Environment Conservation Journal 12(3) 139-142, 2011
(ISSN 0972-3099) Abstracted and Indexed

Status of noise pollution in households of Kathua city (J&K)

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Received:15.07.2011 **Accepted: 18.09.2011**

Abstract

The present study has been carried out to assess the seasonal variations of L_{eq} ,NC and L_{NP} noise levels in households located at different areas of Kathua city. Indoor as well as outdoor L_{eq} in the households located in the study area revealed lower values during winter season as compared to summer season of first year as well as second year study period. The indoor L_{eq} in Households exhibited higher values as compared to that of outdoor but both values exceeded the prescribed limits of noise level in the residential and commercial area but within the limits in industrial area. Households located in the residential area and near the institutes exhibited statistically significant ($p<0.05$) lower values of L_{eq} than the households located in the commercial area and industrial area.

Keywords: *Noise pollution, L_{eq}, NC, L_{NP}*

Introduction

There is growing evidence that noise pollution is not merely an annoyance like other forms of pollution, it has wide-ranging adverse health, social and economic effects. It is more severe and widespread than ever before and it will continue to increase in magnitude and severity because of population growth, urbanization and the associated growth in the use of increasingly powerful, varied, and highly mobile sources of noise.

Noise produces direct and cumulative adverse effects that impair health and that degrade residential, social, working and learning environments. It interferes with sleep, concentration, communication and recreation.

One challenge for researchers today is to increase our understanding of the possible health impacts of being exposed to noise pollution for longer period of time. With research indicating that a very large number of people spend more than 90% of their time indoor, the indoor noise pollution could also be great risk to the health. In many countries of the world steps are being taken to stop the damage to our environment from noise pollution i.e. scientific groups study the ill effects of noise on living organisms, Legislative bodies write laws to control noise pollution and educators in schools and universities teach students about effects of noise pollution.

The first step for solving noise pollution is assessment. In present study an attempt has been made to assess the status of noise pollution in households located at different areas of Kathua city.

Materials and Method

The study area was divided into 4 zones viz. Residential, Commercial, Institutional and Industrial to cover all sites having potential sources of noise pollution.

Sampling of noise level at each site of the study area was done with the help of Digital Sound Level Meter, Model-8928 at 'A' weight age. For collection of noise level data, each household was further divided into subsites viz. drawing room, bedroom, kitchen and outside. Three sampling of noise levels were recorded at each sub-site of Households during Morning hours (0800-1000 hours), Afternoon hours (1200-0200 hours) and Evening hours (0600-0800 hours).

The sampling of noise level was done twice during each of summer season and winter season in the two years study period i.e. sampling was done once during April to June and once during July to September of the summer season of first year as

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well as second year study period. Similarly sampling was done once during October to December and once during January to March of the winter season of first as well as second year study period.

Monitoring was carried out at a height of 1.5m, away from the chest. During each sampling of noise, 20 readings of SPL were recorded at an interval of 30 seconds in a period of 10 minutes. The minimum and maximum SPL were also recorded. From the observed readings of SPL obtained for each time-interval, following Noise Indices were calculated:

Equivalent Noise Level $\mathbf{L_{eq}}$:-

$$L_{eq}(A) = 10 \log \left(\sum_{i=1}^{n} fi\ 10^{Li/10}\right) dB$$

where,

fi=fraction of time for which the sound level persists.

i=time interval.

n=number of observations.

Li=sound intensity.

- Combined $\mathbf{L_{eq}}$

$$L_{eq}(A) = 10 \log \left(\sum_{i=1}^{n} 10^{Li/10}\right) dB$$

where,

i=time interval.

n=number of observations.

Li=L_{eq} of particular room.

- $\mathbf{L_{10}}$=the noise level exceeding 10% of the time.
- $\mathbf{L_{90}}$=the noise level exceeding 90% of the time.
- Noise Climate **NC** is the range over which the sound levels are fluctuating in an interval of time and is given by the following relation:
  - $\mathbf{NC=L_{10}-L_{90}}$
- Noise Pollution Level $\mathbf{L_{NP}}$:
  - $\mathbf{L_{NP}= L_{eq}+ (L_{10}-L_{90})}$

Equivalent Noise Level L_{eq} was calculated for each indoor subsite i.e. drawing room, bedroom and kitchen and combined L_{eq} of the particular household was calculated.

Results and Discussion

The analysis of the data of indoor as well as outdoor L_{eq} in the households located in the study area revealed lower values during winter season as compared to summer season of first year as well as second year study period (Table I).Overall analysis of the L_{eq} values of the different sites (i.e. households located at different sites) revealed that indoor L_{eq} during all the seasons of two year study period exhibited higher values than outdoor L_{eq}. A significant positive correlation was observed between outdoor L_{eq} and indoor L_{eq} in households at all sites during summer season of first year as well as second year study period i.e. residential (+0.3), institutional (+0.1), commercial (+0.4), industrial (+0.6) during summer season of first year study period and r value of +0.2 (residential), +0.7 (institutional), +0.1 (commercial) and +0.5(industrial) during summer season of second year study period. During winter season of first year as well as second year study period no correlation (r) was observed in households (Table II).The positive correlation between outdoor and indoor noise levels in households at all the sites during summer season clearly indicated that outdoor noise from various sources penetrated households through open doors, windows but no specific correlation between outdoor and indoor noise levels during winter season indicated that due to closed doors and windows penetration of outdoor noise was reduced so that indoor and outdoor noise levels acted as independent variants.The compiled indoor as well as outdoor L_{eq} values in the average household located in the study area during second year of study period were observed to be higher as compared with that of first year study period but at the same time the overall survey of the compiled noise level data revealed that average household in the study area exhibited higher value of indoor Noise Pollution Level (L_{NP}) and both indoor as well as outdoor Noise Climate (NC) during winter season of first year as well as second year study period as compared with that of summer season. But the computed outdoor Noise Pollution Level (L_{NP}) value exhibited higher value during winter season of first year study period and summer season of second year study period (Table I).

Table I: Average Outdoor and Indoor Noise Levels in the Households located in Kathua city.

Area	Noise Level Indices	Site	Noise Levels dB(A) during			
			First Year Study Period		Second Year Study Period	
			Summer Season	Winter Season	Summer Season	Winter Season
Residential Area	L_{eq}	Indoor	68.6±5.2 *(+13.6) (58.4-78.5)	64.4±6.3 *(+9.6) (56.2-79.3) #	68.7±7.5 *(+13.7) (53.7-78.1)	65.7±4.3 *(+10.7) (56.8-72.4)
		Outdoor	59.4±6.7 *(+4.4) (50.8-72.3)	58.2±5.1 *(+3.2) (49.2-66.0)	60.2±4.9 *(+5.2) (53.2-68.5)	57.1±5.1 *(+2.1) (50.1-67.5)
	NC	Indoor	12.0±4.0 (2.7-20.0)	15.9±4.9 # (6.5-25.1)	11.5±6.6 (2.9-29.4)	15.7±5.4 # (5.0-29.0)
		Outdoor	13.1±5.8 (3.8-24.7)	15.3±4.6 (3.8-21.7)	14.5±7.3 (3.0-29.3)	13.6±5.6 (4.6-21.7)
	L_{NP}	Indoor	80.6±5.8 (69.8-91.6)	80.2±8.6 (66.6-97.2)	80.1±9.2 (65.1-96.2)	81.4±6.3 (67.8-89.9)
		Outdoor	72.5±10.8 (54.8-93.9)	73.5±8.2 (60.0-87.6)	74.8±11.6 (57.4-94.7)	70.7±8.7 (57.3-86.6)
Near Institutes	L_{eq}	Indoor	68.7±3.6 (61.3-73.2)	65.7±4.0 # (60.5-73.5)	68.7±5.2 (56.5-76.0)	66.1±4.7 (58.1-75.9)
		Outdoor	62.1±5.3 (53.1-70.3)	61.2±4.1 (55.1-72.6)	62.5±4.9 (54.3-72.5)	61.5±4.9 (54.5-69.6)
	NC	Indoor	12.2±4.7 (5.2-26.8)	14.4±4.0 # (6.2-22.5)	12.6±2.8 (3.9-19.9)	15.6±4.1 # (9.7-30.0)
		Outdoor	13.9±3.6 (6.8-20.1)	13.9±3.4 (8.9-19.9)	14.2±3.3 (9.0-20.4)	14.3±3.4 (8.9-20.1)
	L_{NP}	Indoor	80.9±4.7 (72.4-89.2)	80.1±6.2 (72.0-94.0)	81.3±6.5 (66.3-91.9)	81.7±7.3 (69.7-100.0)
		Outdoor	76.1±8.7 (59.9-90.3)	75.1±6.9 (64.4-92.5)	76.7±8.1 (63.7-92.9)	76.0±7.8 (64.8-88.2)
Commercial Area	L_{eq}	Indoor	69.6±3.3 *(+4.6) (64.1-74.3)	68.2±3.7 *(+3.2) (61.3-74.0)	70.0±3.3 *(+5.0) (62.8-74.6)	68.0±4.5 *(+3.0) (57.2-73.3)
		Outdoor	65.5±6.0 *(+0.5) (53.4-75.2)	61.8±6.6 *(-3.2) (46.5-70.8)	65.9±5.7 *(+0.9) (54.5-74.8)	63.3±6.3 *(-1.7) (50.3-71.9)
	NC	Indoor	12.9±4.1 (6.5-26.2)	15.3±5.2 # (4.0-29.3)	13.4±3.4 (6.8-22.2)	15.3±4.0 # (6.7-26.7)
		Outdoor	11.9±4.1 (4.4-21.6)	14.8±4.0 # (8.7-23.0)	13.4±3.3 (7.5-18.2)	15.1±3.2 (10.5-21.2)
	L_{NP}	Indoor	82.5±4.5 (76.4-91.9)	83.5±5.7 (73.9-93.6)	83.4±4.0 (75.9-90.9)	83.3±5.5 (69.9-90.0)
		Outdoor	77.4±9.3 (57.8-96.8)	76.6±9.4 (57.7-91.0)	79.3±8.2 (62.0-92.0)	78.4±8.2 (61.1-91.5)
Industrial Area	L_{eq}	Indoor	70.4±6.2 *(-4.6) (54.6-78.3)	68.1±4.3 *(-6.9) (58.7-75.7)	71.0±4.5 *(-4.0) (61.0-77.8)	68.6±4.0 *(6.4) (60.3-75.5)
		Outdoor	67.7±4.3 *(-7.3) (56.7-72.3)	66.5±3.9 *(-8.5) (57.9-73.8)	68.4±3.5 *(-6.6) (60.5-72.7)	67.2±4.5 *(-7.8) (58.5-73.1)
	NC	Indoor	10.5±3.6 (4.0-19.6)	15.9±5.1 # (6.7-33.0)	12.2±2.7 (7.3-23.6)	16.0±4.3 # (8.6-26.7)
		Outdoor	12.5±3.5 (8.0-20.3)	14.7±2.6 # (11.5-21.1)	12.3±2.5 (6.9-16.3)	13.9±3.2 (9.9-20.0)
	L_{NP}	Indoor	80.9±7.9 (62.6-89.4)	84.0±8.1 (69.0-101.4)	83.2±5.5 (73.4-93.7)	84.6±6.8 (72.7-96.7)
		Outdoor	80.1±7.2 (64.7-90.4)	81.3±5.9 (69.4-93.3)	80.7±5.8 (67.4-89.0)	81.1±7.1 (69.6-91.1)
Study Area	L_{eq}	Indoor	69.3±4.7 (54.6-78.5)	66.6±4.9 # (56.2-79.3)	69.6±5.3 (53.7-78.1)	67.1±4.5 # (56.8-75.9)
		Outdoor	63.7±6.4 (50.8-75.2)	61.9±5.8 (46.5-73.8)	64.3±5.7 (53.2-74.8)	62.3±6.3 (50.1-73.1)
	NC	Indoor	11.9±4.2 (2.7-26.8)	15.4±4.8 # (4.0-33.0)	12.4±4.2 (2.9-29.4)	15.6±4.4 # (5.0-30.0)
		Outdoor	12.8±4.3 (3.8-24.7)	14.7±3.7 # (3.8-23.0)	13.6±4.5 (3.0-29.3)	14.2±4.0 (4.6-21.7)
	L_{NP}	Indoor	81.2±5.8 (62.6-91.9)	82.0±7.3 (66.6-101.4)	82.0±6.6 (65.1-96.2)	82.8±6.5 (67.8-100.0)
		Outdoor	76.5±9.3 (54.8-96.8)	76.6±8.1 (57.7-93.3)	77.9±8.8 (57.4-94.7)	76.5±8.7 (57.3-91.5)

L_{eq}: Equivalent Noise Level

NC: Noise Climate

L_{NP}: Noise Pollution Level

* values in paranthesis indicate deviation from CPCB Prescribed noise levels.

\# Seasonal difference statistically significant ($p<0.05$) during particular year of study period.

Table II: Correlation coefficient (r) of Outdoor and Indoor Leq at Households in different areas of Kathua city.

Outdoor Leq of Households	Indoor Leq during			
	First Year Study Period		Second Year Study Period	
	Summer Season	Winter Season	Summer Season	Winter Season
at Residential Area	+0.3	0.0	+0.2	0.0
near Institutes	+0.1	0.0	+0.7	0.0
at Commercial Area	+0.4	0.0	+0.1	0.0
at Industrial Area.	+0.6	0.0	+0.5	0.0

From above analysis, it can be concluded that various external sources of noise like traffic, public noise, noise from industries were responsible for increase in indoor noise level along with various indoor sources of noise like domestic appliances, fans, exhaust fan, desert coolers, television, grinder, whistling of cooker, washing machine etc.

The indoor L_{eq} in Households exhibited higher values as compared to that of outdoor but both values exceeded the prescribed limits of noise level in the residential and commercial area but within the limits in industrial area.Srivastava and Dhabal (1998) also reported the penetration of traffic noise and noise from other sources to increase indoor noise level in the residential buildings in Delhi and Kolkatta. Wilson (1963) in London, Ali (1988) in Rourkela, Dhillon *et al.* (1990) in Ludhiana, Singh and Mahajan (1990) in Kolkatta, Rao and Rao (1990) in Vishakhapatnam, Pandya and Verma (1997) in Nagpur, Koijam *et al.* (1998) in Imphal, Rampal (2005) Jammu city, Patel *et al.* (2006) in Jarsuguda and Rampal and Pathania (2008) in Bishnah also observed higher values of noise levels in residential area as compared to noise level prescribed by Central Pollution Control Board. They also observed that increasing values of noise was the most disturbing factor for residents of the area.The overall average values of L_{eq} and NC showed statistically significant ($p<0.05$) difference in the winter season as compared to the summer season of both years of study period at households located in the study area.Households located in the residential area and near the institutes exhibited statistically significant ($p<0.05$) lower values of L_{eq} than the households located in the commercial area and industrial area.

This indicated that higher outdoor noise levels in the commercial and industrial area raised the indoor noise levels in the households.

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