International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

Air Pollution in mining Industries has very adverse effects on Human Health, Flora, and Fauna, and proper assessment is needed around the mining areas

Dharmendra Kumar[1], Navin Singh Rajput[2]
[1] *Ph.D. (Research Scholar) – Electronics Engineering, IIT(BHU), Varanasi, Uttar-Pradesh*
[2] *Associate Professor, Electronics Engineering, IIT(BHU), Varanasi, Uttar- Pradesh*

ABSTRACT
The rapid development in India has resulted in rapid growth in the number of Heavy Motor vehicles(HMV) and light motor vehicles(LMV). Automation and Demand in transportation have also resulted in a tremendous increase in the number of vehicles in mining industries. In a few states, this has doubled in the last decade. Mining activities contribute to the problem of air pollution directly or indirectly. Rapid urbanization and the growth of motor vehicles impose a very serious effect on human life and the environment in recent years. Heavy Motor vehicles in the mining industry, mining blasts, and Open fires are more significant sources of air pollution and are main important contributors to carbon dioxide (CO_2), Carbon Monoxide(CO), Nitrogen dioxide(NO_2), Hydrogen Sulphide, Methane, and other greenhouse gases. These are the most dangerous gases in the mining industry and not only in the mining industry but also to the mining surrounding areas and other areas. The most important emissions during coal mining, transportation, and active mine fires are Particulate matter (PM), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), and heavy metals. These air pollutants deteriorate air quality and ultimately affect human health, fauna, and the flora in and around coal mining areas. Air pollution is a serious environmental health threat to humans, flora, and fauna. Adverse effects range from nausea, difficulty in breathing and skin irritations, birth defects, blood, lung cancer, etc. in and around the coal mining areas. All these situations indicate that air pollution in mining areas is becoming an affected problem in the Indian context and also in the rest of the world. The present paper includes a study done on the Jharia coalfield. Due to mining, the criteria most affected are air, water, soil, vegetation, agricultural land, and topography. There is an essential need to build up a healthy environment and increase the level of research and awareness around the world. The present paper is a study of an increase in air pollution in India, especially in mining areas, and its effect on human health, fauna, and flora. The conventional coal fuel cycle is among the most destructive activities on the earth, threatening health, polluting the air, and water, harming the land, and contributing to global warming, and environmental temperature rise. The major sources contributing to air pollution in coal mining-related activities and active mine fires and secondarily vehicular emissions, while windblown dust through unpaved roads also contributed to some extent. It is therefore important that a systematic study on coal mining areas is carried out to assess the effects of coal mining on the particular region and its environment, including, cultural, historical, and social aspects.

.**Keywords— Coal Mining, Jharkhand Coal field(JCF), Air Quality Index (AQI), Air Pollution Monitoring, Vehicular emission, Cardiovascular mortality, Mutagenicity**

1. Introduction

Air pollution can be defined as an alteration of air quality which can be characterized by the measurement of physical or chemical pollutants present in the air, which means the presence of unwanted impurities or the increase in the proportion of some pollutants or constituents in the atmosphere. Coal is one of the most abundantly available fossil fuels, It's need is so much necessary for the field of electricity or power generation. It is used in various industries such as power, steel, refineries, and cement industries as well

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

for domestic purposes and various local and small-scale industries. India is the third largest coal producer in the world. Coal mining is badly affected by soil, air, and water pollution. In[1] Air pollution, particularly in the form of smog, has caused a serious loss of amenities in winter months since the fourteenth century, but its impact on health was rarely recognized. Recently research has been done in this area perfunctory, haphazard, and largely without direction. In [2]A semi-empirical mathematical model, Urban Street Model (USM), is proposed to efficiently estimate the dispersion of vehicular air pollution in cities. This model describes urban, building arrangements by combining building density, building heights and the permeability of building arrangements relative to wind flow. In [3] the author selected four monitoring sites namely Ena colliery, Dhansar, Bastacolla and Bhagatdih were selected in different directions and distances in coal mining area of JCF for monitoring the air pollution of the mines area. In [4] Multivariate statistical analyses were adopted including principal component analysis(PCA) to identify the major sources of air pollutants in the area of JCF. According to WHO air pollution accounts for 1 in 8 deaths worldwide, approximately 7 million deaths in 2012[5] recently WHO publish an article where they said that 4.2 million deaths every year occur as a result of exposure to ambient(Outdoor) air pollution[6].IN[7] Author present a distributed infrastructure based on wireless sensors network and Grid computing chronology for air pollution monitoring and mining, which aims to develop low-cost and ubiquitous sensor networks to collect real-time, large scale and comprehensive environmental data from road traffic emissions for air pollution monitoring in the urban environment.

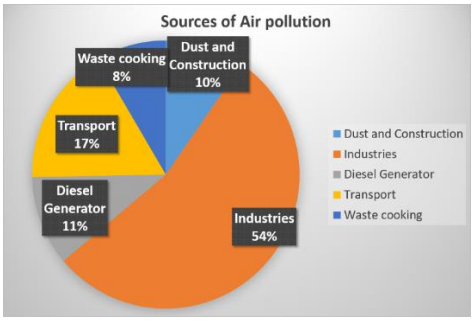

Figure 1 Sources of Air Pollution [8]

In Figure 1, the major contribution of air pollution is come out from the industries sector and after that transportation, both will be responsible for air pollution in mining areas.

1.1 Jharkhand Coal field(JCF): An Introduction

JCF has a long history of commercial mining. In India Coal mining covering nearly 220 years starting from 1774 by M/S Sumner and Haetly of East India company in the Raniganj coalfield along the western bank of Damodar river[9].The mining activities in Jharia is started in 1920s and its grows extensively and exponentially due to the availability of coal mines in this region. At present, there are more than 35 underground and opencast mines in the JCF. Mostly bituminous coal available and is the only cola-field in India that produces cooking coal, which is the prime need of power and steel industry. The coal mining has affected water, air, soil and has also led to the infamous coal mine fires that have remained active underground for more than a century [4]. These burning underground mines fires constitute a major cause of disaster and have also been damaging the precious natural resources. It is required to regular monitor the areas under fire, the direction of spread of fire and the number of fire so that one can understand the impact. Jharkhand coal mines area such as Jharia located in the co-ordinates of 23°45′5.6″N 86°25′13.2″E which is the largest coal reserves in India having estimated reserves of 19.4 billion tonnes of coking coal. Jharia is also the mostly polluted due to the extraction of coal. There are many other's mine present in

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

this state are Jaduguda uranium mines, Giridih coal mine, East and west Bokaro coalfield, Lalmatia colliery etc. Figure 2 shows the map of India in which we locate the Jharkhand state with few coal mines area i.e. Jharia, Bokaro, Singrauli and Raniganj. In our study the region chosen is mines of Jharia.

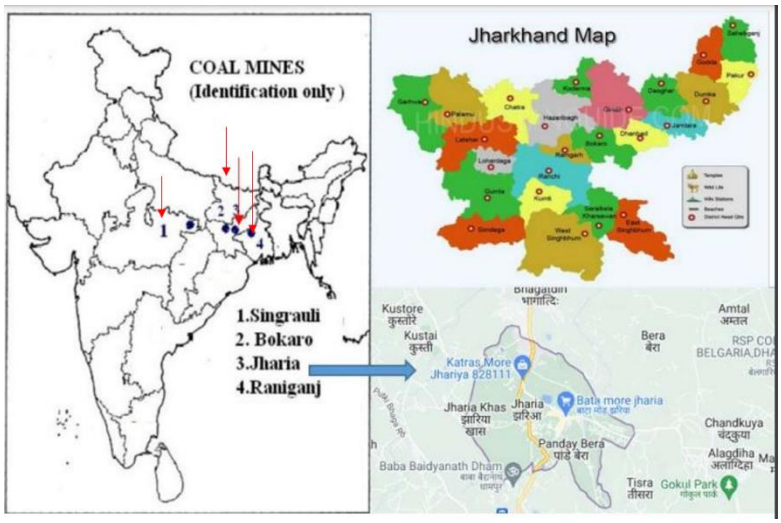

Figure 2 Map of Jharkhand with few coal mines area Jharia, Bokaro, Singrauli and Raniganj

2. Air Quality Index

AQI is the standard of the measurement of the air quality, each country has their own AQI standards and indices parameter. Different country has different regulating agencies of AQI as shown in Table 2.1. AQI levels per Indian Government is shown in Table 2.1. Different country has their own AOI value and colour marking scheme. In below Table 2.1. We show the AQI value corresponding to their remarks, indicative colour and possible health Impact factor. The AQI Indicative colour of red is the most dangerous zone and its responsible for respiratory illness etc. Recently it has been observed that the PM2.5 is the major pollutant of JCF. PM2.5 concentration in Jharia is currently 3 times the WHO annual air quality guideline value[10]

Table 2.1 AQI levels according to the Indian Ministry of Environmental protection,[11]

AQI Value	Remark	Indicative Colour	Possible health Impact
0-50	Good	Green	Minimal impact
51-100	Satisfactory	Parrot	Minor breathing discomfort to sensitive people
101-200	Moderate	Yellow	Breathing discomfort to the people with lungs, asthma, and heart disease
201-300	Poor	Orange	Breathing discomfort to most people on prolonged exposure
301-400	Very poor	Red	Respiratory illness on prolonged exposure
401-500	Severe	Marron	Affects healthy people and seriously impacts those with existing diseases.

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

2.1 AQI Computation

AQI is the main standard for the measurement of air quality and forecasting. AQI tells the people how clean or polluted the air is, Main Pollutants considered for the analysis (as mentioned by EPA) are SO_2, NO_2, CO, CO_2 and O_3 are measured in parts per billion(ppb), while PM2.5 and PM10 are measured in micrograms per cubic meter ($\mu g/m^3$). Below in equation 1 shown to calculate the AQI of a pollutant and its Index. Several parameters and values has been taken in consideration for the calculation of air quality index. In table 2.2 AQI breaking point is shown ,Which describe the level of various air pollutant up to remarkable and acceptable unit[11].The AQI range is categorised from 0 to 500 and with the proper level of health alert. As shown in table 2.2 the health alert is categorized in to seven different group ranging between 0-50 [Good], 51-100 [Moderate], 101-150 [unhealthy for sensitive group], 151-200 [unhealthy], 201-300 [very unhealthy], 301-400 [hazardous], 401-500 [Very hazardous]. The AQI breaking point of O_3, O3, PM2.5, PM10, CO, SO_2, and NO_2 are with the accurate health alert level is categorised in the table 2.2. Formula for calculating the AQI is also shown in equation 1.

$$I_p = \frac{I_{Hi} - I_{Lo}((C_p - BP_{LO}) + I_{Lo}}{BP_{Hi} - BP_{LO}}$$	Equation 1

$$I_p = \frac{I_{Hi} - I_{Lo}((C_p - BP_{LO}) + I_{Lo}}{BP_{Hi} - BP_{LO}}$$

Where, I_p = Index for pollutant p
Cp=Truncated concentration of pollutant p
BP_{Hi} = Concentration breakpoint that is >= Cp
BP_{LO} =Concentration breakpoint that is <= Cp
I_{Hi} = AQI value corresponding to BP_{Hi}
I_{LO} = AQI value corresponding to BP_{LO}

Table 2.2 AQI breakpoints for the AQI[11]

O_3(ppm) 8-h	O3(ppm) 8-h	PM2.5 ($\mu g/m^3$) 24-h	PM10 ($\mu g/m^3$) 24-h	CO (ppm) 8-h	SO_2 (ppb) 1-h	NO_2 (ppb) 1-h	AQI	Health alert
0.000-0.054	-	0.0-12.0	0-54	0.0-4.4	0-35	0-53	0-50	Good
0.055-0.070	-	12.1-35.4	55-154	4.5-9.4	36-75	54-100	51-100	Moderate
0.071-0.085	0.125-0.164	35.5-55.4	155-254	9.5-12.4	76-185	101-360	101-150	Unhealthy for sensitive groups
0.086-0.105	0.165-0.204	(55.5-150.4)[3]	255-354	12.5-15.4	(186-304)[4]	361-649	151-200	Unhealthy
0.106-0.200	0.205-0.404	(150.5-250.4)[3]	355-424	15.5-30.4	(305-604)[4]	650-1249	201-300	Very unhealthy
-	0.405-0.504	(250.5-350.4)[3]	425-504	30.5-40.4	(605-804)[4]	1250-1649	301-400	Hazardous

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

-	0.505-0.604	(350.5-500.4)[3]	505-604	40.5-50.4	(8005-1004)[4]	1650-2049	401-500	Very Hazardous

3. Biological environment

Ecology is the study of the relation and interaction between organisms and their environment. It comprises the flora and fauna communities of an area. With the changes in environmental conditions, structure, density and composition of plants, animals also undergo changes along with the changes in atmosphere too. The habitat of the animals may change and they migrate from one place to another. Thus it's a huge loss of biological mammals and birds.

3.1 Objectives of the Study

For Sustainable and eco-friendly development, biological environment, effects of flora and fauna with the human health is taken in to objective. This Study was taken with the following objective:

- To assess the nature and distribution of vegetation.
- To assess the health effects due to mining.
- To understand the study of water bodies and its effects.
- To assess the biodiversity.
- To Identify the parameters for assessing the impacts in Jharkhand Coal field(JCF).
- To identify the parameters which may enable the policy makers to revise the existing mine policies and implement new measures in mine planning and new regulation act so as to reduce the impact of mining on the environment.

3.2 Impact on Air

The study conducted by V Saini et al. [12] they observed that vehicular traffic and coal dust have maximum effect on the ambient air quality of Jharkhand coal field(JCF). Vehicles deploy on the roads and other roads cause the settled fine coal dust to be released in to the air and thus causing air pollution. Since the air quality is very much poor. Drilling and Blasting are the major cause of air pollution in these area. Fires release harmful and toxic gases during burning like NOx, SOx, PAHs, CO2, CO etc. and form the next cause of air pollution in JCF. Also illegal mining activities are one of the major source of air pollution. These gases are responsible for the smog and acid rain over JCF and surroundings area [13].They outlined the main sources of air pollution due to the coal mining in JCF and discuss the characteristics and effects of the pollutants.

3.3 Impact on water

. Coal mining operation in JCF have resulted in the decrease in the PH level and deterioration in the quality of the ground water[14].The study conducted by A.Saravanan et al[15] and V Saini et al [12] tailing ponds have been found to be most potential source of water contamination followed by acidic waters released from mines. They outlined that these sources contain toxic, hazardous chemicals in much higher concentrations, which will pollute the water and make it unfit for the domestic purposes and drinking. Any release from tailing ponds can severely affect the local water bodies making the water unsuitable for humans and animals. Even bathing in this ponds and water bodies may cause several skin diseases. Mining also has an impact on the groundwater.

3.4 Impact on Soil and Vegetation

The study conducted by V Saini et al [12] indicates that all the three factors i.e. wind erosion, coal dust from OB dumb or coal dumps and opencast mining, holed almost equal impact on the soil in JCF.It leads to generation of fine particles matter(PM), which slowly settles on the surface of the earth. This PM is consisting of toxic chemicals which leads to contamination of soil. It effects the soil contents, composition, quality and ultimately the plant growth. Loss of vegetation due to mining is the least potential cause of soil degradation. OCM leads to direct destruction of vegetation for installation of mining industry, machinery and clearing the area for drilling and blasting operations. This kills the soil

International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

microorganisms which is essential for plant growth and their overall development [15], [16]. Underground mining is also the cause of impact on vegetation. The coal which is mined out is stacked in the form dumps leading to clearing of the vegetation for the same. Hence settlements are also responsible for the destruction of vegetation as new areas are cleared for providing housing and accommodation facilities to workers and helpers in JCF.

3.5 Impact on Human

Exposure to coal mine dust causes various pulmonary diseases, including coal worker's pneumoconiosis(CWP) and chronic obstructive pulmonary disease(COPD). Since living in heavily mined areas increase the risk of lung cancer and respiratory disease. The level of exposure to pollution are highest in this areas with the most mountaintop removal. Scientists and researcher found a direct link between dust from mountaintop removal and lung cancer[17].From the Central Pollution control Board (CPCB) pollution control program in India (2010) the adverse health effects of the pollutant is shown in the table 3.1.

Table 3.1 Health effects associated with the pollutants[18]

Pollutant	Effects
Carbon dioxide(CO_2)	Particularly affects the nervous system, cardiovascular system, creating nausea and headaches.
Hydrocarbons(PAHs)	It has potential to cause cancer
Particulate Matter	Alter the immune system and penetrate deep in to the respiratory system which alter the ling tissue and causing long-term disorders.
Sulphur dioxide(SO_2)	Adversely affect the lungs function and respiratory system
Nitrogen Oxides(NO_x)	Responsible for pulmonary diseases, impairment of eye, nose and throat irritations.

3.6 Impact on Agricultural land and topography

Coal dust and open fire is the biggest source of contamination of agricultural land lying close to collieries in JCF as reported by Rai et al. [19].The factors affecting agricultural land and vegetation land are similar to those affecting the soil as given by V Saini et al. in (Table 7) [12].As fire moving underground, they may lead to raising the normal and surface temperature and making it not suitable for the growth of crop, as reported by Rai et al. and V Saini et al. [12], [19].OCM leads to removal of OB and creation of pits. This leads to troughs and the crest in the mining areas altering the topography fully.

3.7 Illegal Coal mining and its Impact

Coal is often very close to the surface in many areas of the Jharia coalfields, particularly in the context of the stagnant agricultural sector, that to dig it out is very simple. Illegal mining can be defining as, "Unethical and illogical cutting of coal seams beneath the earth surface without the prior permission of the coal mining authority". Saxena et al.[20] reported that the illegal mining in JCF is the human activity that can be controlled immediately by the agencies.

4. Conclusion

Coal mining has always been associated with negative impacts on the environment. Various studies revealed that air pollution due to mining are the combination of various pollutants which have the potential to result in adverse health effects, including cardiovascular mortality, mutagenicity, carcinogenicity and the aggravation of the health of the vulnerable group such as people with compromised health conditions like the asthmatics, children and elder. Acute exposures have resulted in hospitalization due to respiratory conditions while other health effects led to chronic exposures in the mine area. Therefore, it is recommended that effective heavy vehicle emission and outdoor air emission

DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

control strategies should be developed to ensure the effectiveness of air pollution control systems. Proper maintenance, inspection, clean the heavy vehicle, awareness program and use of clean and exact fuel is the ways to reduce emissions. Vehicles with PUC certificate will be allowed in the mining area. Proper steps could be taken by policy maker for modification of the existing mine policies and incorporating the new measures in future mine planning so as to reduce the impact of mining on the environment and human. The population living close to the mining areas are the worst affected. Thus, quantifying the impacts finding their casual factors and suggesting appropriate remedial measures are warranted for in mining areas. Also the regular maintenance of vehicles will be done to ensure the smooth running of Heavy duty vehicles(HDV) in the mining areas this would improve the environmental performance and may surely lead to sustainable and suitable mining practices.

References

[1]M. J. Chadwick, "Air pollution," *Bioenergy Environ.*, pp. 267–286, Jan. 2019, doi: 10.4324/9780429045639-10.
[2]O. V. Taseiko, S. V. Mikhailuta, A. Pitt, A. A. Lezhenin, and Y. V. Zakharov, "Air pollution dispersion within urban street canyons," *Atmos. Environ.*, vol. 43, no. 2, pp. 245–252, 2009, doi: 10.1016/j.atmosenv.2008.09.076.
[3]J. Lang *et al.*, "Science of the Total Environment Understanding the impact of vehicular emissions on air pollution from the perspective of regional transport : A case study of the Beijing-Tianjin-Hebei region in China," *Sci. Total Environ.*, vol. 785, p. 147304, 2021, doi: 10.1016/j.scitotenv.2021.147304.
[4]B. Pandey, M. Agrawal, and S. Singh, "Assessment of air pollution around coal mining area: Emphasizing on spatial distributions, seasonal variations and heavy metals, using cluster and principal component analysis," *Atmos. Pollut. Res.*, vol. 5, no. 1, pp. 79–86, 2014, doi: 10.5094/APR.2014.010.
[5]"Technical Assistance Document for the Reporting of Daily Air Quality | AirNow.gov." https://www.airnow.gov/publications/air-quality-index/technical-assistance-document-for-reporting-the-daily-aqi/ (accessed Dec. 09, 2021).
[6]S. Sarkar, A. Chauhan, R. Kumar, and R. P. Singh, "Impact of Deadly Dust Storms (May 2018) on Air Quality, Meteorological, and Atmospheric Parameters Over the Northern Parts of India," *GeoHealth*, vol. 3, no. 3, pp. 67–80, Mar. 2019, doi: 10.1029/2018GH000170.
[7]Y. Ma, M. Richards, M. Ghanem, Y. Guo, and J. Hassard, "Air Pollution Monitoring and Mining Based on Sensor Grid in London," *Sensors*, vol. 8, pp. 3601–3623, 2008, doi: 10.3390/s8063601.
[8]"File:Sources of Air Pollution.png - Wikipedia." https://en.wikipedia.org/wiki/File:Sources_of_Air_Pollution.png (accessed Nov. 25, 2021).
[9]"Ministry of Coal, GOI." https://coal.nic.in/ (accessed Jul. 13, 2022).
[10] "Jharia Air Quality Index (AQI) and India Air Pollution | IQAir." https://www.iqair.com/in-en/india/jharkhand/jharia (accessed Jul. 14, 2022).
[11] "National Air Quality Index." https://app.cpcbccr.com/AQI_India/ (accessed Dec. 02, 2021).
[12] V. Saini, R. P. Gupta, and M. K. Arora, "Environmental impact studies in coalfields in India: A case study from Jharia coal-field," *Renew. Sustain. Energy Rev.*, vol. 53, pp. 1222–1239, Jan. 2016, doi: 10.1016/J.RSER.2015.09.072.
[13] S. K. Yadav, M. K. Jain, and D. K. Patel, "Monitoring of Air Pollution in Different Regions Along Road Network, Jharia Coalfield, Dhanbad, India," pp. 125–134, 2018, doi: 10.1007/978-981-10-5792-2_10.
[14] "Water pollution from coal washeries and its impact on Damodar river (Journal Article) | ETDEWEB." https://www.osti.gov/etdeweb/biblio/21059038 (accessed Jul. 14, 2022).
[15] A. Saravanan *et al.*, "A comprehensive review on sources, analysis and toxicity of environmental pollutants and its removal methods from water environment," *Sci. Total Environ.*, vol. 812, p. 152456,

DOI:10.46647/ijetms.2022.v06i05.114 ISSN: 2581-4621

Mar. 2022, doi: 10.1016/J.SCITOTENV.2021.152456.
[16] P. Aakko-Saksa *et al.*, "Comprehensive emission characterisation of exhaust from alternative fuelled cars," *Atmos. Environ.*, vol. 236, Sep. 2020, doi: 10.1016/j.atmosenv.2020.117643.
[17] A. K. Yadav and A. Jamal, "Impact of mining on human health in and around mines," *Environ. Qual. Manag.*, vol. 28, no. 1, pp. 83–87, Sep. 2018, doi: 10.1002/TQEM.21568.
[18] "CPCB | Central Pollution Control Board." https://cpcb.nic.in/monitoring-network-3/ (accessed Feb. 25, 2022).
[19] A. K. Rai, B. Paul, and G. Singh, "A study on the Bulk density and its effect on the growth of selected grasses in coal mine overburden dumps, Jharkhand, India," *Int. J. Environ. Sci.*, vol. 1, no. 4, 2010.
[20] N. C. (Naresh C. Saxena, "Reinventing Jharia coalfield," p. 245, 2005.