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ASSESSMENT AND IMPACT OF AMBIENT AIR QUALITY IN SONEPUR- BAZARI OPENCAST PROJECT – AN APPROACH TOWARDS SUSTAINABLE ENVIRONMENT, RANIGANJ COALFIELD, BARDDHAMAN, WEST BENGAL, INDIA

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ABSTRACT

To get fresh air in urban areas, especially in industrial and mining areas is practically impossible in the context of sustainable state of environment. Assessment and impact of ambient air quality, especially in the coal field area, played significant role in assessing the pollution status in the respective areas. Opencast mining dominate the coal production scenario in India due to a number of favourable factors like economic viability, better safety, large scale mechanization , ease in mass production, higher productivity etc. In opencast mining, the surface alluvium and rock beds (i.e. overburden) below which coal lays are removed by various machineries to reach the coal deposits. Every opencast mining activity like drilling, blasting, excavation, loading, transportation, size reduction, stock piling, etc. releases particulate matter. Also burning of coal, exhaust from vehicle, blasting etc. produce a lot of gaseous pollutants like Oxides of sulpher, Nitrogen, Carbon mono-oxides etc. These are causing air pollution problem not only in mining premises but also in the surrounding areas. To study the status of air pollution caused by opencast coal mining, Sonepur – Bazari Opencast Project of Ranging Coalfield is selected. For the present purpose, primary observation and on spot measurement have been done for getting results. Particularly attempts are made for maintaining pollution free environment and so, necessary measure has been suggested.

KEYWORDS*:* Air Quality, Air Quality Index (AQI), Monitoring Stations, RSPM, Solid Residues

INTRODUCTION

In the study area, the main sources of ambient air due to Opencast coal mining includes ***Mining activities*** (Blasting, Drilling, overburden removal etc.); ***Transport*** of coal from mine to Coal Handling Plant; coal transportation from Coal Handling Plant to Railway siding; ***Storage and wagon loading*** of coal at the Railway siding etc. These mining activities produces Particulate matters which includes all the solid residue of different elements, liquid droplets, aerosol, metallic contaminants, soil dust, fumes, carbon spray, oil , grease etc. Particles with size less than 10 mm in diameter are likely to remain suspended in the atmosphere for long time and are commonly called as Suspended Particulate Matter (SPM), still fine particles less than 2.5 mm in size can easily cross the tracheal membrane and reach the respiratory system and are called as ***Respirable Suspended Particulate Matter (RSPM).*** With a view to protect the human environment due to air pollution caused by opencast mining, it is felt necessary to study the status of air pollution due to mining activities. The present study has been undertaken with the objective of determining the ambient air quality levels in respect of Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), and NOx, in Sonepur – Bazari Opencast Project of Raniganj coalfield. Studies were carried out to determine seasonal and spatial variation of the said pollutants.

Levels of air pollutants depend not only on the quantities that are emitted but also on the ability of the atmosphere to absorb or disperse excess amount.

Objectives

The primary objective of the present study is to search and suggest the necessary steps and measures to maintain the green and pollution free environment in the studied coal field area. For this purpose following observations are also considered, which are -

- To observe and monitor ambient air quality on the basis of air pollutants viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) and Nitrogen Oxides (NOx).
- To determine the spatial and temporal variation in air pollutant concentration,
- To evaluate air quality status by comparing with Environmental standards prescribed by Ministry of Environment and Forest(MOEF),
- To carry out statistical analysis of experimental data,
- To calculate the Air Quality Index (AQI) of study area, and
- To analyse the Air Quality Status of the study area.

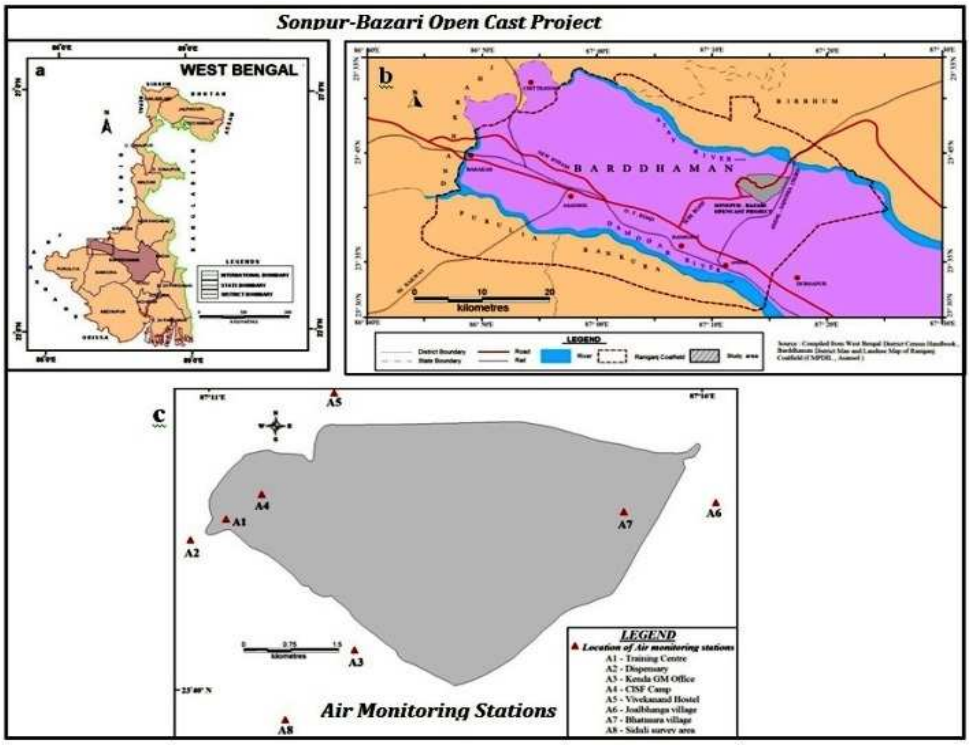


Figure 1: Location of the Study Area with the Location of Air Monitoring Stations

Study Area

For the present study, Sonepur – Bazari Opencast mining area has been selected .The selected mining area is located in the North - Eastern part of Raniganj Coalfield in Burdwan district of West Bengal bounded between latitude *23˚40' N and 23°43'N and longitude from 87°11'15"E to 87°17'42"E.* The project is located at a distance of about 15 km

from Raniganj and 19 km from Durgapur townships which are connected with Howrah - Delhi lines of the Indian Railways as well as by the Howrah- Delhi Grand-Trunk Road (NH-2). Raniganj- Suri Road passes through the geological block along the strike and meets the G. T. Road at Panjabi More at a distance of about 14km. The Pandaveswar Railway Station on Andal-Sainthia line of Eastern Railway is only 5 km from the project. Ukhra Railway Station is in close proximity of the block. The area is covered in Survey of India Toposheet No. 73 M/2 and 73 M/6. Moreover, for the specific purpose of the study, several air quality monitoring stations are selected and from those sample stations air quality data have been recorded by primary observation on which quality status determination experiments are carried out.

Table 1: Location of Ambient Air Monitoring Stations

Station ID	Station Name	Location	Latitude and Longitude
A1	Training Centre	Industrial	*23°41'42"/ 87°12'14"*
A2	Dispensary	Residential	*23°41'30"/ 87°11'54"*
A3	Kenda GM office	Residential	*23°40'25"/ 87°13'26"*
A4	CISF camp	Residential	*23°41'57"/ 87°12'34"*
A5	Vivekanand Hostel	Residential	*23°42'56"/ 87°13'14"*
A6	Joalbhanga village	Residential	*23°41'52"/ 87°16'48"*
A7	Bhatmura village	Residential	*23°41'46"/ 87°15'57"*
A8	Siduly survey area	Industrial	*23°39'40"/ 87°12'50"*

RESULTS AND DISCUSSIONS

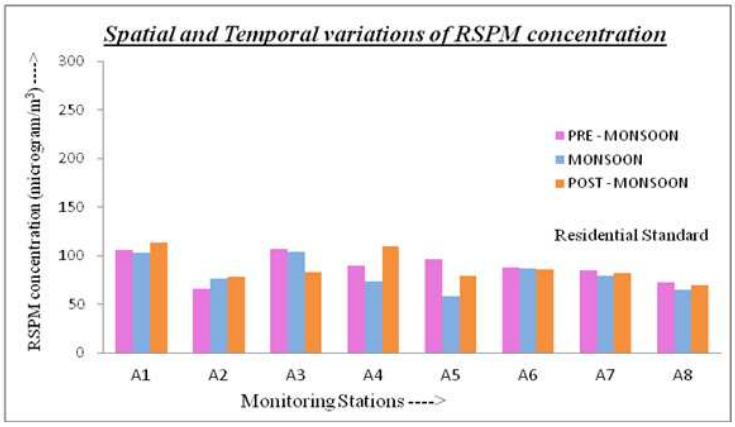
Statistical data for ***Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) and Oxides of Nitrogen (NO_X)*** during Pre-monsoon, Monsoon and Post-monsoon are observed collected and presented in Tables- 2, 3, 4 and depicted in Figures- 2, 3, and 4 respectively. A1 (Training centre) and A8 (Siduli survey area) are considered as Industrial locations while rest other locations are falling under the Residential locations.

Seasonal variation of RSPM concentration in the study area is shown in Table -2 and Figure -2. RSPM concentration in the study area varies from 113.7 microgram/m^3 to 58 microgram/m^3. The data of Pre-monsoon, Monsoon and Post-Monsoon reveals that RSPM concentrations at all the monitoring stations are within the Environmental standards except at the monitoring stations A3 (Kenda GM office) during pre-monsoon and monsoon; and A4 (CISF Camp) during post-monsoon periods. At the residential location A3 (Kenda GM office), average RSPM concentration was found to be 107.2 microgram/m^3 and 104.3 microgram/m^3 during pre-monsoon and Monsoon period respectively which exceeds the permissible limit specified by MOEF of 100 microgram/m^3. At the residential location A4 (CISF camp), average RSPM concentration was found to be 110 microgram/m^3 during Post - monsoon.

Table 2: Spatio-Temporal Variation of RSPM Concentration (Microgram/m^3) in and around Sonepur – Bazari Opencast Project

Monitoring Station No.	Monitoring Station Name	Location	PRE - MONSOON	MONSOON	POST-MONSOON	MOEF Standards
A1	Training Centre	Industrial	105.55	102.55	113.7	300
A2	Dispensary	Residential	66.2	75.9	78.25	100
A3	Kenda GM office	Residential	107.2	104.3	83.15	100
A4	CISF camp	Residential	89.4	73.25	110	100
A5	Vivekanand Hostel	Residential	96.05	58	79	100
A6	Joalbhanga village	Residential	87.5	86.8	86.05	100
A7	Bhatmura village	Residential	84.5	79	81.95	100
A8	Siduly survey area	Industrial	72.15	64.5	69.85	300

Source: *Routine environmental monitoring reports of Eastern Coalfield Limited, 2010*



Source: *Routine environmental monitoring reports of Eastern Coalfield Limited, 2010*

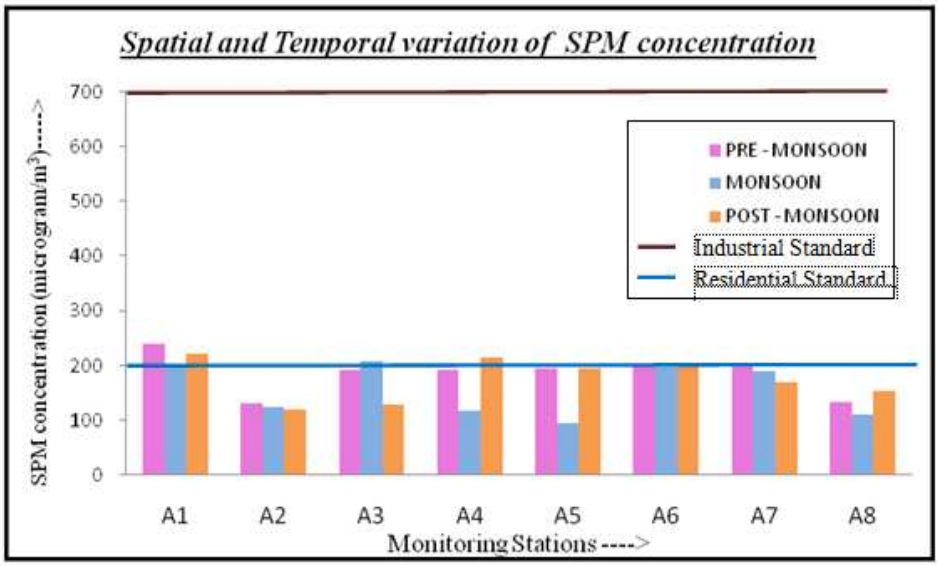
Figure 2: Spatial and Temporal Variation of RSPM Concentration (Microgram/M^3) in and Around Sonepur – Bazari Opencast Project

Table 3: Spatial and Temporal Variation of SPM Concentration (Microgram/m^3) in and Around Sonepur – Bazari Opencast Project

Monitoring Station No.	Monitoring Station Name	Location	PRE - MONSOON	MONSOON	POST-MONSOON	MOEF Standards
A1	Training Centre	Industrial	239.45	201	222.4	700
A2	Dispensary	Residential	130.4	123.45	119.7	200
A3	Kenda GM office	Residential	192.3	207.35	128.7	200
A4	CISF camp	Residential	192.3	117.55	214.55	200
A5	Vivekanand Hostel	Residential	194.4	95.25	194.55	200
A6	Joalbhanga village	Residential	200.4	197.45	198.75	200
A7	Bhatmura village	Residential	197.8	189.75	169.75	200
A8	Siduly survey area	Industrial	132.6	111.45	153.45	700

Source: *Routine environmental monitoring reports of Eastern Coalfield Limited, 2010*

Seasonal variation of SPM concentration in the study area is shown in Table 3 and Figure 3. SPM concentration in the study area varies from 239.45 microgram/m^3 to 95.25 microgram/m^3. The data of Pre-monsoon, Monsoon and Post-Monsoon reveals that SPM concentrations at all the monitoring stations are within the Environmental standards except at the monitoring station A6, A3 and A4 during pre-monsoon , monsoon and post-monsoon period respectively. At the residential location A6 (Joalbhanga village), average SPM concentration was found to be 200.4 microgram/m^3 during pre-monsoon. At the residential location A3 (Kenda GM office), average SPM concentration was found to be 207.35 microgram/m^3 during monsoon. At the residential locations A4 (CISF camp), average SPM concentration was found to be 214.35 microgram/m^3 during post - monsoon and exceeds the permissible limit specified by MOEF of 200 microgram/m^3. The high SPM concentration was due to coal mining and associated activities, transportation of coal on roads (uncovered), coal washery, coal loading and unloading, movement of vehicles on unpaved road. High SPM concentration was reported due to frequent movement and operation of Heavy Earth Moving Machinery (HEMM).



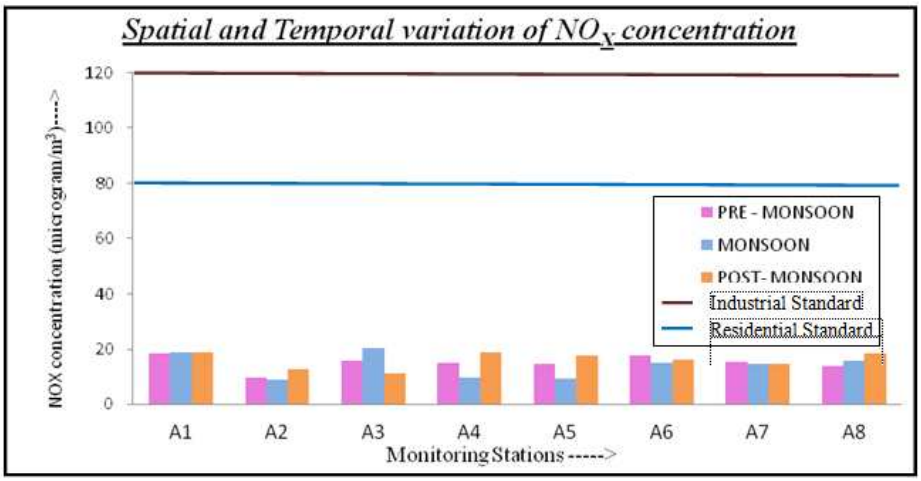
Source: *Routine environmental monitoring reports of Eastern Coalfield Limited, 2010*

Figure 3: Spatial and Temporal Variation of SPM Concentration (Microgram/M^3) in and Around Sonepur – Bazari Opencast Project

Table 4: Spatio-Temporal Variation of NOx concentration (microgram/m^3) around Sonepur-Bazari Project Source: Routine Environmental Monitoring Reports of Eastern Coalfield Limited, 2010

Station ID	Station Name	Location	PRE-Monsoon	Monsoon	POST- Monsoon	MOEF Standards
A1	Training Centre	Industrial	18.6	19	18.75	120
A2	Dispensary	Residential	9.8	8.75	12.6	80
A3	Kenda GM office	Residential	15.9	20.3	11.15	80
A4	CISF camp	Residential	14.95	9.85	18.8	80
A5	Vivekananda Hostel	Residential	14.75	9.3	17.7	80
A6	Joalbhanga village	Residential	17.6	15.15	16.3	80
A7	Bhatmura village	Residential	15.3	14.45	14.8	80
A8	Siduly survey area	Industrial	14	15.9	18.5	120

Seasonal variation of NOx concentration in the study area is shown in Table 4 and Figure 4. **NO_x** concentration in the study area varies from 20.3 microgram/m^3 to 8.75 microgram/m^3. The data of Premonsoon, Monsoon and Post-Monsoon reveals that NOx concentrations at all the monitoring stations are within the Environmental standards. During monsoon a significant reduction in NOx concentrations can be seen. Coal mining areas experienced additional nitrous fumes emitted from the blasting of explosives. Spontaneous heating of coal in waste dumps and mine fires release considerable amount of oxides of nitrogen (NO, NO_2 and N_2O). During combustion process (at high temperature), atmospheric nitrogen combines with oxygen to form NOx which is aggravated when engine is diesel operated.



Source: *Routine environmental monitoring reports of Eastern Coalfield Limited, 2010*

Figure 4: Spatial and Temporal Variation of NOX Concentration (Microgram/M^3) Around SONEPUR Project

Air Quality Index (AQI)

The concentrations of the parameters of air quality in Sonepur-Bazari Opencast project are compared with the Environmental Standard for Raniganj Coalfield and Air Quality Index was calculated using ***Mudri formula***: q = 100*V /Vs ; where q = quality rating; V = observed value of parameter; Vs = value recommended for that parameter-

g= anti log (log a +log b+……..log x/n) ; where g= geometric mean ; a, b, x= different value of air quality rating; and n= no. of value of air quality , log= logarithm.

Table 5: Air Quality Status on the Basis of Air Quality Index (Mudri, 1990)

Air Quality Index	Air Quality Status
Below 10	Very clean
11-25	Clean
26-50	Fairly Clean
51-75	Moderately Clean
76 - 100	Polluted
101 - 125	Heavily Polluted
More than 125	Severely Polluted

Air Quality Status in and Around Sonepur – Bazari Opencast Project

Table number 06 and 08 represents air quality index and air quality category corresponding to the index calculated on the basis of three criteria pollutants viz. RSPM, SPM and NO_X. The seasonal variation of Air Quality Index for each sites are achieved to reflect the study area's air quality in Pre-monsoon, Monsoon and Post – monsoon periods.

Table 6: Air Quality Index and Status in and Around Sonepur – Bazari Opencast Project (Pre – Monsoon)

Monitoring Station no.	Monitoring Station Name	Location	Air Quality Index	Air Quality Status
A1	Training Centre	Industrial	66.4711	Moderately Clean
A2	Dispensary	Residential	37.5289	Fairly Clean
A3	Kenda area GM office	Residential	58.9431	Moderately Clean
A4	CISF camp	Residential	54.3542	Moderately Clean
A5	Vivekanand Hostel	Residential	55.6203	Moderately Clean
A6	Joalbhanga village	Residential	57.7741	Moderately Clean
A7	Bhatmura village	Residential	54.2625	Moderately Clean
A8	Siduly survey area	Industrial	43.7421	Fairly Clean

During Pre-Monsoon period, the air quality index of the study area varies from 66.4711 to 37.5289. The residential stations A3, A4, A5, A6, A7 and Industrial station A1 are found as “Moderately Clean” whereas Residential station A2 and Industrial station A8 are found to fall in “Fairly Clean” category. so, mainly two categories - “Moderately Clean” and “Fairly Clean” are observed among the residential and industrial zone in pre-monsoon period.

Table 7: Air Quality Index and Status in and Around Sonepur – Bazari Project (Monsoon) Area

Monitoring Station no.	Monitoring Station Name	Location	Air Quality Index	Air Quality Status
A1	Training Centre	Industrial	62.5491	Moderately Clean
A2	Dispensary	Residential	37.1397	Fairly Clean
A3	Kenda area GM office	Residential	64.9733	Moderately Clean
A4	CISF camp	Residential	37.5608	Fairly Clean
A5	Vivekanand Hostel	Residential	31.7809	Fairly Clean
A6	Joalbhanga village	Residential	54.5432	Moderately Clean
A7	Bhatmura village	Residential	51.3443	Moderately Clean
A8	Siduly survey area	Industrial	41.4906	Fairly Clean

During Monsoon period, the air quality index of the study area varies from 62.5491 to 31.7809. The residential stations A3, A6, A7 and Industrial station A1 are represented as “Moderately Clean” whereas Residential stations A2, A4, A5 and Industrial station A8 are found to fall in “Fairly Clean” category. so, mainly two categories - “Moderately Clean” and “Fairly Clean” are observed among the residential and industrial zone in monsoon period also. As the monsoon approaches to the study area, it is observed that due to scavenging effect of rain the situation becomes quite clear with respect to AQI value.

Table 8: Air Quality Index and Status in and Around Sonepur – Bazari Project (Post-Monsoon)

Monitoring Station no.	Monitoring Station Name	Location	Air Quality Index	Air Quality Status
A1	Training Centre	Industrial	66.6659	Moderately Clean
A2	Dispensary	Residential	41.9335	Fairly Clean
A3	Kenda area GM office	Residential	42.0875	Fairly Clean
A4	CISF camp	Residential	65.2024	Moderately Clean
A5	Vivekanand Hostel	Residential	55.3980	Moderately Clean
A6	Joalbhanga village	Residential	55.8517	Moderately Clean
A7	Bhatmura village	Residential	50.4796	Fairly Clean
A8	Siduly colony	Industrial	49.8533	Fairly Clean

During Post - Monsoon period, the air quality index of the study area varies from 66.6659 to 41.9335. The residential stations A4, A5, A6 and Industrial station A1 are represented as “Moderately Clean” whereas Residential stations A2, A3, A7 and Industrial station A8 are found to fall in “Fairly Clean” category. So, mainly two categories - “Moderately Clean” and “Fairly Clean” are observed among the residential and industrial zone in Post - monsoon period also. The pollution level with respect to AQI again increased due to less circulation for stable and stagnant condition of

winter in the study area.

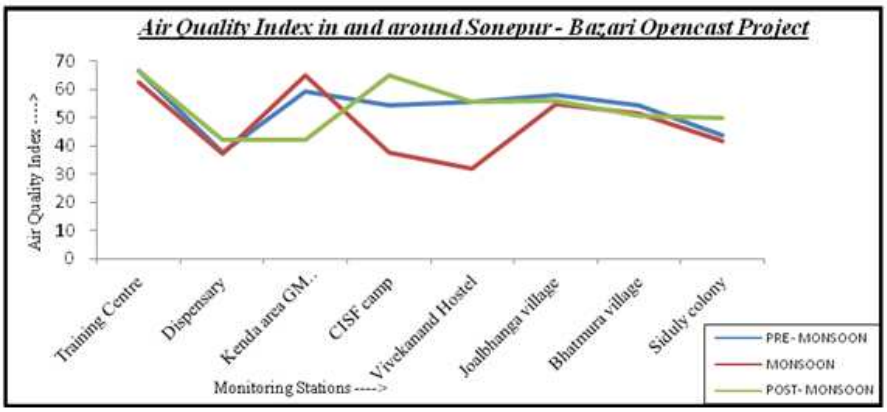


Figure 5: Air Quality Index in and Around Sonepur – Bazari Opencast Project

CONCLUSIONS

Ambient air quality in the study area has been found satisfactory as RSPM, SPM and NO_X levels at most of the monitoring stations were recorded below the permissible levels as per limits prescribed by Ministry Of Environment and Forest for Raniganj Coalfield. The Air Quality Index (AQI) value reflects that the air quality status of the study area ranges from "Moderately Clean" to "Fairly Clean". Based on the result of the present study, following suggestions are made:

- Reducing dust generation by wetting the surface to be blasted before drilling and blasting.
- Regular and routine maintenance of machineries and other vehicles.
- Coal transportation by covered trucks and railway wagon.
- Development of green belt around the mining area etc.

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