

Assessment of Noise Levels in Various Residential, Commercial and Industrial Places in and around Belpahar and Brajrajnagar, Orissa, India

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Abstract: Noise assessment is carried out in various residential, commercial and industrial places in and around Belpahar and Brajrajnagar of Ib River coalfield. The average noise intensities at various residential places range from 57.10 to 63.25 dB during day time (6 am-10 pm) and from 46.77 to 56.22 dB during night (10 pm-6 am). It clearly demonstrates that the noise levels are in close proximity or beyond the permissible limit. Though the average noise intensities at various commercial and industrial places are within the permissible limit, the L_{\max} noise values are more than the permissible limit. Analysis of variance is also computed for different residential, commercial and industrial places to infer the level of significance.

Key words: Belpahar, Brajrajnagar, noise pollution, noise descriptors.

Introduction

Noise pollution is one of the biggest occupational hazards in the Indian mining industries. A cumulative effect of mining activities produces enormous noise and vibrations in the mining area, which constitute a source of disturbance. Prolonged noise exposure threatens auditory and non-auditory effects leading to noise-induced hearing loss. In addition, noise produces other health effects, influences work performance and makes communication more difficult (Ouis, 2001; Zannin et al., 2003, 2006; Yang and Kang, 2005; Thakur, 2006; Zannin and Marcon, 2006). Thus, an attempt has been made for systematic noise monitoring in investigated coal mining complexes in and around Belpahar and Brajrajnagar areas of Jharsuguda District, Orissa (Figure 1) and the assessed noise levels are compared with the standard noise levels prescribed by the CPCB (Anonymous, 2000) (Table 1).



Figure 1: Map of India showing the study area.

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Table 1: Ambient noise quality standards

<i>Area code</i>	<i>Category of area</i>	<i>Limits in dB (A) day time (6 am to 9 pm)</i>	<i>Limits in dB (A) night time (9 pm to 6 am)</i>
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zone	50	40

CPCB, 2000

This studied area around Belpahar and Brajarajnagar comprises five opencast projects namely, Samaleswari, Lilari, Lakhanpur, Lajkura and Belpahar of Ib River coalfield.

Materials and Methods

Noise levels around residential, commercial and industrial places of Belpahar and Brajarajnagar (a major part of Ib River coalfield) areas have been assessed during December, 2010. The noise levels are measured following standard procedure using calibrated sound pressure dB meter (Model Lutren, SL-4010) (Krishna Murthy et al., 2007; Ziaudin et al., 2007). This light weight instrument (wt = 460g with batteries) is primarily designed for community noise survey. It is calibrated acoustically using an external reference source, which is placed over the microphone. Sound level meter works on the principle of evaluation of sound pressure on a linear or weighted scale. It normally indicates the rms value of the sound. Altogether 120 observations are made for two hours duration (i.e. at one minute interval) to assess the noise level in different residential, commercial and industrial places in and around Belpahar and Brajarajnagar during both day and night time. Assessment of noise levels is carried out by holding sound pressure dB meter in hand at arms length at the chest level in order to reduce errors due to reflection of sound from the body of the investigator. The analysis of the measured noise levels generally depicts that there are existence of variations of noise with variable viz., categories of zone specific sites. In order to determine the existence and statistical significance of these variations and trends, a cross classification analysis along with F-test is assessed on the data.

Results and Discussion

The average noise intensities of various residential places during day time (6am-10pm) range from 57.1 to 63.25

dB (Table 2) and during night (10 pm-6 am) range from 46.77 to 56.22 (Table 3). In most of the cases, the noise intensities of the said area are more than the standard noise level (55 dB during day and 45 dB during night) (Table 1; Anonymous, 2000). The noise intensities of different commercial and industrial places range from 54.3 to 93.5 dB during the day time (Table 4) and are beyond the permissible limit, while during night time noise intensities range from 45.2 to 81.5 dB and are somewhat within the permissible limit (Table 5).

The differences of noise levels estimated at different monitoring locations in residential places during day time are significant at both 1% and 5% level of significance. However, the differences of estimated noise levels at residential places during night and commercial and industrial places during day and night are not significant at both 1% and 5% levels of significance (Table 6).

The present study explicitly reveals that the noise levels are more than the permissible limit in most of the investigated sites including residential, commercial and industrial zones during both day and night time, while in some cases noise levels are below the limit values. Similar attempt had been made to monitor noise levels in these studied areas in the year 2008 (Mohapatra and Goswami, in press). This earlier study demonstrates that the average noise intensities (6 am-10 pm: 51.6-60.875 dB and 10 pm-6 am: 42.6-49.8 dB) and L_{eq} values (6 am-10 pm: 50.9-67.0 dB and 10 pm-6 am: 40.8-53.3 dB) during both day and night time of the residential places around Belpahar and Brajarajnagar areas are in close proximity or beyond the permissible limit. The L_{eq} values at some of the commercial and industrial places are beyond (6 am-10 pm: 61.6-88.3 dB and 10 pm-6 am: 55.4-64.8 dB) the permissible limit. However, in most of the cases the L_{max} noise values are more (6 am-10 pm: 68.5-91.4 dB and 10 pm-6 am: 69.3-76.4 dB) than the permissible limit. This data on noise levels of the year 2008 is compared with present data of the year 2010. It explicitly reveals that the noise levels have increased subsequently in the studied residential, commercial and industrial areas during both day and night time.

Table 2: Noise intensity of various residential places during day time (6 am-10 pm) around Belpahar and Brajrajnagar areas

Sl.No.	Monitoring locations	Observed Noise intensity dB(A)		
		Min.	Max.	Mean and SD
1	Village Orangbasti near Samaleswari OCP	48.3	71.8	59.67±11.175
2	Village Kudapali near Samaleswari OCP	45.7	66.4	57.1±9.589
3	Khairikuni village near Lakhanpur OCP	47.6	77.3	62.45±13.676
4	Bandhbahal Colony near Lakhanpur OCP	55.5	69.9	63.25±6.022
5	Adarsh Nagar Colony near Lajkura OCP	47.3	73.3	61.35±12.564
6	Jurabaga village near Lilari OCP	55.7	68.5	62.8±5.377
7	Darlipali village near Lilari OCP	49.4	74.4	62.65±11.769
8	Banjipali village near Belpahar OCP	51.3	63.7	59.75±5.718

Table 3: Noise intensity of various residential places during night time (10 pm-6 am) around Belpahar and Brajrajnagar areas

Sl.No.	Monitoring locations	Observed Noise intensity dB(A)		
		Min.	Max.	Mean and SD
1	Village Orangbasti near Samaleswari OCP	39.3	63.2	49.125±10.683
2	Village Kudapali near Samaleswari OCP	35.6	61.4	48.525±10.691
3	Khairikuni village near Lakhanpur OCP	43.4	58.7	52.425±6.575
4	Bandhbahal Colony near Lakhanpur OCP	47.5	62.6	56.225±6.8006
5	Adarsh Nagar Colony near Lajkura OCP	37.8	62.5	50.3±10.834
6	Jurabaga village near Lilari OCP	43.5	57.6	50.7±5.8963
7	Darlipali village near Lilari OCP	41.6	57.2	49.325±6.4783
8	Banjipali village near Belpahar OCP	39.4	52.3	46.775±5.6405

Table 4: Noise intensity of various commercial and industrial places during day time (6 am-10 pm) around Belpahar and Brajrajnagar areas

Sl.No.	Monitoring locations	Category	Observed Noise intensity dB(A)		
			Min.	Max.	Mean and SD
1	Brajrajnagar market	Commercial	59.3	81.2	70.4±11.098
2	On the Haul road of Samaleswari OCP	Industrial	56.4	88.2	72.7±14.292
3	Near Lajkura store	Industrial	59.3	93.5	76.575±17.27
4	Near coal crusher house near Lajkura OCP	Industrial	58.0	90.3	75.4±15.996
5	Near Lilari pump house	Industrial	54.3	75.5	65.15±9.6445

Table 5: Noise intensity of various commercial and industrial places during night time (10 pm-6 am) around Belpahar and Brajrajnagar areas

Sl.No.	Monitoring locations	Category	Observed Noise intensity dB(A)		
			Min.	Max.	Mean and SD
1	Brajrajnagar market	Commercial	45.2	81.5	65.175±17.626
2	On the Haul road of Samaleswari OCP	Industrial	48.7	77.2	63.125±13.149
3	Near Lajkura store	Industrial	48.6	76.8	63.4±13.467
4	Near coal crusher house near Lajkura OCP	Industrial	47.5	73.4	61.6±11.711
5	Near Lilari pump house	Industrial	49.2	81.5	70.175±14.471

Table 6: Analysis of variance of noise intensity of residential, industrial and commercial places around Belpahar and Brajrajnagar areas

<i>Parameters</i>	<i>Source of variations</i>	<i>S.S.</i>	<i>D.F.</i>	<i>M.S.</i>	<i>Calculated value of F</i>	<i>Tabulated value of F</i>
Residential places during day time (6 am-10 pm) around Ib River coalfield (Dec. 2008).	Among the noise intensities	2081.16	3	693.72	F=5.77	$F_{0.05}=8.65,$
	Among the monitoring locations	126.61	7	18.08	F=6.41	$F_{0.01}=26.68$
	Within the samples for both the variables	2521.64	21	120.07		$F_{0.05}=3.44,$ $F_{0.01}=6.15$
Residential places during night time (10 pm-6 am) around Ib River coalfield (Dec. 2008).	Among the noise intensities	1472.62	3	490.87	F=5.53	$F_{0.05}=8.65,$
	Among the monitoring locations	230.25	7	32.89	F=2.70	$F_{0.01}=26.68$
	Within the samples for both the variables	1861.91	21	88.66		$F_{0.05}=3.44,$ $F_{0.01}=6.15$
Commercial and industrial places during day time (6 am-10 pm) around Ib river coalfield (Dec. - 2008).	Among the noise intensities	2775.96	3	925.32	F=3.41	$F_{0.05}=8.74,$
	Among the monitoring locations	329.81	4	82.45	F=3.28	$F_{0.05}=27.05$
	Within the samples for both the variables	3253.85	12	271.15		$F_{0.05}=5.91,$ $F_{0.01}=14.37$
Commercial and industrial places during night time (10 pm-6 am) around Ib River coalfield (Dec. 2008).	Among the noise intensities	2863.31	3	954.43	F=3.56	$F_{0.05}=8.74,$
	Among the monitoring locations	175.93	4	43.98	F=6.08	$F_{0.05}=27.05$
	Within the samples for both the variables	3210.63	12	267.55		$F_{0.05}=5.91,$ $F_{0.01}=14.37$

S.S.: Sum of squares, D.F.: Degree of freedom, M.S.: Mean squares

Table 7: Permissible noise exposure limits (DGMS, 1975)

<i>Duration of exposure in hours</i>	<i>Noise intensity dB(A)</i>
8	90
4	95
2	100
1	105
$\frac{1}{2}$	110

Sound level should not to be exceeding 115 dB (A) at any instance.

Most of the local inhabitants support the ban of hydraulic horn, improved traffic control, banning very old dumpers, massive scale plantation of species of rich canopy. Noise pollution is not properly recognized despite the fact that it is steadily growing in developing countries like India and in particular in the mineral-rich state Orissa. It is well established now that noise is a potential health hazard in mining areas. Noise pollution is an interfering air-pollutant, which possesses both auditory, and a host of non-auditory effects on the

exposed mine workers and local inhabitants (Goswami, 2009, 2011).

Director General of Mines Safety (DGMS) provides a guide line (Circular No 18, Anonymous, 1975) for noise limit values of 90 dB during '8' hours of work per day at unprotected condition (Table 7). Prolonged exposure to high sound levels will lead to hearing damage. Miners are not usually exposed to the strong noise level continuously. It is important to note that sound level above 130dB causes hearing impairment. DGMS

Table 8: List of noise attenuating plant

<i>Scientific name</i>	<i>Vernacular name</i>	<i>Family</i>
<i>Azadiracta indica</i>	Neem	Melinaceae
<i>Bauhinia accuminata</i>	Kanchana	Caesalpinaceae
<i>Bauhinia variegata</i>	Kanchana	Caesalpinaceae
<i>Bombax malabaricum</i>	Shimuli	Malvaceae
<i>Cassia fistula</i>	Sunari	Caesalpinaceae
<i>Cassia recemosa</i>	Chakunda	Caesalpinaceae
<i>Cassia sophera</i>	Nalichakunda	Caesalpinaceae
<i>Erythrina indica</i>	Paldhua	Fabaceae
<i>Ficus bengalensis</i>	Bara	Moraceae
<i>Ficus glomerata</i>	Dimiri	Moraceae
<i>Ficus religiosa</i>	Peepul (Aswattha)	Moraceae
<i>Jacaranda mimosfolia</i>	Krushnachuda	Bignoniaceae
<i>Lagerstroemia parviflora</i>	Sidha	Lythraceae
<i>Madhuca indica</i>	Mahul	Sapotaceae
<i>Millingtonia hortensis</i>	Nagamalli	Bignoniaceae
<i>Pithecolobium deluce</i>	Bilatikoina	Mimosaceae
<i>Saraca indica</i>	Ashok	Caesalpinaceae

Goswami and Swain, 2011.

circulars permit a worker to be exposed to a level of 90 dB for '8' hours per day. The permissible time reduced to half for each 5 dB increase in noise level (Table 7). The working noise limit below 85 dB is little risk to an unprotected ear. Continuous exposure to a noise level of 115 dB is not permitted. Danger noise limit is above 90 dB in which hearing impairment is likely to be occurred. Appropriate ear protection (ear muffs or plugs) should be used, if the noise level is more than 115 dB. Nobody is permitted to enter an area, if noise level exceeds 140dB (Chakrabarti, 2000).

The increasing noise level in and around residential, commercial and industrial places near the coal mining premises around Belpahar and Brajrajnagar areas is due to operation of heavy earth moving machineries, heavy road traffic and other anthropogenic activities. The following range of strategies should be applied in and around the investigated mining areas (Goswami et al., 2011).

- Before commencing any mining project, potential sources of noise pollution associated with the proposed project should be identified.
- Programmes should be launched to monitor and control noisy vehicles on the mine roads.
- Proper periodic maintenance of heavy earth moving machineries should be encouraged. Cabins of all heavy equipments should be made sound proof to muffle the noise produced from it.
- Plantation of trees with dense foliage (Table 8) should

be encouraged as they are found to be highly effective in absorbing the acoustic noise and act as very good screens in bringing down the noise levels. The enhanced noise can be reduced in thickly vegetated area.

- Periodic noise assessment and annual audiometric examination of employees and people of nearby villages should be carried out by the mining authorities to monitor the hearing impairment.

Hence, by increasing general awareness among the mine workers and villagers of nearby area, adopting better technologies, and strictly promulgating laws, the noise pollution can be controlled. The laws should be implemented properly to reduce the unwanted sound. Protections related to planning, technical, biological, legislative and educational issues should be taken in order to avoid negative effects of noise pollution on environment. Therefore, Ib-River Coalfield Administration, Belpahar and Brajrajnagar Police Stations and local bodies should take some imperative steps and regulatory measures to abate such noise pollution.

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