Measurement and Analysis of Air Quality and noise Level along a Highway Corridor

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Abstract

In the present study, Environmental Assessment of Highway adjoining to Gorakhpur Industrial Developmental Authority (GIDA) Project Area is carried out with a view to look into the present status of environmental quality and issues relating to public health. Environmental Assessment of This Project Area has never been done earlier. Industrial pollution is considered to be the major problem in this area. Environmental Assessment should carefully examine the various environmental parameters related to water, air, and noise because the pollution may adversely affects the adjoining areas and ultimately the city. So, there is a need to assess the environmental condition of the area and to look into improvement measures to reduce, prevent or avoid the potential adverse environmental penalty from the project activities and to ensure a high quality environment in the region. Significance of this work lies in dropping environmental acquiescence issues, waste minimization and to protect occupational safety of workers and to promote sustainable development. Mitigation measures are needed in order to eliminate or minimize adverse environmental impacts. Various environmental issues are existing and discussed. The Environmental Assessment has included the assessment of Ambient Air Quality, And Noise Pollution Project Area.

Keywords: Ambient Air Quality, And Noise Pollution

1. INTRODUCTION

Air pollution due to anthropogenic sources is a matter of concern in whole world. The urban areas may be viewed as dense sources of enormous anthropogenic emissions of pollutants which can alter the atmospheric composition, chemistry and life cycles in it's down wind regimes, extending over several hundred kilometers. Moreover, worldwide epidemiological study on the effect of air pollution has revealed that gaseous pollutants and particulate matter has enough potential to cause severe health effect like respiratory, cardiovascular diseases and cardio pulmonary mortality. Modernization and Industrialization of developing countries has led to the increased use of fossil fuels and their derivatives.

Noise can be defined as an unpleasant and unwanted sound. Exposure to loud noise is indeed annoying and harmful too. Various noise scales have been introduced to describe in a single number, the response of an average human being to a complex sound made up of various frequencies at different loudness levels. The scale has been designed to weigh various components of noise according to the response of a human ear.

2. MATERIALS AND METHODS

2.1 Study Area

The Environmental Assessment was conducted on Highway Adjoining to Gorakhpur Industrial Development Authority (GIDA) Project Area.

The Project area consists of large, medium and small industries. At present, there are 98 industries with 56 small and 12 large units. Gorakhpur Industrial Development Authority emerges as a model industrial township with latest technology and modern urban facilities. It is being developed in the shape of a new Gorakhpur City with the self-sufficient industrial township keeping in view its future needs.

Mainly, three components of air are analyze during the monitoring of Ambient Air Quality in Project Area including RSPM, SO₂, NOₓ.
Progress in industrialization has resulted in creating noise pollution. So, the noise levels were also monitored in Project Area

3: Methodology of the Work

3.1: For Noise level meter: Firstly we have collected data for 10 minutes at 15 second interval. Thus we have 40 data for every hour by which we have calculated $L_{eq}$ for every hour by following formula :-

$$L_{eq} = 10 \log \left[ \frac{1}{T} \int \left( \frac{P \cdot A}{P_{ref}} \right) dt \right]$$

$T$ = time period
$P \cdot A$ = sound pressure
$P_{ref}$ = reference sound pressure

3.2: FHWA model: - To use the FHWA model one needs to collect the following data:- Hourly vehicle count for each type of vehicles (at least five)
Average operating speed of individual type of vehicles.
Distance from the centre of the concerned lane.

$$L_{eq} = L_o + \Delta L_i$$

Jain and Parida in 2001 made some modifications which are represented by formula given below:

$$L_{eqi} = L_o + A_{vs} + A_D + A_S$$

Where,
$L_{eqi}$ = Hourly equivalent noise level for each vehicle type.
$L_o$ = the reference energy mean emission level.
$A_{vs}$ = Volume and speed correction for subscribe.
$A_D$ = Distance correction.
$A_S$ = Ground cover correction.

<table>
<thead>
<tr>
<th>S.no</th>
<th>Category of vehicle</th>
<th>Individual vehicle noise emission equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 wheelers</td>
<td>$Y = 59.364 + 0.93 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>2</td>
<td>3 wheelers</td>
<td>$Y = 88.527 - 4.8433 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>3</td>
<td>Car</td>
<td>$Y = 68.992 - 0.0796 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>4</td>
<td>Truck</td>
<td>$Y = 39.012 + 10.074 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>5</td>
<td>LCV (mini bus)</td>
<td>$Y = 54.908 + 4.9153 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>6</td>
<td>Bus</td>
<td>$Y = 37.867 + 10.253 \text{ Ln}(S)$</td>
</tr>
<tr>
<td>7</td>
<td>Tractor/trailer</td>
<td>$Y = 60.83 + 5.3257 \text{ Ln}(S)$</td>
</tr>
</tbody>
</table>

Source (Pandey and pattnaik,2011)
Avs = 10*log(Do*V/)-25
AD = 10*log(Do/D)^{(1+\alpha)}

Where,
Do = Reference distance taken as 10m
D = distance from centerline.
V = individual average velocity of vehicles.
\alpha = Ground coefficient.

4: Results and Discussion

The results of the assessment of Ambient Air Quality, Wastewater and Groundwater samples, Noise Levels and Solid Waste Management in Project Area are given here:

The results of Ambient Air Quality monitoring are given below:

Table.1: Monthly Variation in Ambient Air Quality(2015)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>NAAQS (Permissible limit) ( \mu g/m^3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSPM</td>
<td>194.4</td>
<td>225.4</td>
<td>234.1</td>
<td>238.6</td>
<td>100</td>
</tr>
<tr>
<td>SO(_2)</td>
<td>27.3</td>
<td>29.2</td>
<td>29.86</td>
<td>27.2</td>
<td>80</td>
</tr>
<tr>
<td>NO(_X)</td>
<td>49.2</td>
<td>51.5</td>
<td>52.22</td>
<td>50.8</td>
<td>80</td>
</tr>
</tbody>
</table>

![Fig 1: Monthly Variation in Ambient Air Quality Parameters in Project Area](image)

It is revealed from Table.1 that repairable suspended particulate matter (RSPM) is found to be more than the permissible limit whereas sulphur dioxide (SO\(_2\)) and nitrogen oxides (NO\(_X\)) are within the limits. It is also evident from Fig.2 that the highest values for all the air quality parameters are observed in winter season followed by summer and monsoon seasons.
Noise monitoring was done at 3 locations on highway adjoining to Gorakhpur Industrial Development Authority (GIDA) Project Area which are given in Table 2. While the noise levels recorded from the locations are given in table 3.

### Table 2 : Site Description

<table>
<thead>
<tr>
<th>S.No</th>
<th>Site No.</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site 1</td>
<td>At Nausad Chauraha towards Varanasi</td>
</tr>
<tr>
<td>2</td>
<td>Site 2</td>
<td>At 4 Lane Diversion towards Muzaffarpur</td>
</tr>
<tr>
<td>3</td>
<td>Site 3</td>
<td>At GIDA sector 15 towards Lucknow</td>
</tr>
</tbody>
</table>

### Table 3: Noise Assessment Results

<table>
<thead>
<tr>
<th>TIME</th>
<th>L&lt;sub&gt;eq&lt;/sub&gt; from Noise Level Meter</th>
<th>L&lt;sub&gt;eq&lt;/sub&gt; from FHWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-9 am</td>
<td>69.56</td>
<td>69.52</td>
</tr>
<tr>
<td>9-10 am</td>
<td>65.74</td>
<td>70.04</td>
</tr>
<tr>
<td>10-11 am</td>
<td>67.60</td>
<td>70.09</td>
</tr>
<tr>
<td>11-12 pm</td>
<td>68.69</td>
<td>70.25</td>
</tr>
<tr>
<td>4-5 pm</td>
<td>67.08</td>
<td>70.22</td>
</tr>
<tr>
<td>5-6 pm</td>
<td>68.27</td>
<td>71.01</td>
</tr>
<tr>
<td>6-7 pm</td>
<td>66.56</td>
<td>70.70</td>
</tr>
<tr>
<td>7-8 pm</td>
<td>68.48</td>
<td>67.68</td>
</tr>
</tbody>
</table>

**Data at Nausad Chauraha**

![Graphical Data at Nausad Chauraha](image)
Abhay Pratap Singh, Dr. A.K Mishra

<table>
<thead>
<tr>
<th>Time</th>
<th>$L_{eq}$ from Noise Level Meter</th>
<th>$L_{eq}$ from FHWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-9 am</td>
<td>69.97</td>
<td>70.34</td>
</tr>
<tr>
<td>9-10 am</td>
<td>70.51</td>
<td>70.59</td>
</tr>
<tr>
<td>10-11 am</td>
<td>66.36</td>
<td>71.49</td>
</tr>
<tr>
<td>11-12 pm</td>
<td>69.96</td>
<td>71.37</td>
</tr>
<tr>
<td>4-5 pm</td>
<td>68.48</td>
<td>72.59</td>
</tr>
<tr>
<td>5-6 pm</td>
<td>67.42</td>
<td>72.27</td>
</tr>
<tr>
<td>6-7 pm</td>
<td>66.99</td>
<td>71.68</td>
</tr>
<tr>
<td>7-8 pm</td>
<td>67.88</td>
<td>67.51</td>
</tr>
</tbody>
</table>

Data At 4 Lane Diversion toward Muzaffarpur

Graphical Data at 4 Lane Diversion toward Muzaffarpur

<table>
<thead>
<tr>
<th>Time</th>
<th>$L_{eq}$ from Noise Level Meter</th>
<th>$L_{eq}$ from FHWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-9 am</td>
<td>70.29</td>
<td>69.43</td>
</tr>
<tr>
<td>9-10 am</td>
<td>69.63</td>
<td>70.01</td>
</tr>
<tr>
<td>10-11 am</td>
<td>69.37</td>
<td>70.09</td>
</tr>
<tr>
<td>11-12 pm</td>
<td>62.35</td>
<td>69.99</td>
</tr>
<tr>
<td>4-5 pm</td>
<td>67.01</td>
<td>70.25</td>
</tr>
<tr>
<td>5-6 pm</td>
<td>69.98</td>
<td>70.40</td>
</tr>
<tr>
<td>6-7 pm</td>
<td>65.47</td>
<td>70.58</td>
</tr>
<tr>
<td>7-8 pm</td>
<td>63.42</td>
<td>66.74</td>
</tr>
</tbody>
</table>

Data near GIDA Sector 15 towards Lucknow
Common exposure periods T are 24 hr (full day) and 8 hr (work day). For some environmental health assessment purposes, the day-night level (Ld”) is used. This metric is the equivalent sound level over 24 hr with the sound levels during the night (11 PM-7 AM) increased by 10 dB(A). Also a day-evening-night level (L1, is used, which is constructed similarly, such that the sound levels during the evening (7 PM-11 PM) are increased by 5 dB(A) and those during the night (11 PM-7 AM) by 10 dB(A). These adjustment factors of 10 or 5 dB(A) take into account that night-time and evening-time noise are more annoying than day-time noise with the same equivalent sound level. Because of road, railway, and aircraft traffic noise, most of the urban population in industrialized countries are exposed to outdoor Ld, levels of > 50 dB(A). Rural populations usually are exposed to outdoor traffic Ld, values of < 50 dB(A). Rough estimates of the percentage of people in Europe living in locations with Ld,, values > 60 dB(A) vary from 2 to 8%, depending on the country in which they live. For the India population this percentage is 4%. It is further estimated that 0.6% of the India population is exposed to traffic noise with Ld,, values of > 70 dB(A) (8,9). Both in research and in policy, Ld,, or Ld,, is applied in a specific way: the metrics are used as location-specific quantities to be measured in front of the facade of residential buildings.

The Day time noise level were recorded in the range of 55.3 -70.1 db (A). Noise levels at all industrial locations during day time were found below the prescribed limit of 75.0db(A) whereas during night time the noise level were recorded in range of 45.0 db(A) - 60.2 db(A) which were also below the prescribed limit of 70 dB(A). During industrial process and operations, heavy equipment and machinery generate noise, thereby causing a nuisance to the surrounding population and environment. The noise levels vary widely and depend on the type of activity performed. Thus, it is revealed that the noise levels in Project Area are within the permissible limit prescribed by Noise Pollution (Regulation and Control Rules, 2000).

However, there is a need to keep vigil on noise levels in near future also in view of the fact those industrial areas in surrounded by rural areas and any further increment in noise levels weight render adverse effects in the adjoining areas.

5: CONCLUSION AND RECOMMENDATIONS

The study carried out, regarding the Environmental Assessment of Highway adjoining to Gorakhpur Industrial Development Authority (GIDA) project Area has revealed various important findings related to Air, And Noise Pollution.

In this context, the important findings and recommendations are given below.
1. The Ambient Air Quality Monitoring has revealed that the Reparable Suspended Particulate Matter (RSPM) and NOX exceeded the permissible limits, which is a point of worry in respect of respiratory health of human beings living in the adjoining areas. However, the value of sulphur dioxide (SO2) is found inside permissible limits. It is also revealed that the concentrations of these air pollutants are found to be maximum in winter season with receding values during the summer and monsoon seasons. Thus, there is a need for regular Ambient Air Quality Monitoring in the area and to ensure the effective control of air pollutants in the industrial units. In addition, it is also necessary to take up Stack Monitoring in the area and to ensure safe dispersion of air pollutant by providing an effective stack height.

2. The Assessment of Noise Pollution in Project Area has revealed that the noise level is found to be within the permissible limits during the day time as well as night time. However, Noise Level Monitoring should also be done regularly to make sure that the adjoining rural belt is not subjected to any adverse effect in future.

3. The analysis of data has shown that the observed noise level along the highway corridor between Nausad to GIDA is under the prescribed limit but due to the huge increment of traffic volume the step need to be taken for the control of noise in future by prescribed authority.

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