv limit by 3.9%, while maximum noise values recorded at all
 159 monitoring points far exceeded the prescribed limit (Figure 4). This poses serious health
 160 implications on those doing business in the market area.

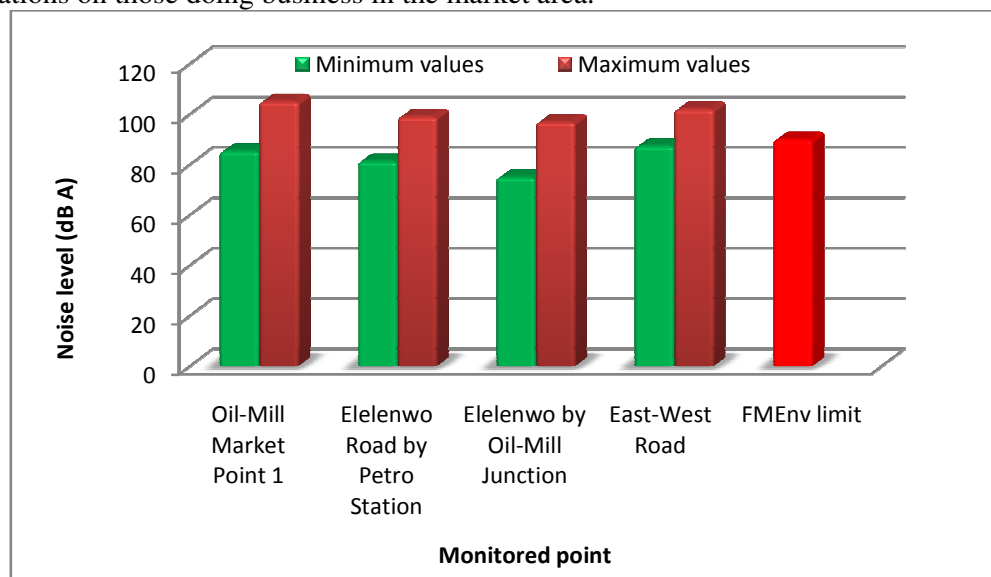


Figure 4: Minimum and maximum Noise levels on Day 3 in comparison with FMEnv limit

Noise levels recorded on day 4 in comparison with FMEnv limit are shown in Figure 5. A minimum noise value of 71.0dB(A) was measured around Elenwo Road by Petro Station; while a maximum noise value of 103.6dB(A) was recorded along East-West Road between Oil mill market and Eleme junction. This value exceeded regulatory limit by 15.1%. Minimum values, L_{min} are below FMEnv limit, while maximum values, L_{max} exceeded FMEnv limit at all monitoring points within the market (Figure 5). These noise levels lasting for a long time could pose serious health effects on those doing business in the market.

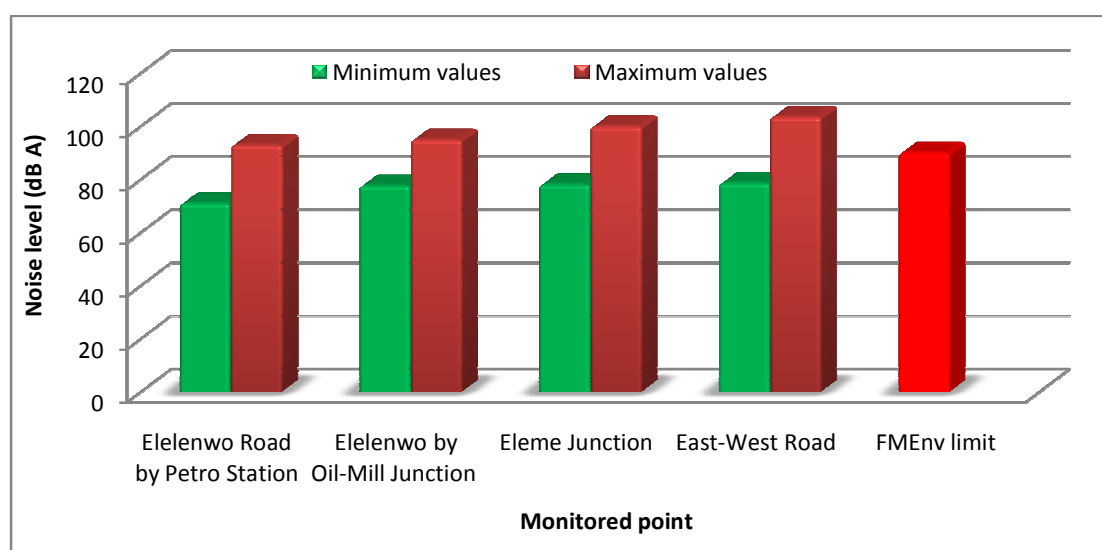


Figure 5: Minimum and maximum Noise levels on Day 4 in comparison with FMEnv limit

Cumulative noise levels for all monitoring points in the market in comparison with FMEnv limit are shown in Figure 6. The cumulative noise levels far exceeded the stipulated limits in all monitoring points within the market area. High noise levels of this magnitude is very hazardous and may pose significant health risks to traders and all those who spent more time doing business in the market area.

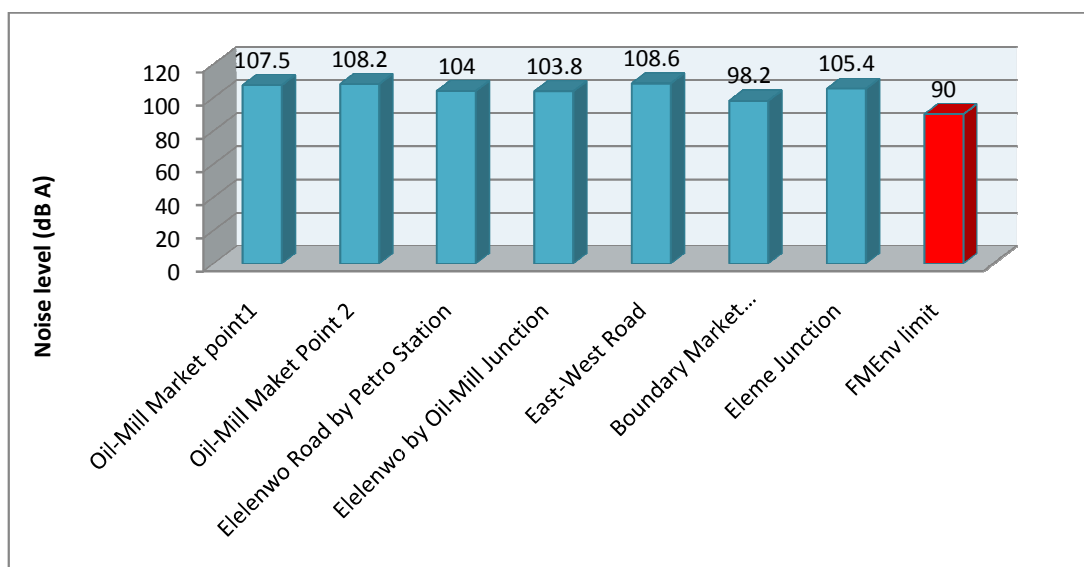


Figure 6: Cumulative Noise levels in comparison with FMEnv limit

Equivalent continuous equal energy level (L_{eq}) and Noise pollution levels (L_{np}) showed the degree of noise pollution prevailing in the market area. Computed Average noise level, L_{avg} , and Equivalent Continuous Equal Energy level, L_{eq} for the market far exceeded both NESREA and WHO permissible exposure limits of 75dB (A) and 70dB(A) respectively for commercial environment as shown in Table 3 and Figure 7. Total L_{eq} value of 123.6 ± 2.3 dB (A) exceeded NESREA limit by 64% and WHO permissible limit by 75.71% and is ranked very high based on standards. L_{eq} value of this magnitude constitutes noise hazard and accordingly, traders doing business should not expend more than 2 hours in the market, however, it is observed that majority of the traders spent up to 12 hours in the market and are not aware of the deleterious effects of noise pollution on their health.

	Lavg	Leq	WHO limit	NESREA limit	Lnp	EF	Noise Rating	Impact/Risk Ranking
Day 1	101.4	116.9	70	75	122.9	1.67	Very high	Significant
Day 2	100.1	116.2	70	75	116.2	1.66	Very high	Significant
Day 3	102.6	120.3	70	75	120.3	1.72	Very high	Significant
Day 4	98.9	114.8	70	75	114.8	1.64	Very high	Significant
Total	109±3	123.6±2.3	70	75	117.1			

Table 3: Computed Average noise level, L_{avg} , L_{eq} and L_{np}

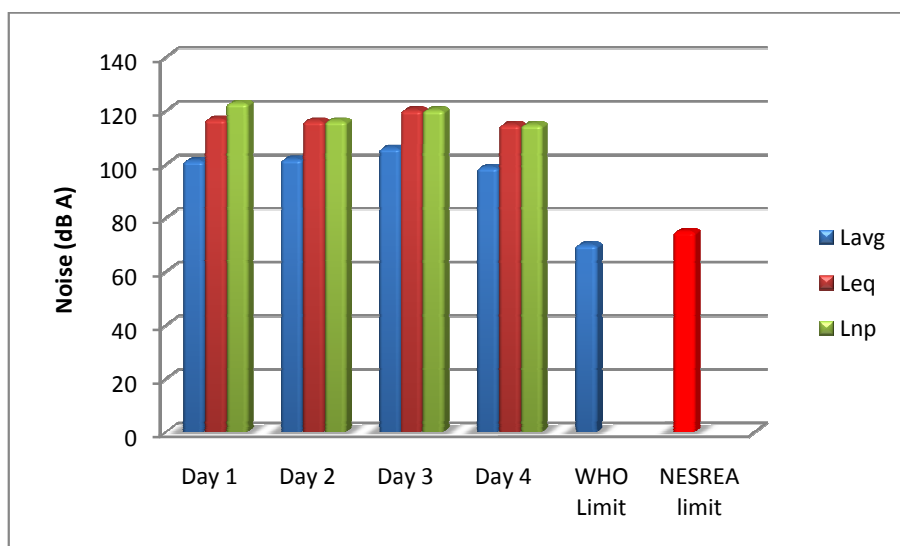


Figure 7: Computed Lavg, Leq and Lnp in comparison with NESREA/WHO Limit

3.1 Sources of noise in the market

Main sources of noise around the market and its environs were identified and rated as presented in Figure 8. Mobile sellers (music record sellers, herbal medicine sellers and telecom equipment sellers) all used public address system/megaphone to advertise or announce their products and constituted 26% of noise produced in the market; Horns from cars and heavy duty trucks on traffic constituted 19%; Sirens from security vehicles which produce loud wailing sounds constituted 8%; use of grinding machines and generators within the market constituted major source of noise and accounted for 27%; sellers shouting to draw people's attention to their products constituted 13% of the commercial noise, while other sources such as people loading commercial vehicles accounted for 7% of the noise monitored in the market area.

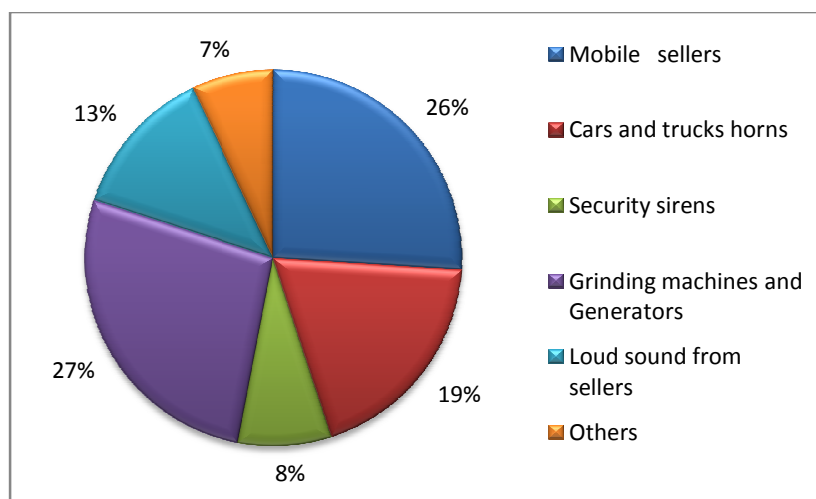


Figure 8: Percentage contribution of each noise source in the market

3.2 Traffic Flow count around the market area

Traffic flow around the market area was assessed to determine the contribution of vehicular movement to total noise production in the market place. Total volume of traffic recorded on day 1 was 26776 with a mean value of 3347 and an average speed of 10km per hour (Figure 9). Total volume of traffic flow counted on day 2 was 8192 with a mean value of 1024 and an average speed of 46 km per hour (Figure 9). Today volume of traffic on day 3 was 24899 with a mean value of 3112 and an average speed of 11Km per hour. While the total number of vehicle counted on day 4 was 22959 with a mean value of 2870 and an average speed of 20 km per hour. Heavy duty vehicles contributed an average of 37% of total traffic flow in the area. While light vehicles (cars and buses) constituted majority (an average of 63%) of the vehicles counted in the study area. It was observed that vehicular movements in the area are not quite evenly distributed with time; this may be due to the prevalence traffic congestion in the Oil mill market and Eleme junction from morning till evening time. It is discovered that percentage of heavy vehicle has great significance influence on noise levels in the study area.

Generally, Figures 8 to 10 indicated that the Oil Mill market experienced heavy vehicular traffic and contributed 19% to the high noise levels obtained in the market area (Figure 8). The high volume of vehicular traffic around the market area is expected because the market is located around the major Eleme junction and often witness heavy traffic.

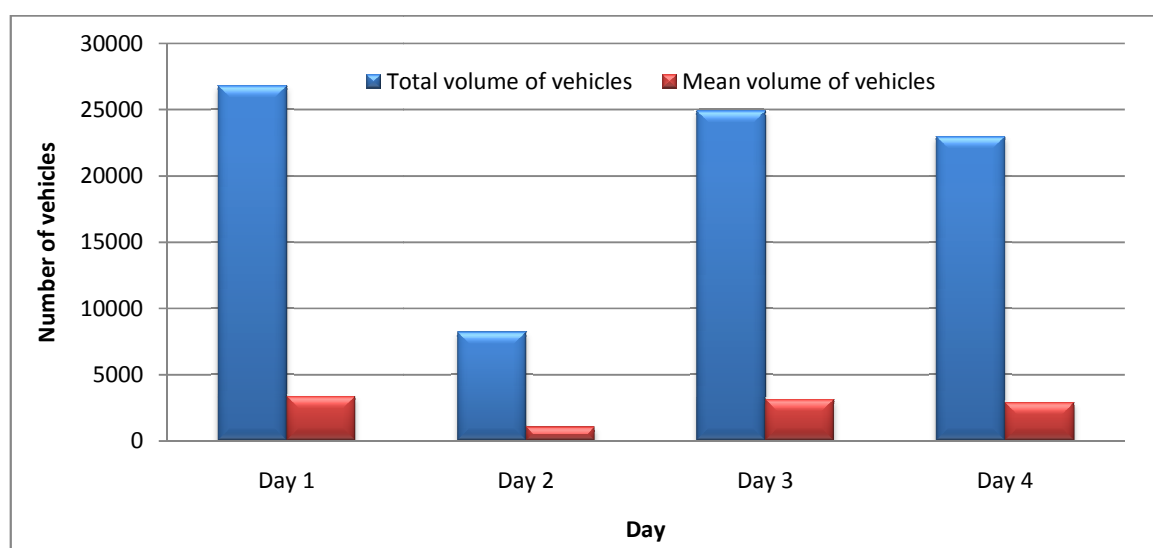


Figure 9: Total and Mean volume of Vehicles

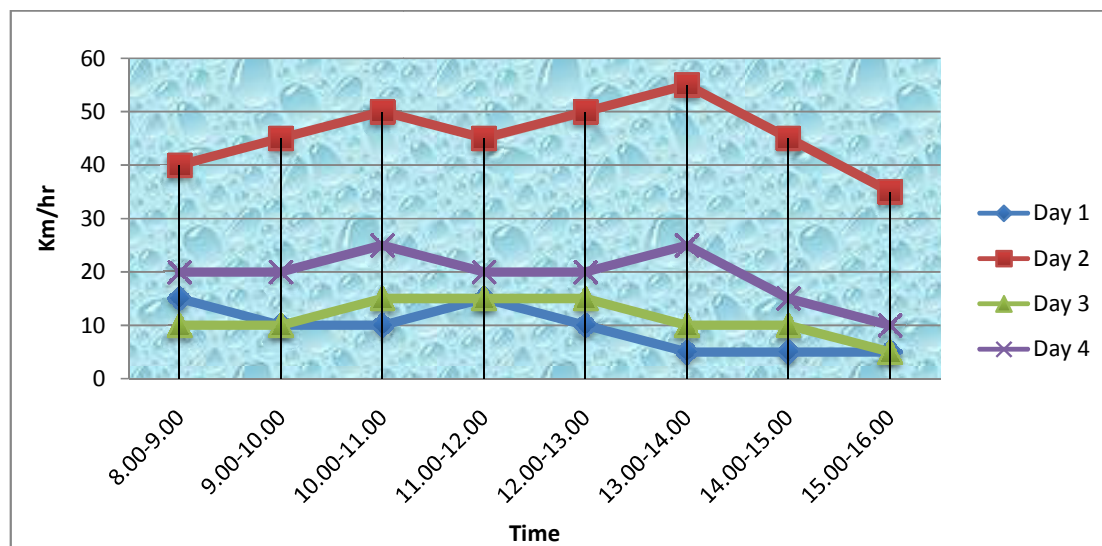


Figure 10: Average speed of vehicles (Km/Hour)

3.3 NOISE MAPPING/MODELING

A model showing noise mapping of the study area is presented in Figure 11. The model showed high noise level within the Oil-Mill Market as indicated by the red colour band contour of the map. A cumulative noise level of 108.2dB (A) was obtained indicating that there is high noise pollution within the market area. These noise levels were caused mainly by use of several grinding machines and generating sets within the market. High noise level up to a cumulative value of 108.6dB (A) was also obtained along East-West Road between Oil mill market and Eleme junction as indicated by red/orange colour band contour. This was caused mainly by sirens from security vehicles and sounds from vehicle's horns as well as loud shouts sound from traders along the road. Cumulative noise level around Eleme junction was high, up to 105.4dB (A) as indicated by light orange colour band contour. This was caused by a combination of people loading commercial vehicles, security vehicles and sounds from vehicle's horns. Area around Elelenwo by Oil-Mill Junction also has high cumulative noise level up to 103.8dB (A) as indicated by the yellow colour band contour. This was also caused by sirens from security vehicles and sounds from vehicle's horns as well as loud shouts sound from traders along the road. The noise levels decreased towards Market Boundary with Rumukwurushi town as indicated by the dark green contour on the model.

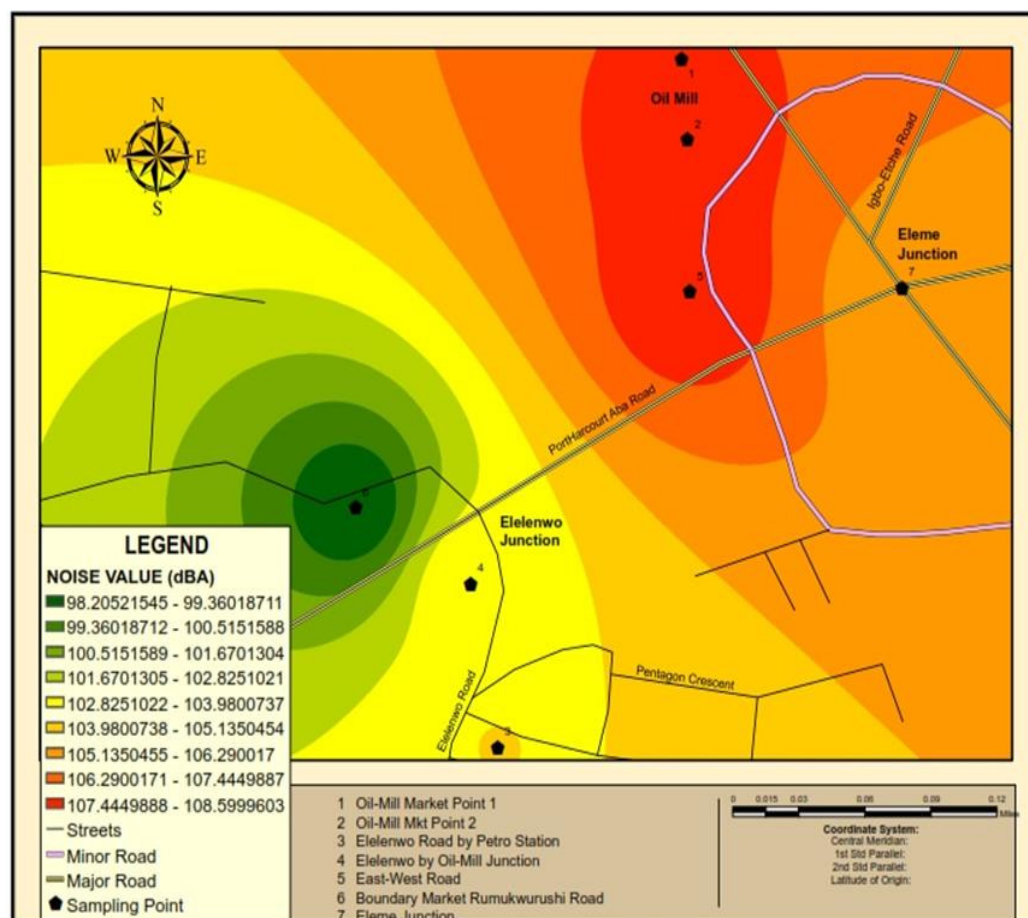


Figure 11: Noise mapping/modeling of the market area

3.4 STUDY FINDINGS

The competitive natures of commercial activities among merchants in the Oil mill market generated enormous noise. Noise is common among merchants in the market and serves as a key factor in attracting customers' attention. Shouting, ringing of bells, use of public address systems (mobile and fixed) are common among merchants as means of getting at customers. Modeling of noise levels showed very high noise levels prevail in the oil mill market area which decreases towards Rumukwurushi town. Study revealed that people doing business within the study area are exposed to very high noise levels with significant risk of Noise Induced Hearing Loss as well as other physiological and psychological noise effects. Also, some risks of psychological effects are envisaged among people living in close proximity to the market, especially residence of Rumukwurushi town.

4. CONCLUSION

The following conclusions are drawn based on results of field measurements and data analysis.

Result showed that maximum noise levels for all monitoring points within the Oil mill market area and Eleme junction exceeded FMEnv limit.

Computed Leq and noise pollution levels, Lnp showed noise values that far exceeded NESREA and WHO exposure permissible limits.

Results showed that percentage (%) of heavy vehicle has great significance influence on noise levels in the study area.

The traders in the market are at risk of Noise-Induced Hearing Loss and Hearing Acuity that may result in temporary or permanent noise-induced threshold shift (NITS). Results of noise mapping showed noise levels are very high within the market area and decreased towards Rumukwurushi town.

Significant risk of noise induced hearing impairment may exist among traders and other people who spent more than 2 hours in the market environment.

5. RECOMMENDATIONS

State and/or Local Governments should carry out awareness campaign among traders on the effects of noise on their health.

More by-pass roads should be created to divert vehicles from the main Eleme junction. This will reduce the volume of traffic in the study area.

Noise control by-laws or regulations should be enforced so as to regulate the activities of mobile advertisers or sellers.

Traders who intend to spend more than two hours in the market should be encourage to use ear protection device.

REFERENCES

1. Mackenzie L. D. and David A. C. (2008): Introduction to Environmental Engineering. McGraw – Hill Companies, Inc; New York, 4ed.
2. WHO (2005); United Nation road safety collaboration: a hand book of partner profiles. Geneva: World Health Organization; pp 1-5.
3. WHO (1999); Guidelines For Community Noise. World Health Organization, Geneva Cluster of Sustainable Development and Healthy Environment (SDE)
4. NESREA (2009); National Environmental (Noise Standards and Control) Regulations,
5. Agbalagba, E.O Akpata, A.N.O; Olali S.A. (2013); Investigation of Noise Pollution Levels of Four Selected Sawmill Factories in Delta State, Nigeria. J. Advances in Applied Acoustics (AIAAS) Volume 2 Issue 3. www.aiaas-journal.org
6. Ugbebor J. N., Raphael, Yorkor B., (2015a); Evaluation of Construction Noise at Selected Highway Road Construction Sites in Urban City of Port Harcourt and Its Effects on Residential Environment. Journal of Environmental Science, Computer Science and Engineering & Technology, Sec .A Vol.4.No.2, 0000-0000, pp 1-10.
7. Toronto Public Health (2000); Health Effects of Noise. Toronto: City of Toronto..
8. Talbott, E., and Thompson, S.J. (1995). Health effects from environmental noise exposure. In Introduction to Environmental Epidemiology. pp. 209-219. New York: Lewis Publishers.
9. Thompson, S. (1996). Non-auditory health effects of noise: Updated review. Proceedings of Internoise, 2177-2182.
10. T. Ibekwe, D. Folorunso, A. Ebuta, J. Amodu , M. Nwegbu, Z. Mairami, C. Okebaram, C. Chimdi , B. Durogbola , H. Suleiman, H. Mamven, I. Liman, N. Baamlong; E. Dahilo; I. Gbujie, P. Ibekwe and O. Nwaorgu (2016): EVALUATION OF THE ENVIRONMENTAL NOISE LEVELS IN ABUJA MUNICIPALITY USING MOBILE PHONES. Annals of Ibadan Postgraduate Medicine. Vol. 14 No. 2, pp 58-64
11. Koehnck N. K., (1999); An investigation of noise levels in Alberta sawmills. Edmonton, Alberta, University of Alberta

- 345 12. Ebeniro, J.O and O.E., Abumere, (1999); Environmental noise assessment of an
346 industrial plant. Nig. J. Physics 11:40-45.
- 347 13. Ugbebor J. N. and Yorkor, B., (2015); Assessment and Evaluation of Noise Pollution
348 Levels in Selected Sawmill Factories in Port Harcourt, Nigeria. International Journal
349 on Emerging Technologies 6
- 350 14. K. Rawat, V.K. Katiyar and Pratibha; Mathematical Modeling of Environmental Noise
351 Impact. Indian Journal of Biomechanics: Special Issue (NCBM 7-8);
- 352 15. Ugbebor J. N., Raphael, Yorkor B., (2015b); Measurement and Evaluation of Road
353 Traffic Noise in Three Selected Junctions in Port Harcourt Metropolitan,
354 Nigeria. Journal of Environmental Science, Computer Science and Engineering &
355 Technology, Sec .A Vol.4.No.2, 0000-0000, pp 1-10.
- 356 16. Hamoda M. F., (2008); Modeling of Construction Noise for Environmental Impact
357 Assessment Journal of Construction in Developing Countries, Vol. 13. No. 1,
- 358 17. Edozie V., (2016); "Oil Mill: Port Harcourt's risky mid-week market". Daily Trust,
359 <http://www.dailytrust.com.ng/>
- 360 18. NSW (2000) "New South Wales Industrial Noise Policy" " Published by
361 Environment Protection Authority, 59- 61 Goulburn Street Sydney South NSW 1232.
362 ISBN 0 7313 27152
- 363 19. FEPA (1991): "Guidelines and Standards for Environmental Pollution Control in
364 Nigeria". Federal Ministry of Environment, Nigeria.
- 365 20. Patrick, N. B. and Peter, S. J.L. (2006); Noise. Johns Hopkins Bloomberg School of
366 Public Health, Johns Hopkins University
- 367 21. IFC (2007); "Environmental Health and Safety (EHS) Guidelines - General EHS
368 Guidelines: Environmental Noise Management " General EHS Guidelines.
369 International Finance Corporation, World Bank Group [Complete version] at
370 www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.