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Impact Assessment of Mining Activities on Environmental Degradation: A Geographic Study of Air Pollution in Bikaner District (Rajasthan)

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Abstract

In the present century, environmental degradation has emerged a major global concern for human survival. The srains of the ecological crisis are so apparent that the task to preserve and protect the environment has become the primary requisite of the economics of development. The resource squeeze has led to an ever- intensification of ecological damage. Industrialisation has been closely related to the utilization and, often enough, exploitation of the earth's surface. Many of the raw materials and energy sources used in the industrial production are obtained directly from the earth through mining of minerals, or from the biological sources.

The mining as an activity not only removes the fertile top soil, along with the flora and associated fauna, but also creates deep depressions that are a sore to the eyes. It renders the earth unproductive. That's why the mining has been christened as a 'robber economy'. Bikaner district has an assortment of sedimentary minerals which include non-metallic minerals and lignite as an energy source. Mining as a complementary activity to industrialization may be deemed to have created degradation of the environment and landscape in the district.

Keywords: Mining, Robber Economy, Exploitation of the Earth's Surface.

Introduction

The environment is an integrated system in which all its elements act and react in such a way that a balance is always maintained. All the physical elements i.e. relief, climate, natural vegetation, soil, water bodies etc.are the determining factors of environment on the one hand, and man's activities on the other. Man is a user of the environment for his developmental activities and always disrupts this natural system and creates a background for environmental degradation.

The environmental consequences have been at the centre-stage of debate since 20th century and the resource depletion and pollution have become the most challenging problems of discussion. Large scale, automated production in the industries, coupled with excessive growth rate of population necessitates intensive exploitation of the mineral and energy resources. Now, the environment is sufficiently saturated by the complex chemical emissions, aerosols, toxic effluents, sewage, pesticides, solid wastes, dust and radiation.

The mining activities have been done since Bronze Age. At those times, the population and consumption levels were very low. So, effects of mining and manufacturing, in any form were limited. With the arrival of Industrial Revolution and growth of population the demand for raw material increased geometrically. There was a spurt in mining activity and geo-environmental degradation due to vegetation, soil and faunal loss. Therefore, mining and industrialization have vital economic significance but possible serious consequences for our life support system in the form of resources and environment. The mining areas have quickly turned into degraded landscapes, or mine spoils (Bell, Fred G. and Donnelly, Laurence J.; 2006).

The mining is a physio-economic activity with deep consequences for the environment. Excavations at the mines create a landscape of creaters/dry-outs and west or over burden dumps. It destroys the fertile top soil. Since, soil and vegetation are interrelated; removal of soil and over burden destroys the forests, farmlands and pastures in the wealth of the area. Stacks of waste or overburden are hazardous and potentially

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disasterous because natural or authropogenic factors can set-up landslides or soil creeps. For the miners working itself is hazardous to health and life because of highly dusty ambience and unstable earth (Chaudhuri, A.B., 1992)). Air pollution due to dust or suspended particulate matter is perhaps the most serious from of pollution in the mines. Besides SPM, it can occur through oxides of sulphaur and nitrogen. Air pollution from industries and automobiles is, perhaps most extensive and unboundable form of pollution. Processing of raw material, for e.g. in cement and Plaster of Paris industries ejects a large amount of SPM in the air. Fly ash from thermal power plants contributes greatly.

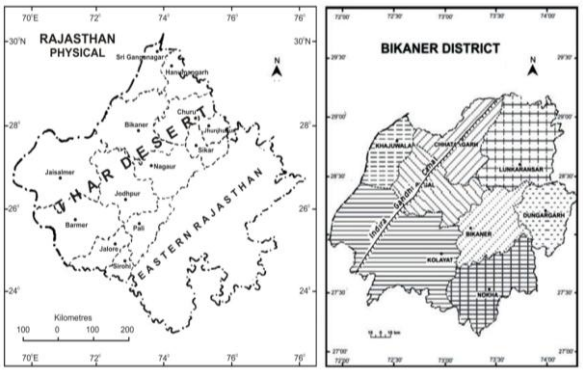
Soil and land pollution is another form of environmental degradation which can be perpetuated by mining and industrialization. Non-degradable, inert solid wastes like those emanating from ceramic tiles and sanitaryware industry, for e.g., degrade the soil quality, hamper ecosystem functioning and impart unaesthetic looks to the ambient setting. Water pollution can occur at mines when SPM fall out, leachates from workshop and sewage and surface flow from over the mineral and OB reaches the drains and ultimately, surface or ground water resources. This study work lays emphasis upon impacts of mining activities on environment in the study area.

In the western arid region of Rajasthan, the economic scenario began to change after the attainment of statehood and following the effects made by the government. Extension of canal irrigation through IGNP, and tube-well irrigation following electrification, has transformed agriculture. Livestock rearing has been commericalised as a result of development of infrastructure. Minerals and lignite wealth has been utilized in clay-based industries, producing goods mainly for construction activities, and now in thermal power plants. Industrialisation has based itself upon agricultural products, livestock products and mineral resources.

Location and Extent

Bikaner district is located between 27°11' and 29°03' north latitudes and 71°54' and 74°12' east longitudes by covering an area of 30289.62 sq km. It lies in the north- western part of Rajasthan and is bounded by Sriganganagar district in the north, Churu and Hanumangarh districts in the east, Nagaur and Jodhpur districts in the south and south-west, and Jaisalmer district and Pakistan in the west.

LOCATION MAP



Objectives of Study

The study is aimed to evaluate the impact of mining activities on air pollution and to suggest its controlling measures in the study area.

Hypotheses

1. There are favourable conditions for mining due to good quality of mineral deposits.
2. The environmental degradation is the result of unsystematic mining activities running in the study area.

Source of Data and Methodology

The present study is based on primary as well secondary sources of data. The data and information regarding geographical beckground of the study area, infrastuctue, type of mining and employment etc. has been collected from various secondary sources like District Statistical Outline, Department of Mines and Geology, RIICO and District Industrial Centre. Analysis reports on mining and industrial wastes and pollutants, and Environmental Impact Assessment (EIAs) reports of various mines have been collected from Rajasthan State Pollution Control Board (RPCB), Bikaner.

In order to generate information, and to know the perception of people regarding impacts of mining on environment, two separate primary field works during August and September, 2013 which included 165 and 210 respondents living near various mining and industrial units or engaged in these activities. Occupationally, these were found to work as mine owners, private workers, labourers and local residents. The data obtained from fieldwork were tabulated, analysed and presented by using cartographic techniques.

Mineral Resources

Most parts of Bikaner district are covered with sedimentary basins of Phanerozoic age and completely lack igneous and plutonic rocks, which are associated with metallic minerals. Though lacking in metallic minerals, the available mineral wealth of the district has been instrumental in the development of industrial activities here. The major minerals mined here include clay and ceramic minerals like ball clay, china clay, fire clay; Fuller's earth, gypsum, gravel, calcrete and sandstone. Clay and ceramic minerals are used in industries such as sanitary ware, electric insulators, white ware, floor and wall tiles and pesticides (Khandelwal, D.K. *et al.*; 2004). The main mineral of the study area are as described below:

Lignite

The district is sufficiently rich in lignite or brown coal, which is a low quality, immature type of coal formed in Tertiary age. A thermal power plant has been established at a place called Barsingsar, about 35 km from Bikaner and run by Neyveli Lignite Corporation. The chief deposits of lignite in the district are as follows-

Palana

The first deposits of lignite in Rajasthan were discovered at Palana, 23 km southwest from Bikaner district, in 1896. The deposits here spread over an area of 16.71 sq. km., and occur at depth of 40 to 98m from the surface and in a thickness of 18 metres. The deposits contain 3.5 – 8 per cent ash, 20-30 per cent inflammables and 21 per cent stable carbon. The estimated deposits are 23.57 million tonnes.

Barsingsar

These mines are located at a distance of 25 km from Bikaner and a distance of 3 km to the south-west of Palana. The mines spread over an area of 53.5 sq km, and occur in a thickness of 6 to 45.5 m at a depth of 67 m. The lignite contains 2.4 -10 per cent ash, 20-28 per cent inflammable matter, 16-28 per cent stable carbon and gives heat at the rate of 3000 Kcal/kg. The estimated reserves are 77.83 million tonnes.

Bithnok

This area extends over an area of 3 sq km, about 30 km west of Kolayat. The layers themselves are 2-14 m thick and are at a depth of 100-150 m. The reserves are 78 million tonnes and contain 15-20 per cent ash and 20-25 per cent inflammable matter.

Gurha

The mine extends over an area 9 sq km at a distance of 22 km north-west of Kolayat. The layers are 38-148 m deep and 20-27 m thick. Total estimated reserves at Gurha East and Gurha West are 50 million tonnes. The ash content is 11.9, inflammable matter 31.81, stable carbon 21.28 per cent, while heat value is 2867 Kcal/kg.

Mandal Charnan

The mine area extends over 8 sq km, 20 km south-west of Kolayat. The deposits occur in layers of 0.20-6.10 m thickness and 120-138 m depth, containing 12.77 per cent ash, 18.54 per cent inflammable matter and 22.94 per cent stable carbon. The reserves are around 17.7 million tonnes.

Raneri

This mining area is located at a distance of 80 km south-west of Bikaner and spreads over an area of 28 sq km. An estimated 44.66 million tonnes of lignite are found at a depth of 48.5-134.4 m with a thickness of 0.50-12 m.

Explorations for lignite are underway at Hadla-Bhatian, Akkasar, Lalamdesar, Bhojasar, Gajroopdesar, Surpura, Gajner, Chaneri, Swaroopdesar and Payau in the district.

Clays

Various types of clays are mined in Chandi, Gurha, Marh, Kotri, Indkabala, Khari Charanan, Madhogarh and Suraj ki Dhani etc. areas of Kolayat tehsil of the district.

Gypsum

It is used in the production of Plaster of Paris and is obtained from Hansera evaporite of Marwar Supergroup from mines at Anandgarh, Ballar, Berianwali, Dantor, Kundal, Jamsar, Lunkaransar, Kavri, Akkasar, Bharu, Ghand etc.

Limestone

It is obtained from Dava Silva in Nokha tehsil.

The production and export of minerals brings in a huge amount of revenue to the district. A large amount of clays, gypsum, limestone and lignite is exported outside the district and the State because there is insufficient infrastructure and technology for the processing and value addition to the raw material produced. These factors combine to ensure that, generally, the value of the produced goods is not competitive in the national market. Hence, the study area remains a net exporter of good quality raw material, available in profusion, but not of the manufactured goods, thus losing the opportunity of taking lead given by the natural advantage.

Mining and Air Pollution

All the major as well as minor components of the air are biologically important and the participation of each in the living processes is in some cases critically sensitive to slight changes in concentration. whenever the proportion of the components is disturbed by human activities, that becomes a cause of air pollution, which nowadays has become a major global problem (H M Saxena, 1999).

The mining process releases a lot of particulate matter into the atmosphere, creating air pollution, inhibiting insolation and exposing the people to the risks of asthma and other respiratory problems. The workers in the mines are the most exposed people being nearest, to particulate matter pollution. They fall prey to silicosis and tuberculosis of the lungs, and often die young. The particulate matter settling on the leaves not only bars the photosynthesis process but also the transpiration which occurs through the vacuoles of the leaves. The nearby structures and buildings can also be covered by the soil and mineral power emanating from the mining site. For example, the lignite handling plant, crushers, conveyors, transfer points etc. at Gurha East Lignite Mine, Kolayat tehsil are the probable point for emission of particulate matter into the air. Sprinkling of water is being practiced to control fugitive emissions from haulage roads. High efficiency bag filters are being installed at the site to check fugitive emission from crushing operations, conveyor belts and transfer points.

Mining operation also leads to release of gases like Sulphur dioxide, Nitrogen Oxides etc. when the rocks in the mines are disturbed and exposed to air. Oxidation of the constituents of the minerals, like sulphur and nitrates, causes formation of such pollutive oxides. These oxides are the agents for formation of acid rain, and can cause various health problems for those who come in contact while working or living nearby. The ambient air quality at the Gurha lignite mine, Gurha power plant and at sites located 5 km or more from Gurha lignite mine is shown in table 1.

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Table 1
Bikaner District- Level of Air Pollution at Lignite Mining Area

Suspended Particulate Matter (µg/m^3)					
Village	**Site**	**April 2013**	**May 2013**	**June 2013**	**Mean**
Gurha	Gurha Mine	151.2	167.5	161.8	160.2
	Rasemadaniya Mine	82.3	99.9	98.1	93.4
	Gurha Power Plant	110.7	130.5	135.0	125.4
	Sankhla Ki Basti, Gurha (0.5-1.5 km)	81.8	108.3	102.4	97.5
	Nearby Sites (>5km)	93.2	97.9	91.6	94.2
Bithnok	Rampura Mines	154.16	155.29	220.39	176.61
	Bithnok Village (0.5 - 1.5 km)	160.95	176.37	209.30	182.21
	Nearby Area (>5 km)	149.89	191.68	227.65	189.74
Respirable Suspended Particulate Matter (µg/m^3)					
Gurha	Gurha Lignite Mine	151.2	167.5	161.8	160.2
	Rasemadaniya Mine	82.3	99.9	98.1	93.4
	Power Plant	110.7	130.5	135.0	125.4
	Sankhala Ki Basti, Gurha (0.5 - 1.5 km)	81.8	108.3	102.4	97.5
	Nearby Area (>5 km)	93.2	97.9	1.6	94.2
Bithnok	Lignite Mine, Rampura	46.71	51.85	71.60	56.72
	Bithnok Village (0.5-1.5 km)	50.55	57.41	70.31	59.42
	Nearby Sites (>5 km)	49.33	63.66	73.24	62.08
Sulphurdioxide (µg/m^3)					
Gurha	Gurha Mine Area	11.6	12.8	12.4	12.3
	Rasemadaniya Mine	7.1	8.5	8.8	8.1
	Gurha Power Plant	10.9	12.4	12.9	12.1
	Sankhala Ki Basti, Gurha (0.5 - 1.5 km)	7.65	9.25	8.95	8.62
	Nearby Area (>5 km)	8.30	8.67	8.73	8.57
Bithnok	Rampura Mine Area	4.02	4.19	3.91	4.04
	Bithnok Village (0.5-1.5 km)	4.04	4.28	5.30	4.54
	Nearby Sites (>5 km)	3.01	3.62	4.36	3.66
Nitrogen Oxide Levels (µg/m^3)					
Gurha	Gurha Mine Area	14.1	15.0	14.2	14.4
	Rasemadaniya Mine	8.6	10.3	10.8	9.9
	Gurha Power Plant	14.3	14.4	15.1	14.6
	Sankhala Ki Basti, Gurha (0.5 - 1.5 km)	9.75	12.45	12.0	11.40
	Nearby Area (>5 km)	10.5	11.67	11.5	11.20
Bithnok	Rampura Mine Area	7.18	6.86	6.95	6.99
	Bithnok Village (0.5-1.5 km)	6.82	7.71	8.85	7.79
	Nearby Sites (>5 km)	5.26	6.21	7.22	6.23

Source: Field Survey conducted during April- September, 2013

The total SPM is a general indicator of dust pollution. Dust particles beyond a threshold size do not enter human body through respiratory system. Hence, Respirable Particulate Matter (RPM) or Respirable Suspended Particulate Matter (RSPM) is a more exact indicator from the human health view. RPM includes smaller dust particles that can easily enter in our lungs through nostrils when we breath in. The status of Suspended Particulate Matter, Respirable Suspended Particulate Matter, Sulphurdioxide and Nitrogen Oxide (µg/m3) at and around Lunkaransar selenite mining area is shown in table 2.

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Table 2
Bikaner District- Level of Air Pollution at Lunkaransar Selenite Mines

Suspended Particulate Matter (µg/m^3)			
Site	**Maximum**	**Minimum**	**Mean**
Core Mining Area- Lunkaransar	237	162	200.7
Buffer Zone - Rajhan	245	177	216.5
Jakharwala	253	175	212.5
Kalwas	263	166	218.8
Respirable Suspended Particulate Matter (µg/m^3)			
Core Mining Area- Lunkaransar	93	63	78.5
Buffer Zone- Rajhan	103	70	90.7
Jakharwala	108	73	86.9
Kalwas	107	65	87.8
Mean Buffer	106	69.30	88.5
Sulphurdioxide (µg/m^3)			
Core Mining Area- Lunkaransar	11.2	7.6	9.7
Buffer Zone - Rajhan	11.8	6.8	9.1
Jakharwala	10.6	6.4	8.5
Kalwas	12.1	6.6	9.7
Mean Buffer	11.5	6.6	9.1
Nitrogen Oxide Levels (µg/m^3)			
Core Mining Area- Lunkaransar	14.3	10.8	12.8
Buffer Zone - Rajhan	17.6	10.6	12.7
Jakharwala	13.1	8.3	10.1
Kalwas	14.0	9.7	11.2
Mean Buffer	14.9	9.5	11.3

Source: Field Survey conducted during April- September, 2013

Problems and Suggestions

The presence of mines in an area can usher in quite a few problems for those living nearby. These may take the form of physical, environmental, hygiene or aesthetic problems. Physically, the presence of deep crater-like structures creates hindrances to free movement of man, wildlife and traffic. The uneven topography engendered by the mines also obstructs the further growth and extension of human settlements, infrastructure and activities.

In this scenario, the mine areas can be seen as source of problems. The respondents from different mining areas of Bikaner district have been asked to rank the first three basic problems arising from the mines. The outcome shows that the chief problem, as perceived by them, are the respiratory problems causing bronchitis, emphysema, asthma and lung cancer due to exposure to polluted air. The diseases like cough, shortness of breath, spasm of the larynx and accute irritation to membranes of eyes are considered to be the second main problem while the third problem, in order of preference, is perceived to be allergy.

A vast majority of the respondents have felt that the use of air filters in mines should be given the first priority. Development of green belt to improve the atmospheric composition in the mining areas is accorded the second priority. Control Over smoke and dust has been given the third preference by many of the respondents. And the fourth and last priority was given to assorted views, including the continuation of the present practices.

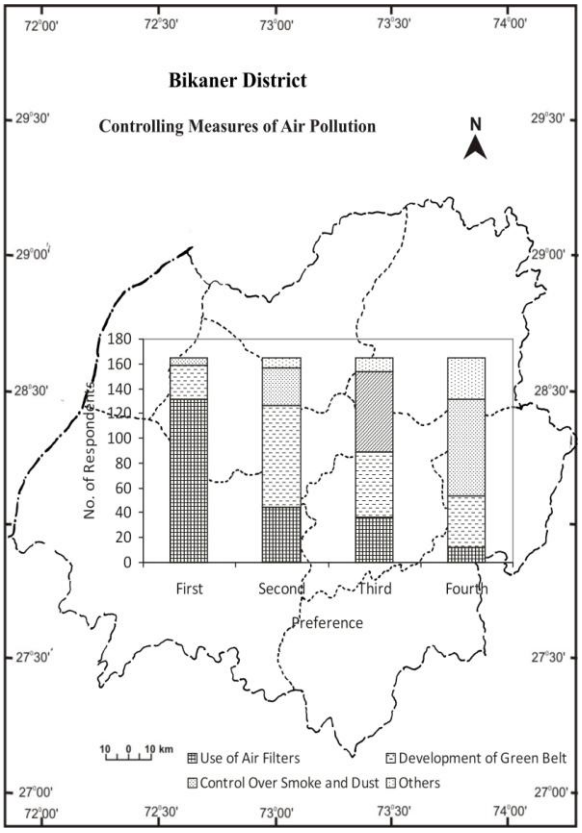

Table 3
Bikaner District- Controlling Measures of Air Pollution

Measures	Preference			
	First	Second	Third	Fourth
Use of Air Filters	131	44	36	12
Development of Green Belt	28	82	53	42
Control Over Smoke and Dust	6	31	65	77
Others	0	8	11	34
Total	165	165	165	165

Source: Field Survey conducted during April-September, 2013

Conclusion

Mining as an economic activity is related to the retrieval of minerals and resources from the upper or sub-surface layers of the earth. This process involves disturbance of the rocks and soil, which almost inevitably causes release of soil particles into the atmosphere. Automated mining not only increases the efficiency of the process but also the amount of particulate matter going into the ambient air. This particulate matter not only affects the health of the mine workers, causing respiratory system diseases like silicosis and T.B., but also the growth and development of trees and plants. The particulate matter settling on leaves also affects the process of photosynthesis and transpiration. The mining operation also leads to release of gases like Sulphur dioxide and Nitrogen Oxides when the rocks in the mines are disturbed and exposed to air.

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