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The Spatio-Temporal Distribution of Noise Island within the Campus of Cross River University of Technology, Calabar, Nigeria

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Abstract A study to determine the spatio-temporal distribution of Noise Island within the campus of Cross River University of Technology, Calabar, Nigeria, was carried out. Bam and Kom (BK) precision (732) digital sound level meter was used to measure noise level within the campus. The campus was divided into six zones; the campus main gate, student's centre, administrative block, ETF block, engineering workshop, and campus staff quarters. Data were collated and analyzed on daily basis and average for six weeks. The following noise levels were recorded; campus main gate (92.37dB), student's center (85.30dB) administrative block (80.89dB), ETF block (76.39dB), Engineering workshop (91.38dB) and campus staff quarters (53.23dB). A Simple bar chart was used to compare noise level of working days with a non-working day. Results show that on the average, noise level in most zones are above WHO standard.

Keywords noise level, noise island, WHO Standard, decibel, spatial distribution

Introduction

Noise is an unwanted sound that constitutes nuisance to the environment [1]. Noise pollution ranks third as the most hazardous form of pollution behind air and water pollution [2]. Over the years, environmental pollution was thought of being within the purview of poisonous substances being introduced into the environment. Skimpy attention was paid to noise as a form of pollution with the earlier belief that noise differs from other forms of pollution in that, noise leaves no residual accumulation in the environment or the human body [3]. The spurious belief that noise leaves no evidence has been discredited by various researches which has proven the damaging effect of noise [4-8].

Due to technological advancement, urbanization and population growth, it has been agreed by researchers that noise pollution is increasing in magnitude and severity [9-10]. Consequently, some studies have summarily termed noise pollution as a modern plague [10-11].

Noise pollution contributes to environmental debasement and constitutes a threat to life. Common sources of noise pollution include road, railway, air traffic, construction works, churches and mosques, highly amplified music from record shops, electricity generating plants, bell rung constantly by peddlers, hawkers and other salesmen to advertise their wares. Also, noise from industrial work places constitutes industrial noise pollution [12-14]. Noise remains a hassle with negative consequences on the physical, social and psychological wellbeing of man. A short period subjection to more than 90 dB can instantly damage the ear. Tiny hairs in the hearing mechanism are destroyed and can never grow again.

Noise aggravates chronic illnesses like hypertension, increase in cholesterol level, slow sleep breathing, increase in gastrointestinal mobility, diastolic pressure, decrease in salivary and gastric secretion, urinary ketosteroid, temporary and permanent hearing loss, acoustic trauma, ossicular chain dislocation, tympanic membrane perforations and other cardiopulmonary diseases [15-18].

Recent studies have discovered the relationship between noise and cardiovascular disease (CVD) with the causal route attributed to neuroendocrine alterations accompanied by aggravated release of cortisol and catecholamine. Furthermore, persistent exposure to noise has been associated with hyperlipidemia which is a corollary to hypertension [19-21]. Sleep disturbance, annoyance and anxiety, let down in workers' productivity, stress in learning process and disorders are also well studied adverse effects of noise [22-24].

Establishing a functional enforcement programme requires a firm commitment on the part of the Government and a stable leadership in the enforcement agency [25]. Many countries do not have regulations/legislation on noise pollution due to lack of the political will or the insight into its harmful effect on environmental life and the ecosystem. On the other hand, the associated difficulty in defining, evaluating and devising control measures for environmental noise, especially those of neighborhood, has been observed as a dampening factor towards an effective control [26].

A tertiary institution is a centre of excellence whose aims and objectives are researching, teaching and public service. This can only be achieved in a healthy environment. However, an increase in the number of admitted students, coupled with economic activities within the campus has resulted in its overcrowding [27], making the environment noisy due to noise from generators, business centres, cars, hawkers and students themselves and these has led to difficulty in learning, researching and teaching.

[28] studied urban environmental noise pollution and perceived health effects in Nigeria while noise pollution and perceived health challenges among Lagos residents was x-rayed by [29]. With the upsurge in the menace of noise, it is necessary to conduct a detailed acoustical survey that will form the basis of noise control in Cross River University of Technology, Calabar.

Noise Islands as being used in this research are simply noise spurs or distinct noise levels at different spatial locations, caused by varying social, cultural, religious and economic activities. Noise is derived from the Latin word "nausea" implying unwanted sound or sound that is loud or unexpected [30]. The term, "island" has been used concertedly with another term, "heat" in several urban heat studies to refer to the distribution and the intensity of heat in a metropolitan area [31-35]. Therefore, Noise Islands as being used in this research are simply noise spurs or distinct noise levels at different spatial locations, caused by varying social, cultural, religious and economic activities.

This research investigates the spatio-temporal distribution of noise islands in the campus of Cross River University of Technology, Calabar, due to perceived updates in the configuration of the campus dynamics.

Materials and Methods

A study to determine the spatio-temporal distribution of Noise Island within the campus of cross River University of Technology, Calabar, Nigeria, was carried out.The experimental apparatus used in the recording of noise levels consisted of a BK Precision 732 Digital Sound Level Meters. It is equipped with 4 digits Liquid Crystal Display (LCD), a condenser microphone and an octave filter. During measurements, the microphone was positioned in such a way as not to be in acoustic shadow of any obstacle in the field of the reflected waves. It has a resolution of 0.1 dB and an update cycle of 0.5 second. The system provides 30 to 130dB capability in three convenient measurement ranges. The ranges are Low (30 to 80 dB), Medium (50 to 100 dB) and High (80 to 130 dB), with an accuracy of ±1.5 dB. The meter meets the International Electrotechnical Commission (IEC) 651 Type II standard and includes frequency weighting of A and C and fast and slow time weighting. The A-weighting was used because of its recommendation for environmental and industrial studies [36].

Bam and Kom (BK) precision (732) digital sound level meter was used in the measuring of noise level within the campus. The campus was divided into six zones; the campus main gate, students Centre, administrative block, ETF block, engineering workshop, and campus staff quarters. Data were collated and analyzed on daily basis and average for six weeks. The following noise levels were recorded; campus main gate (92.37 dB), student's center (85.30 dB) administrative block (80.89 dB), ETF block (76.39 dB), Engineering workshop (91.38 dB) and campus staff quarters (53.23 dB). A Simple bar chart was used to compare noise level of working days with a non-working day (Sunday). Results show that on the average, noise level in most zones are high above WHO standard.

Results & Discussion

In this study, data is made up of noise level reading from line source such as traffic noise and point sources such as commercial sites, loudspeakers, generators, and machines. All noise values were expressed in the decibel (dB) scale.

Table 1: Noise level in the different zones within the campus of the University

NOISE LEVEL IN DECIBEL (dB)									
Locations	**Time**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Average**	**Sunday**
School Gate	Morning	92.50	96.60	96.10	95.20	96.00	94.40	95.15	85.20
	Afternoon	97.20	97.00	97.80	98.20	98.40	95.70	97.21	78.80
	Evening	89.00	79.60	82.00	85.00	85.70	87.20	84.75	75.40
Students Center	Morning	83.30	82.60	84.90	83.80	82.00	83.10	83.21	70.60
	Afternoon	87.90	85.30	86.30	87.10	85.20	83.10	83.21	72.60
	Evening	89.90	84.90	88.40	90.30	92.00	88.00	89.47	74.70
Administration Block	Morning	82.90	84.30	85.50	84.20	84.10	83.10	84.02	74.50
	Afternoon	87.30	86.10	85.20	66.70	87.70	85.00	86.33	77.60
	Evening	72.80	73.30	71.50	73.00	72.40	70.40	72.32	66.90
ETF Block	Morning	78.70	81.00	82.40	79.50	78.50	75.40	79.25	60.90
	Afternoon	77.20	75.00	76.40	75.50	76.90	74.00	75.83	64.00
	Evening	77.00	74.90	74.60	75.00	73.30	71.20	74.08	59.90
Engineering Workshop	Morning	92.30	91.90	92.90	90.40	93.00	91.90	92.07	65.40
	Afternoon	97.20	96.40	97.00	95.90	96.00	91.90	95.73	67.90
	Evening	87.80	87.00	86.40	83.90	86.30	84.70	86.35	62.70
Staff Quarters	Morning	50.70	51.40	54.20	52.30	54.00	50.20	52.13	50.70
	Afternoon	51.80	51.90	55.00	53.20	54.90	50.90	52.95	49.70
	Evening	54.20	54.00	42.10	51.10	55.70	56.80	54.62	49.90

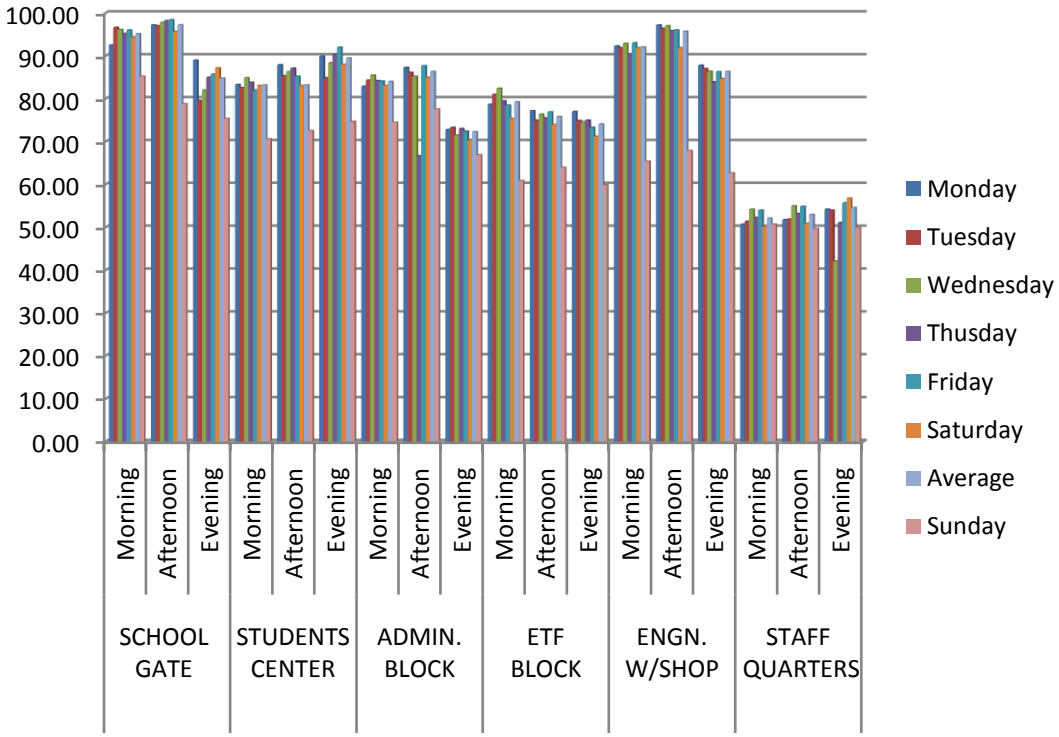

Figure 1: Bar chart representing results of noise level

Table 1 shows data recorded for the various zones during week days, divided into morning, afternoon and evening hours.

At the campus main gate, noise level were high throughout the period of measurement. On the average, morning hours recorded 95.15dB, afternoon hours 97.21 dB and evening hours 84.75dB. The high noise level was due to vehicular movement and car horns at the gate, picking and dropping staff and students. Generator noise from nearby commercial centres by the school gate contributed to the noise. At evening, noise level reduced due to less vehicular movement in and out of the gate and closure of business centres by the school gate.

The noise level at the student's centre was 83.21dB, mainly due to commercial activities in the centre. This built up to 89.47dB in the evening when students were back from classes and recreational activities are on (social and religious).

The administrative that is supposed to be quiet as the focal point of the campus was rather noisy because of its proximity to the school gate. Noise from the school gate was heard from the administrative block. The morning hours recorded noise level of about 84.02dB due to vehicular movement in and out of the campus. In the afternoon, noise level increased due to noise from fans and air- condition units from the offices and from the gate when all the activities are at its peak. This noise decreased in the evening at close of work. At this time, commercial centres by the school gate are closed.

The ETF block comprises of most of the lecture halls in the campus. In the morning hours when lectures are on-going, the noise level rose to 79.25dB. In the evening, the noise level dropped to 75.38dB. Most of this class rooms lack acoustical design. The classrooms have no doors and windows, hence no control mechanism. Noise from the classroom surroundings entered the class rooms, causing distractions and making it difficult for students to hear their lecturers.

The engineering block has a workshop for the faculty of engineering which comprises of Mechanical, Electrical, Civil and Wood and Paper Product engineering workshop. Results show that this zone is very noisy, with noise level of 92.07dB in the morning and 95.73dB in the afternoon when students are carrying out practicals with machines in the workshop.

The staff quarters had a low noise level. In the morning, the noise level was about 52.13dB. This noise was generated from vehicular movement of staff going to work. The afternoon was mostly quiet because most staff were in their offices but at the evenings, a slight noise increase of about 59.90dB were recorded because most staff are back from their offices, increasing human activities.

Sunday is a non-working day with no lectures, no staff in the offices, no practical conducted in the workshops. On Sunday, noise at the campus main gate drops from 95.15dB to 85. 20dB in the morning hours. This is due to less vehicular movement and commercial activities at the gate. But churches around the gate are responsible for the high noise level of 85.20dB. In the afternoon when church have dismissed, noise level dropped to 78.80 and 75.40dB in the evening.

Noise at the student centre reduces when compared to week days. In the morning when student are out for their Sunday workshops the noise level is 70.60dB compared to 83.21dB during week days. This is due to increase in social activities, club meeting etc. Noise level at the administration block is found to be high on Sunday but not to be compared during the week days.

In the morning, noise level at the administrative block is about 74.50dB, because of activities at the main gate. The drop in noise as compared to that of week days is due to less vehicular movement, no noise from school generating plants near the administrative black, no air conditioner and fans. These reduced in the afternoon and evening hours to about 66.90dB when church activities were over.

The noise level on Sunday at ETF black was very low compared to week days as there was no academic activities here. Noise level drops from 79.25dB to 60.90dB in morning, 75.83dB to 64.00dB in the afternoon and 74.08dB to 59.90dB in the evening hours. At the workshop on Sunday, noise level was low compared to weekly days due to the fact that no practical was taking place. Noise level dropped from 92.07dB to 65.40dB in the morning hours, 95.73dB to 67.90dB in the afternoon hours and 86.35 to 62.70 in the evening hours.

The staff quarter is the most quiet zone of the zones studied. On Sunday morning, noise level in the staff quarters is 50.70db as against weekly days of 52.13 db it increases in the afternoon to about 51.70db as compared to 52.95db during week days because most staff have come back from their worship places. Evening hours recorded 48.90db as compared to 54.62db during week days this dropped because most staff are resting preparing for next day work.

Conclusion

Research on the thespatio-temporal distribution of noise island within the campus of Cross River University of Technology, Calabar, Nigeria, has been carried out. The following conclusions were deduced.

1. The campus staff quarters is the most quite zone on campus with noise level on the average of 54.62db on week days and an average of 51.70db on Sunday making it the very save for residential purposes as it meets WHO safety standard.
2. Most of the zone on campus has noise level far above that recommended by WHO, therefore they are noisy and can be hazardous to human health. Except for ETF block with average of 79.25db which is slightly above WHO standard of 75 .00db.
3. The most common source of noise on campus is generated by generators and plant, un-serviced fan and air-conditioner machines from workshops and staff and students roaming the campus and vehicular movement.
4. Cross River University of Technology, Calabar campus is noisy compared to WHO standard.

Therefore, the following recommendations are made:

1. The University should promulgate noise control laws. A noise control unit should be established. This unit should be saddled with the control of noise in the University.
2. The university should build more offices and classroom to reduce the number of staff and student roaming the campuses.
3. Staff and students undergoing practical in the workshops should be advised to use ear mufflers to avoid ear damages.
4. Generating plants within the campus should be relocated to reduce generator noise on campus especially the one behind mathematics department. Alternatively, renewable energy techniques that are noise free should be adopted for power generation.
5. Regular maintenance should be done on machines, equipment, fans and air conditioners to reduce noise in the offices.
6. Speed units/breakers should be set for vehicles plying roads in the school.
7. Hawkers and vendors should be designated locations where they should stay for their businesses. These location should be far away from the learning environment.
8. Departments and faculties should be encouraged to maintain noise-free environments. This can be done by awarding prizes to the noise free department/faculty.

References

[1]. Onuu, M. U. and Inyang, A. (2004). Environmental Noise Pollution in Nigerian Universities: A Case Study of the University of Calabar, Calabar, Nigeria. Journal of Nigerian Environmental Society, 2(1): 100-109.

[2]. World Health Organization (2005). United Nation road safety collaboration: a hand book of partner profiles. 1: 1-82.

[3]. Lai P. Noise Pollution, In: Theodore K. Mary, Theodore Louis (eds.) *Major Environmental Issues Facing the 21st Century*, Upper Saddle River, NJ: 1996: 389-396.

[4]. Hessel PA. (2000). Hearing loss among construction workers in Edmonton, Alberta, Canada. *J Occup Environ Med*; 42(1):57-63.

[5]. Hessel PA, Sluis-Cremer G K. Hearing loss in white South African gold miners. *S. Afr. Med. J.* 1987; 71:364–367.

[6]. Ahmed HO, Dennis JH, Badran O, *et al*. Occupational noise exposure and hearing loss of workers in two plants in eastern Saudi Arabia. *Ann Occup Hyg* 2001; 45(5):371–380.

[7]. Alam JB, Alam MJB, Rahman MM, *et al*. Study on traffic noise level of Sylhet by multiple regression analysis associated with health hazards. *Iran Journal of Environ. Health Sci. Eng*2006; 3(2):71-78.

[8]. Sobotova L, Jurkovicova J, Stefanikova Z, *et al*. Community response to environmental noise and the impact on cardiovascular risk score. *Sci Total Environ* 2010; 408: 1264–1270.

[9]. Ibekwe, T., Folorunso, D., Ebuta, A., Amodu, J., Nwegbu1, M., Mairami, Z., Liman, I., Okebaram, C., Chimdi, C., Durogbola, B., Suleiman, H., Mamven, H., Baamlong, N., Dahilo, E., Gbujie, I., Ibekwe, P and Nwaorgu, O. (2016). Evaluation of the Environmental Noise Levels in Abuja Municipality using Mobile Phones, Annals of Ibadan Postgraduate Medicine, 14(2): 58-64.
[10]. Goines L, Hagler L. Noise pollution: A modern plague. *South Med J.* 2007; 100: 287– 294
[11]. Clark WW. Hearing: The effect of noise. *Otolaryngol Head Neck Surg.* 1992; 106: 669- 764.
[12]. Moudon AV. Real noise from the urban environment: How ambient community noise affects health and what can be done about it. *Am J Prev Med* 2009; 37: 167-171.
[13]. Nwaka G. (2005). The Urban Informal Sector in Nigeria: Towards Economic Development, Environmental Health, and Social Harmony. Global Development (GUD) Magazine 1(1): 14pp. Available from: http://www.globalurban.org/Issue1PIMag05/NWAKA%20article.htm-5/1/07
[14]. Schomer P. (2001). Assessment of Noise Annoyance. A White Paper by Schomer and Associates, Inc., 39pp
[15]. Cave KM, Cornish EM, Chandler DW. Blast injury of the ear: Clinical update from the global war on terror. *Military Medicine* 2007; 172:726-730.
[16]. Talaska AE, Schacht J. Mechanisms of noise damage of the cochlea. *Audiological Medicine* 2007; 5: 3-9.
[17]. Henderson D, Bielefeld EC, Harris KC, Hu BH. The role of oxidative stress in noise-induced hearing loss. *Ear & Hearing* 2006; 27(1): 1-19.
[18]. Liberman MC, Dodds LW. Single-neuron labeling and chronic cochlear pathology. III. Stereocilia damage and alterations of threshold tuning curves. *Hear Res* 1984; 16: 55– 74.
[19]. Mahmood R, Par veen N, Jilani G, *et al*. Cardiovascular effects of short term noise of a constant frequency and intensity. *Pak J Physiol* 2008; 4(2); 20-23.
[20]. Sorensen M, Hvidberg M, Hoffmann B, Andersen Zorana J *et al*. Exposure to road traffic and railway noise and associations with blood pressure and self-reported hypertension: a cohort study. *Environ. Health.* 2011; 10:92.
[21]. Eriksson C, Nilsson Mats E, Willers Saskia M *et al.* Traffic noise and cardiovascular health in Sweden: The roadside study. *Noise and Health* 2012; 14(59):140- 147.
[22]. Agarwal S, Swami BL. Noise annoyance under interrupted traffic flow condition for Jaipur City. *International Journal of Applied Science and Engineering* 2009; 7(2): 159-168.
[23]. Miedema H. Annoyance caused by environmental noise: Elements for evidence-based noise policies. *J Soc Issues.* 2007; 63(1): 41–57.
[24]. Wood, R. (1983). Noise Pollution: it's more than meets the ear. In The Plain truth. November/December.
[25]. Adegoke A. (2007): The Challenges of environmental enforcement in Africa: the Nigerian Experience. Paper presented at the third international conference on environmental enforcement, pp. 43-54: [cited 2007 January 08]. Available from: www.inece.org/3rd vol.1/ pdf/ adegoro.pdf
[26]. Guidelines for Community noise; WHO Expert Task Force 1999. http://apps.who.int/iris/ handle/10665/66217 (accessed on 27/121/2014).
[27]. Abegaz, B. M., (1975). Universities in Africa: challenges and opportunities of international cooperation. In the Universities of Africa in the 1990's and beyond. Assoc. Afr. Unu., Ghana.
[28]. Oloruntoba E. O., Ademola R.A., Sridhar M. K. C., Agbola S. A., Omokhodion F. O. and Ana G.R.E.E and Alabi R. T (2012). Urban Environmental Noise Pollution and Perceived Health Effects in Ibadan, Nigeria. *Afr. J. Biomed. Res.Vol.15 (May 2012); 77 – 84*
[29]. Akinnubi C. F. (2000). Assessment of Noise Pollution and Perceived Health Challenges among Residents in Lagos State, Nigeria. European Journal of Education Studies, 7(3): 363-375.
[30]. Singh, D. and Joshi, B. (2010). Study of the Noise Pollution for three consecutive years during Deepawali festival in Meerut City, Uttar Pradesh. *New York Science Journal*, 3(6): 40-42.
[31]. Baik, J. J. and Kim, Y. H. (2000). Dry and moist convection forced by an urban heat island. *Journal of Applied Meteorology*, 40 (8), 1462-1475.

[32]. Voogt, J. A. (2002). Urban Heat Island. In Encyclopedia of Global Environmental Change, Vol. 3. T. Munn (Ed), 660-666. Chichester: Wiley

[33]. Arnfield, J. A. (2003). Two decades of urban climate research: a review of turbulence, exchanges of energy and water, and the urban heat island. *International Journal of Climatology*, 23, 1 – 26.

[34]. Environmental Protection Agency (2008). The characteristics and negative impacts of the Urban Heat Island effect. The main concerns for USA and the mitigation strategies that are being taken http://www.epa.gov/hiri/ Retrieved: August, 2010.

[35]. Weng, Q. (2009). Thermal infrared remote sensing for urban climate and environmental studies: Methods, applications, and trends. *ISPRSJournal of Photogrammetry and Remote Sensing*, 64; 335 – 344.

[36]. Peterson A. P. G. and Gross E. G (1974). *Handbook of noise Measurement*, 7th Ed., Genkand publishers, USA, 46-50.