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A Study on Noise in Indian Banks: An Impugnation in the Developing Countries

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Abstract. In the present study, noise levels were monitored in twenty one different banks of the Cuttack, the largest commercial city of the State Odisha, India, in the months of January to April, 2011 during two specified times (10 a.m.-1 p.m. and 1-4 p.m.). Different noise descriptors such as L_{10}, L_{50}, L_{90}, L_{eq}, NPL (noise pollution level), NC (noise climate) etc., were analysed to infer the extent of noise pollution in the investigated commercial banks of Cuttack. The noise levels in different banks ranged from 51.1 to 90.5 dB and from 51.4 to 91.1 dB during 10 a.m.-1 p.m. and 1 -4 p.m., respectively. Similarly, L_{eq} ranged from 71.5 to 82.1 and 67.4 to 72.2 dB and NPL ranged from 90.6 to 105.5 dB and 81.6 to 100.8 dB during 10 a.m.-1 p.m. and 1-4 p.m., respectively, which is more than permissible limit i.e., 50 dB (as prescribed in USA). T-test was also computed for all the 21 banks to infer the existence and statistical significance of the variations in noise levels.

Keywords: office noise, bank, noise distraction, noise descriptors, Cuttack

Introduction

Now-a-days, there were records of high level of dis satisfaction due to noise incidence in different offices, especially in commercial banks of India. Due to increase in population, economic development and industrial growth around Cuttack, there are many nationalised and private banks in different parts of the city. Total population of Cuttack is 2,618,708. Thus, the increase in number of customers, increased transactions of different industrial and business establishments of Cuttack make the environment of bank noisy. It is interesting to note that salary solely is disbursed in different banks to the employees and pensioners of government offices, universities, colleges, schools, industries located at Cuttack. So, especially on last working day of the month or during first week of the month, huge crowd rush into the banks to collect their salary. Unlike environmental noise in banks of foreign countries, Indian banks having thousands of customers are always noisy. The Indian banks are usually much noisier than their counterparts in developed countries, where less number of customers, central air-conditioning and carpeted floors and their location away from main roads reduce the noise to fairly low levels. The study on environmental noise of different banks in major cities of India in terms of standard noise indices were not empirically assessed so far except preliminary assessment of Goswami and Swain (2012a) in Balasore and that of Kudesia and Tiwari (2007) in Rourkela. The objective of the study was to assess the level of noise exposure of 21 different banks (both private and nationalised) of Cuttack, Odisha, India. As no agency in India has so far recommended the acceptable limits of noise levels in the offices especially that of banks, therefore, noise levels of the banks in India were studied and compared with the recommended noise levels of bank in USA (50 dB) (Kudesia and Tiwari, 2007; Rettinger, 1977).

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Materials and Methods

Study site. Cuttack city, the commercial and judicial caipital of Odisha, is located at 20 °16' North latitude and 85°31' East Longitude (Fig. 1). Noise levels were monitored in 21 commercial banks of Cuttack city (Table 1).

Acoustic study. The present noise monitoring was conducted with the help of sound level meter (Model LUTREN, SL-4010). This light weight calibrated instrument (wt = 460 g with batteries) is primarily designed for community noise survey. Sound level meter works on the principle of evaluation of sound pressure on a linear or weighted scale. Thus, the noise

Fig. 1. Map of India showing location of Cuttack city (study area).

levels were measured following standard procedure during January to April, 2011, at selected banks around Cuttack (Goswami and Swain, 2013; 2012b; 2011; Swain and Goswami, 2013; Mohapatra and Goswami, 2012a; 2012b; Pradhan *et al.*, 2012; Swain *et al*., 2012a; 2012b; Goswami, 2011; 2009; Goswami *et al*., 2011; Krishna Murthy *et al*., 2007). 180 measurements were made within three hour duration (i.e., at 1 min., interval) during two specified times from 10 a.m. -1 p.m. and 1-4 p.m. in the common corridors of all twenty one investigated banks. Sound level meter was kept in hand at arm's length at the chest level to minimise any error. The noise levels of different banks in different time intervals were predicted along with their equivalent noise levels (L_{eq}). The value of L_{eq} in dB (A) unit was calculated by using the formula given by Robinson, (1971) i.e.:

$$L_{eq} = L_{50} + (L_{10}-L_{90})^2 / 56$$

For the present study, the different percentile noise levels used were:

L_{10} : the level that were exceeded during 10% of the measuring time in dB(A).

L_{50} : the level that were exceeded during 50% of the measuring time in dB(A).

L_{90} : the level that were exceeded during 90% of the measuring time in dB(A).

L_{eq} represents the equivalent energy sound level of a steady state and invariable sound.

It includes both intensity and length of all sounds occurring during a given period (Piccolo *et al*., 2005).

Table 1. Noise level (dB) variations of different banks of Cuttack city at different time intervals

Location	10 a.m.-1 p.m.							1 p.m.-4 p.m.						
	Mean ± SD	L_{10}	L_{50}	L_{90}	L_{eq}	NC	NPL	Mean ± SD	L_{10}	L_{50}	L90	L_{eq}	NC	NPL
UCO Bank, College Square	70.0± 9.0	80.1	72.4	56.7	82.1	23.4	105.5	67.1±7.2	78.5	66.8	58.5	73.9	20	93.9
Central Bank of India, Mahatab Road	68.1±7.4	79.1	69.2	58.5	76.7	20.6	97.3	67.8±7.1	78.6	67.4	59.4	73.9	19.2	93.1
State Bank of India, Link Road	70.8±6.6	79.4	72.2	59.8	79.0	19.6	98.6	68.2± 6.9	77.6	65.6	60.7	70.7	16.9	87.6
ING Vyasa Bank, Arunodaya Nagar	66.2±7.1	76.5	64.7	56.9	71.5	19.6	91.1	65.0±5.5	73.4	63.8	59.2	67.4	14.2	81.6
Union Bank of India, Choudhury Bazar	70.6±6.4	78.6	71.4	61.6	76.5	17	93.5	69.0±6.8	78.4	70.4	58.8	77.2	19.6	96.8
IDBI Bank, College Square	68.5±7.7	79.6	70.1	58.6	77.9	21	98.9	66.8±6.5	75.8	65.4	58.2	70.9	17.6	88.5
Syndicate Bank, Bajrakabati Road	67.1±6.8	78.2	65.5	59.4	71.8	18.8	90.6	66.2±5.8	76.6	64.1	61.4	68.2	15.2	83.4
Bank of Baroda, Buxi Bazar	70.2±7.0	76.3	71.4	58.6	76.9	17.7	94.6	69.9±5.8	77.2	70.1	61.6	74.4	15.6	90
Bank of India, Ranihat	69.1±8.5	79.5	69.3	60.1	76.0	19.4	95.4	67.7± 6.3	73.7	68.8	60.1	72.1	13.6	85.7
Canara Bank, Badambadi	69.8±8.4	81.4	68.5	60.4	76.3	21	97.3	66.0±7.6	74.5	67.2	57.3	72.4	17.2	89.6
Andhra Bank, Malgodown	70.2±8.3	81.2	69.9	60.6	77.4	20.6	98	68.1±6.8	78.2	68.5	60.7	73.9	17.5	91.4
Punjab National Bank, Buxi Bazar	68.2±6.7	79.2	67.4	60.8	73.4	18.4	91.8	66.8±7.2	78.3	64.7	57.2	72.6	21.1	93.7
Dena Bank, Naya Sarak	66.8±8.1	78.4	65.2	57.1	73.3	21.3	94.6	65.8±7.5	78.6	63.2	57.2	71.3	21.4	92.7
~~Oriental Bank of Commerce, Link Road~~	~~68.4±8.5~~	~~81.1~~	~~67.4~~	~~57.4~~	~~77.4~~	~~23.7~~	~~101.1~~	~~65.2±7.2~~	~~76.8~~	~~64.5~~	~~56.9~~	~~71.5~~	~~19.9~~	~~91.4~~
Allahabad Bank, Cantonment Road	69.8±7.8	80.6	69.4	61.3	76	19.3	95.3	66.6±8.3	78.5	65.4	56.5	74.0	22	96
HDFC Bank, Bajrakabati Road	69.0±8.3	81.4	67.3	59.6	75.7	21.8	97.5	66.7±8.4	78.4	65.4	57.3	73.3	21.1	94.4
Axis Bank, Badambadi	66.4±8.4	78.9	63.4	55.8	72.9	23.1	96	64.5±7.5	78.4	62.1	57.2	70.1	21.2	91.3
Vijaya Bank, Buxi Bazar	68.7±7.5	80.7	67.4	60.5	74.6	20.2	94.8	65.6±8.1	78.2	64.3	57.3	72.1	20.9	93
Urban Co-operative Bank, College Square	68.9±9.9	82.1	64.5	58.4	74.5	23.7	98.2	67.5±9.0	82.1	65.1	57.3	76.0	24.8	100.8
ICICI Bank, Bajrakabati Road	67.2±9.4	80.3	63.4	55.8	74.1	24.5	98.6	65.6±9.0	81.1	62.5	56.6	73.2	24.5	97.7
Corporation Bank, Bajrakabati Road	69.3±7.6	81.2	68.5	60.5	76.1	20.7	96.8	65.4±7.5	79	64.1	56.8	72.9	22.2	95.1

As L_{eq} is an insufficient descriptor of the annoyance caused by fluctuating noise (Robinson, 1971), noise pollution level (NPL) in dB (A) was calculated by using the following formula:

$$NPL = L_{eq} + a\ (L_{10}\text{-}L_{90})$$

where:

a = 1.0 (constant in the equation)

NPL takes into account the variations in the sound signal and hence serves as better indicator of the pollution in the environment for physiological and psychological disturbance of the human system (Robinson, 1971).

Noise climate (NC) is the range over which the sound levels were fluctuating in an interval of time and was assessed using the following formula (Robinson, 1971):

$$NC = (L_{10}\text{-}L_{90})$$

where:

L_{10} = the level exceeded for 10% of the time of record (peak noise level); L_{90} = the level exceeded for 90 % of the time of record, is very near to the background noise level in the absence of any motor vehicle traffic.

Statistical analysis. The analysis of the measured noise levels generally depicted that there were existence of variations of noise with variables as the time of day. In order to determine the existence and statistical significance of the variations and trends, t-test was assessed on the observed data of the two different time intervals (Gupta, 2010).

Results and Discussion

Acoustic analysis. The noise data collected from different banks displayed wide ranges of noise level varying in two different specified times (10 a.m. -1 p.m. and 1-4 p.m.). The noise levels ranged from 51.1 to 91.1 dB at the common corridor of 21 investigated banks (Fig. 2). The minimum noise level was recorded at Punjab National Bank, Buxi Bazar (51.1 dB), while maximum noise was observed at Allahabad Bank, Cantonment Road (91.1 dB). Similarly, the maximum mean noise level was assessed at State Bank of India, Link Road Branch (70.8 dB), while minimum was assessed at Axis Bank, Badambadi Branch (64.5 dB).

Average peak noise level (L_{10}) values of all 21 monitored banks ranged from 76.3 to 82.1 dB and 73.4 to 82.1 dB during 10 a.m.-1 p.m. and 1-4 p.m., respectively. Similarly, L_{50} (median value of sound level) and L_{90}

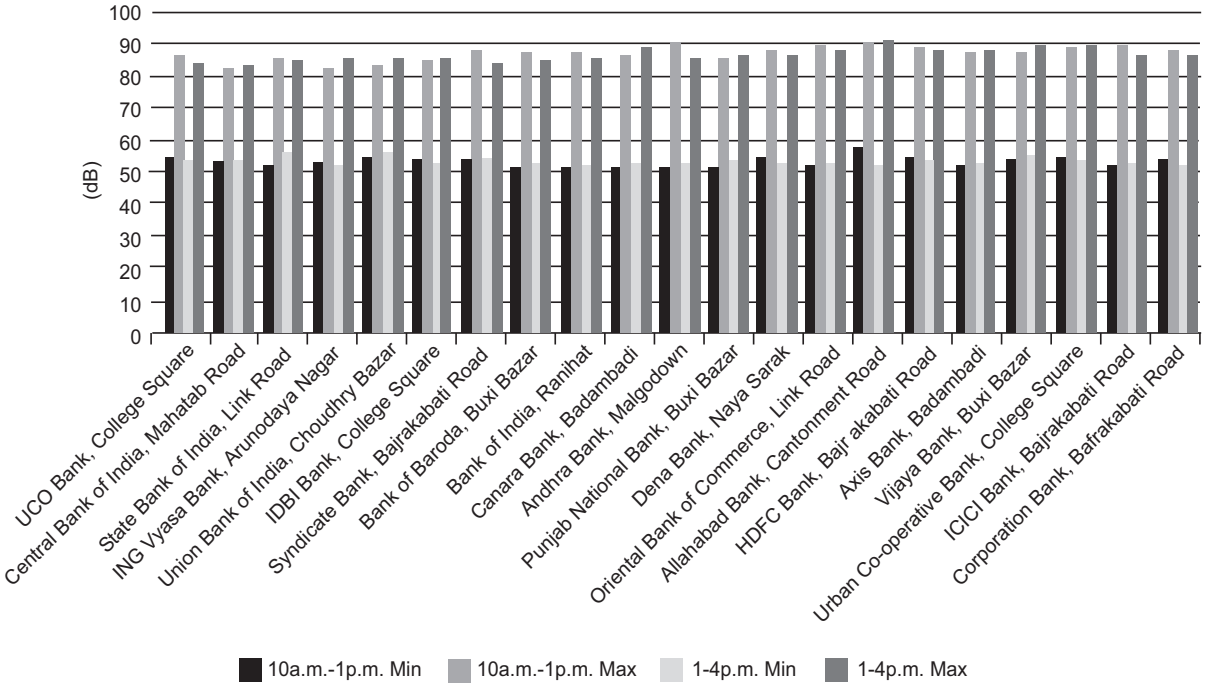

Fig. 2. Maximum and minimum noise level (dB) variations of different banks of cuttack city at two different specified time intervals.

(average background level) values of all 21 banks varied from 63.4 to 72.4 dB and 55.8 to 61.6 dB; 62.1 to 70.4 dB and 56.5 to 61.6 dB during 10 a.m.-1 p.m. and 1-4 p.m., respectively. Accordingly, the calculated L_{eq} (equivalent noise levels) values ranged from 71.5 to 82.1 dB and 67.4 to 77.2 dB during 10 a.m.-1 p.m. and 1 -4 p.m., respectively. All these values clearly showed higher noise levels in banks of Cuttack city mostly during 10 a.m.-1 p.m. NPL (noise pollution level) values of all 21 monitored banks ranged from 90.6 to 105.5 dB and 81.6 to 100.8 dB during 10 a.m.-1 p.m. and 1-4 p.m., respectively (Table 1). Minimum NPL values were more than 80 dB, which clearly revealed extent of noise pollution in the banks. NC (Noise climate) values ranged from 17 to 24.5 dB and 13.6 to 24.8 dB during 10 a.m.-1 p.m., and 1 -4 p.m., respectively (Table 1). NC is otherwise known as the difference between peak (L_{10}) and background (L_{90}) noise. The values of NC simply demonstrated that although the noise levels during any period of the day were generally constant but the presence of single – event noise was sufficient to affect the values of different noise percentile levels and consequently NC. t-test was computed between two different time intervals (10 a.m.-1 p.m. and 1- 4 p.m.). The observed value of t-test was 5.1. The tabulated value of 't' for 40 degree of freedom at 5% level of significance for two tailed test was 2.021. Since, the calculated value is more than the tabulated't', so it is significant. Thus, it was concluded with 95% confidence that the noise levels at 10 a.m.-1 p.m. was more than the noise levels at 1-4 p.m. The present study demonstrated that peak levels of activity occur in the banks in the forenoon i.e., during 10 a.m.-1 p.m. There are fairly less noise during 1-4 p.m. Lastly, it is inferred that even the minimum noise levels are beyond the permissible limit (50 dB as prescribed in USA) in all the cases (Table 2).

It was observed that main sources of noise in the investigated commercial banks were generators, air conditioners, fans, printers, computers, ventilation systems, notes-counting machines, telephone ringing, and chattering among the (bank) employees or the customers. These sounds are classified into steady (continuous hum from a ventilation system, fans, air conditioner or a computer, server); intermittent (sound that comes and goes such as a telephone ringing; printer, notes counting machine, fax, copier); impact (sounds of short duration such as the snap of a stapler or a punching machine; impact on door push bar during opening/closing, walking on hard surfaces) and human generated noise (human conversation and conversation on the phone). Moreover, all the investigated commercial banks are located in the heart of this city and along the main road. Thus, the noise from road traffic was also major contributor to the noisy bank. It was also noticed that the problem of office noise is aggravated due to multiple reflections of sound from concrete walls and bare floors. It was also observed that one of the imperative sources of noise pollution in the banks was the portable electric generator and it is becoming more and more common now-a-days due to frequent power failures. Most of the employees experience annoyance, and in turn disturbance in their work when the noise level crosses 65 dB. It was evident that all the employees of the banks might be experiencing some degree of noise related annoyance.

Table 2. Recommended acceptable noise levels in unoccupied offices in USA (Kudesia and Tiwari, 2007)

Type of office	Recommended noise level
General office	50
Private office	45
Small conference room	45
High standard office	35
High standard conference room	35
Bank	50
Accounting office	50

Noise source generated from chattering among the (bank) employees or the customers, indeed brought much distraction as compared to all other generated noise within the office environment since noise generated are audible and can be understood (Passhier, 1993). Machine generated intermittent noise, and impact noise in contrast is less distractive as there is no content with it. Background noise, would cause even less distraction, perhaps no distraction as it assists in masking the noise around since it has no uniformity. Although noise generated in the office in general and in bank in particular bring no conclusive evidence to physical health impact to the employees after long hour exposure, but studies demonstrated that it brings psychological distraction and annoyance to the employee, which may reduces their productivity (NyunLing and Cheung Chan, 2007; EPA, 1981).

It was also evident that bank employees were highly annoyed by the noise and their work efficiency had

been somehow affected. Moreover, they might be suffered from headache, bad temper, hearing problem and loss of concentration during their working hours manifested by noise pollution (Goswami and Swain, 2012a; Jakovljevic *et al*., 2009; Bluhm *et al*., 2004). One of the most annoying aspects of noise is that it interferes with speech. In the presence of background noise (L_{90}) i.e., 55.8-61.6 dB as measured in the banks of Cuttack, one has to raise the voice to carry out conversation and this contributes to further noise pollution. Maximum speech interference levels are quoted in Table 3 (Kudesia and Tiwari, 2007). This table demonstrates that if the noise level is 67dB (A) – a rather conservative value for Indian offices as evident in the present study- one has to speak in a very loud voice to talk to a person at one meter and has to shout at two meters. For example, if the noise level is 73 dB (L_{eq} during 10 a.m.-1 p.m. of all the investigated banks crosses this limit); one has to shout to talk to a person at one meter. According to (Kudesia and Tiwari, 2007) maximum speech inference levels for normal voice is 55 dB from 1m; 49 dB from 2 m and 43 dB from 3 m; while that of raised, very loud and shouting voices are 61, 67, and 73 dB from 1 m; 55, 61, 67 dB from 2 m and 49, 55, 61 dB from 3 m, respectively (Table 3). Thus, bank employees and customers have to speak in a louder voice due to speech interference, which possibly irritates them and reduces their working efficiency (Kudesia and Tiwari, 2007).

Table 3. Maximum speech interference levels in dB (A), which permit satisfactory hearing (after Kudesia and Tiwari, 2007)

Types of voice	Maximum speech interference levels in dB (A) distance from speaker		
	1 m	2 m	3 m
Normal voice	55	49	43
Raised voice	61	55	49
Very loud voice	67	61	55
Shouting	73	67	61

Conclusion

The present study demonstrates that the noise levels of all the investigated banks are more than the permissible limit (50 dB). Even minimum noise levels and the background noise level (L_{90}) are more than this recommended acceptable noise level of banks (50 dB). So it is apparent that the employees of these banks are experiencing noise related infuriation. Such noise pollution is steadily growing in the public offices of developing countries like India. It is also observed that investigated banks are commonly noisier during forenoon (10 a.m.-1 p.m.) than during afternoon (1-4 p.m.). Moreover, it is pertinent to mention here that the background noise and minimum noise levels are less in private banks such as Axis Bank, Badambadi and ICICI Bank, Bajrakabati road and the noise environment is better in these banks than the investigated nationalised banks of the city.

Since noise is a subjective feeling, the amount of noise caused distraction produced depends up on psychological sensitivity of that individual and loudness of that particular noise. Severe distraction may classify as annoyance (NyunLing and Cheung Chan, 2007; Evans and Johnson, 2000). Recent research suggests acoustics can have a large impact on work efficiency, performance and productivity. Even moderately noisy offices might contribute significantly, to health problems such as heart disease due to increased level of a stress hormone (epinephrine) and musculoskeletal problems (NyunLing and Cheung, 2007; Evans and Johnson, 2000). Noise level of offices such as banks has modest but adverse effects on physiological stress and motivation. Thus, noise is probably the most prevalent annoyance source in offices, and can lead to increased stress for occupants (NyunLing and Cheung, 2007; Evans and Johnson, 2000). Yet, acoustics in most cases do not received the same level of design consideration as thermal, ventilation and lighting as well as other architectural and engineering considerations (NyunLing and Cheung, 2007; Evans and Johnson, 2000; Sundstrom *et al.,* 1994). Therefore, bank administrations should take some imperative steps and regulatory measures to abate noise pollution in the respective banks so that work efficiency can be doubled with every perfection. The opening of new markets, deregulations and developments in information technology over the past few decades have led to heightened competition and greater struggle for survival among banking organiza-tions, encouraging them to take a fresh look at the conventional ways of making business. In order to remain competitive in this turbulent scenario, they have to make bank-environment conducive for customers.

References

Bluhm, G., Nordling, E., Berglind, N. 2004. Road traffic noise and annoyance- an increasing environmental

health problem. *Noise and Health,* **6:** 43-49.

EPA, 1981. *Noise Effects Handbook, A Desk Reference to Health and Welfare Effects of Noise,* EPA 500/9-82-106, Environmental Protection Agency Office of Noise Abatement and Control, Published by the National Association of Noise Control Officials, Fort Walton Beach, Florida, USA.

Evans, G., Johnson, D. 2000. Stress and open-office noise. *The Journal of Applied Psychology*, **85:** 779-783.

Goswami, S., Swain, B.K. 2013. Soundscape of Baripada, India; An appraisal and evaluation from urban noise perspective. *The Ecoscan:* Special Issue, **3:** 29-34.

Goswami, S., Swain, B.K. 2012a. Preliminary information on noise pollution in commercial banks of Balasore, India. *Journal of Environmental Biology,* **33:** 999-1002.

Goswami, S., Swain, B.K. 2012b. Occupational exposure in stone crusher industry with special reference to noise: A pragmatic appraisal. *Journal of Acoustical Society of India,* **39:** 70-78.

Goswami, S., Nayak, S., Pradhan, A., Dey, S.K. 2011. A study of traffic noise of two campuses of University, Balasore, India. *Journal of Environmental Biology*, **32:** 105-109.

Goswami, S., Swain, B.K. 2011. Soundscape of Balasore City, India: A study on urban noise and community response. *Journal of Acoustical Society of India,* **38:** 59-71.

Goswami, S. 2011. Soundscape of Bhadrak Town, India: An analysis from road traffic noise perspective. *Asian Journal of Water, Environment and Pollution*, **8:** 85-91.

Goswami, S. 2009. Road traffic noise: A case study of Balasore town, Orissa, India. *International Journal of Environmental Research*, **3:** 309-316.

Gupta, S.C. 2010. *Fundamentals of Statistics*, pp. 19.1-19.37, 6th edition, Himalaya Publishing House Pvt., Ltd., Mumbai, India.

Jakovljevic, B., Paunovic, K., Belojevic, G. 2009. Road traffic noise and factors influencing noise annoyanance in an urban population. *Environment International,* **35:** 552-556.

Krishna Murthy, V., Majumdar, A.K., Khanal, S.N., Subedi, D.P. 2007. Assessment of traffic noise pollution in BANEPA, a semi urban town of Nepal, Kathamandu. *University Journal of Science, Engineering and Technology*, **1:** 1-9.

Kudesia, V.P., Tiwari, T.N. 2007. *Noise Pollution & Its Control,* 3rd edition, Pragati Prakashan, Meerut, India.

Mohapatra, H., Goswami, S. 2012a. Assessment and analysis of noise levels in and around Ib River coalfield, Orissa, India. *Journal of Environmental Biology,* **33:** 649-655.

Mohapatra, H., Goswami, S. 2012b. Assessment of noise levels in various residential, commercial and industrial places in and around Belpahar and Brajrajnagar, Orissa, India. *Asian Journal of Water Environment and Pollution*, **9:** 73-78.

NyunLing, P., Cheung, C.M. 2007. Study on noise perception and distraction in office. In: *Proceedings of IASDR07* (International Association of Societies of Design Research Hongkong, November, 2007). http: //www.sd. polyu. edu.hk/ iasdr/proceeding.

Passhier, V. W. 1993. *Noise and Health*, Netherlands. The Hague, Health Council of the Netherlands (Publication No. a93/02E)

Piccolo, A., Plutino, D., Cannistraro, G. 2005. Evaluation and analysis of the environmental noise of Messina, Italy. *Applied Acoustics,* **66:** 447-465.

Pradhan, A., Swain, B.K., Goswami, S. 2012. Measurements and model calibration of traffic noise pollution of an industrial and intermediate city of India. *The Ecoscan,* Special Issue, **1:** 377-386.

Robinson, D.W. 1971. Towards a unified system of noise assessment. *Journal of Sound and Vibration,* **14:** 279-288.

Rettinger, M. 1977. *Acoustic Design and Noise Control: Acoustic Design,* vol. **1&2**, Chemical Publishing Company, New York, USA.

Sundstrom, E., Town, J.P., Rice, R.W., Osborn, D.P., Brill, M. 1994. Office noise, satisfaction and performance. *Environment and Behavior*, **26 :** 195-222.

Swain, B.K., Goswami, S. 2013. Integration and comparison of assessment and modeling of road traffic noise in Baripada town, India. *International Journal of Energy and Environment,* **4:** 303-310.

Swain, B.K., Panda, S., Goswami, S. 2012a**.** Dynamics of road traffic noise in Bhadrak city, India. *Journal of Environmental Biology,* **32:** 1087-1092.

Swain, B.K., Goswami, S., Panda, S. 2012b**.** Road traffic noise assessment and modeling in Bhubaneswar, Capital of Odisha State, India: A comparative and comprehensive monitoring study. *International Journal of Earth Sciences and Engineering,* **5:** 1358-1370.