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RESEARCH ARTICLE

STUDIES OF THE AREA AROUND SINGRAULI COAL FIELD & ENERGY BELT, DISTRICT SIGRAULI, MADHYA PRADESH INDIA

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Abstract

The geoenvironmental studies in the area around Singrauli coalfield in parts of Sidhi district, M.P. were taken up by the authors. An area of about 1000 sq. km., was covered' bounded by latitudes 24° 00′ to 24°15′ and longitudes 82°8′ 25″ to 82° 50′ in parts of survey of India toposheet Nos. 63L/7, 8. 11, 12, 15 and 16 on scale 1:50,000, supplemented by air photo and Landsat imagery studies. Geologically the area is occupied by Achaeans, Bijawars (Sidhi group) and Gondwana Supegroup of rocks (Lower Gondwanas) and Quaternary sediments. Geomorphologically, the area is comprised of ten surfaces among these, two are Quaternary surfaces and eight are Pre-Quaternary surfaces. These surfaces are characterized by distinct elevation, slope, drainage, pedogenetic characters, land form elements and morphogenetic expression. The groundwater occurs in the area in three distinct geological formations viz Bijawar, Gondwana Supergroup and Quaternary deposits. The Gondwana and Quaternary deposits form good groundwater aquifers, both at shallow and deeper levels and contain adequate water potential at an average depth of about 65 m. Though the area posses' good potential of groundwater inspite there is dislocation in hydro-ecology due to extensive development of energy belt ,power corridor associated industrialization and urbanization. The study of various land use aspects in the area with the help of different thematic maps indicates that an area about 335 Sq. km (33.5%) is occupied by forest 475 Sq. km. (47.5%), by agriculture land 100 Sq, km (10%), by mining area 75 Sq. km (7.5%), by industries 54 Sq. km. (5.4%), 255 Sq, km (25.5%) by dissected land / land degradation and an area of about 160 sq, km (16%) is occupied by water bodies. Deforestation of the area is excessive and it is anticipated that about 88 Sq, km. area will suffer deforestation by over all mining activity. It is about 23% of existing forest reserve. As a corrective measure and to keep balance in various factors of ecosystem, an area of about 190 Sq. Km is suggested for environmental forestry. The scarification of agricultural land is anticipated to be of the order of about 200 Sq, km, as a result of mining activities, industrialization, urbanization and industry based settlements. It is about 14.50% of existing agricultural land. The Singrauli area has estimated reserves of

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coal of about 9000 million tones. The proposed target of coal production by 2020 was about 210 million tones and in ideal conditions it is expected to be 250 m. tones where it will generate overburden of the order of about 3400 million cubic metres. The scarification of land, forest and waste generation is going to be staggering and alarming which need advanced planning of waste management. The establishment of mining industry, super thermal power plants and other coal based industries have resulted in the loss of top soil of an area about 75 Sq, km, it is about 7.5% of the area studied and has aggravated the problem of land degradation. The estimated area of land degradation by natural processes and man-made activities is about 255 sq. km., it is about 25.5% of the area investigated. It includes an area of about 75 sq, km. of ravines (badland area), of 100 sq, Km. of quarriable mine, 75 sq, km, loss of top soil by mining, coal based industries and their establishments and 5 sq, km for other mass wasting activities. The land degradation in the area by natural processes has posed a serious problem to agricultural land, road, railway lines and other built up features, whereas the man made land degradation has reduced the area of infiltration of rain water and has created siltation problems for Govind Ballabh Pant Sagar. The generation of overburden by coal mining is estimated to be of the order of 3400 million cubic metres . It can be disposed of by dumping it in the ravenous tract around Manihari, Taldah, Gigri and south of Suhare. It will help in reclaiming these areas and will prevent further erosion of land. The surface and subsurface water and top soil of the area is being polluted by mining activities, industrial effluents, disposal of mining waste, ash ponds and other pollutants. The air around Singrauli coalfield shows high concentration of SO_2, NO_2, CO, suspended particulate matter (SPM) and hydrocarbons. It is due to coal mining activities, excessive emission of smoke and fly ash from super thermal power station and other coal based industries. The noise level has been maintained below 90 dz as observed by NTPC and mining authorities. It appears to be at higher side due to excessive mine, blasting, coal transportation and coal handling operations of industries, super thermal power station and vehicular traffic. The coal mining activities and rapid industrialization in the area around Singrauli coal field has also resulted in migration of wild life habitats and local tribal population.

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Introduction:-

The Singrauli is situated In North Eastern Parts of Madhya Pradesh . It is granted a district status on 24 May 2008 with headquarters at Waidan after seprating the three eastern Tehsiles of erstwhile Sidhi district. Singrauli is rich in coal deposits, emerging as India's Energy capita of India and locally is called as 'URGANCHAL' which means land of Energy. The environmental studies of the area around Singrauli coal field in parts of district Singraul M.P. were taken up to for overall environmental appraisal of the area and geoenvironmental management with respect to coal mining activities and industrial growth to assess and evaluate the adverse effects due to haphazard anthropogenic activities and other processes leading to deterioration of the natural eco-system. An Area of about 1000 Sq. Km. bounded by latitude 24°00' to 24°15' and longitude 82°25' to 82°50' in parts of Survey of India toposheet Nos. 63L/7, 8, 11, 12, 15 and 16 was covered on scale 1:50,000 with aid of air photos and LANDSAT imageries.

Previous Work:

The presence of coal in Singrauli coal field was known as early as 1840, when Capt Wroughton located coal in Kota in Mirzapur districts. The first officer of Geological Survey of India who visited this field was Mallet (1872) and examined the coal out crops in a systematic manner. It is a pity that his monumental work was never published and has remained in the archives of the survey. R. D. Oldham reexamined the area in 1894. K.P.Sinor in 1923 described

various exposures of coal in his report on the mineral resources of Rewa State. Coulson in 1923 made a rapid reconnaissance in UP sector of coal field in connection with a Railway Survey Project. Fox (1934) also confirmed large potential of coal field but expressed pessimism because of the poor quality of coal. Ahmed also studied the Kota area in 1948 – 53. The resurvey of the coal field commenced in 1958 by K. G. Ghosh and others who unraveled the real potentiality.

Present Work:

The present study has been carried out, keeping in view the basic objective of Geoenvironmental problems of Singrauli Coal Field area like mining, land degradation, soil erosion, industrialization, urbanization and pollution of air, water and soil. To evaluate and assess these problems, various, thematic maps have been prepared on geology, geomorphology, soil, slope, geohydrology, land use - land cover and environmental hazards Khan et. al (1989). Besides, an attempt is made to evaluate the nature and extent of pollution of the surface groundwater and soil due to coal mining and coal based industries in the area. In addition the scientific data and other information gathered from various other agencies pertaining to Singrauli coal field area have been used in present work for presenting the comprehensive picture of geoenvironmental situation in the area.

Geology:

The area is occupied by Archaean, older metamorphic, Bijawars, Gondwana Surper Group of rocks and Quaternary sediments. The general stratigraphic sequence of these rocks in the area is as follows.

GROUP	FORMATION	LITHOLOGY	AGE
	Quaternary sediments	Sand, Silt and clay	Sub recent to Recent
	Raniganj (215 – 405 m)	Sandstone and shale with coal seam including 134 m. thick Jhingurdha seam	Upper Permian
Gondwana Super Group (Lower Gondwana)	Barren Measure (125 – 300 m.)	Sandstone with greenish shale band	Middle Permian
	Barakars (305 – 600 m.)	Sandstone with carbonaceous shales clays and coal seams	Lower Permian
	Talchir (70 – 130 m.)	Tillites, Sandstones, Siltstones and boulder bed.	Upper Carboniferous
==========UNCONFORMITY==========			
	Bijawar	Phyllite, quartzite, limestone and shale	Lower Proterozoic
Archaean Sidhi Group	Archaean sediments	Granite gneiss with quartz vain/pegmatite and limestone band	Archaean

The Archaean forms the basement in the area and consists of granites, gneisses with quartz pegmatite and limestone. The Bijawars are represented by quartzite, limestone, phyllite and shales. **(Plate No._II)**

Geomorphology:

The Singrauli coal field falls in Son and Rihand sub basin of Ganga Sub-basin. It stands as a plateau over the surrounding plain covered by Talchir sediments. The Barakar sediments project over Talchir outcrops as scarp rocks which form series of East-West trending Hogback ridges. The Singrauli surface rises to a height of over 500 m. above m.s.l. The plateau which refers to as Mohar plateau has series of step like scarp faces towards south. These appear to represent different stages of peneplanation. The Gondwana rocks which constitute the upland in the central part of the area form the distinct north south water divide. The northern part of the area is drained by Khakhan and Bijul rivers which have westerly and easterly flow trend and being of perennial nature, debouche in Son River much further north. The area in the south is drained by number of perennial streams which emerge from the Barakar plateau, the prominent being the Matwani, Baliya and Kachan, Mayor which debouch in the Rehand reservoir.

Based on morphometric expression, elevation landform elements, drainage, erosional and depositional activities, slope characteristics, soil, land use pattern, the area is divided into ten surfaces between 270 to 500 m. The geomorphic sequence of these surfaces in order of decreasing antiquity is as follows.

----------Active flood plain surface of Kachan and Mayar Rivers----------
(265 to 270 m.) above m.s.l.

----------Aggradation and Degradation of younger alluvium----------

Palaeo flood plain surface of Kachan and Mayar River Jaitpura – Jawari Surface (270 to 280 m. above m.s.l.)

----------Peneplanation----------

Waidhan Surface
(280 to 300 m. above m.s.l.)

----------Peneplanation----------

Pipra – Almari Surface
(300 to 340 m. above m.s.l.)

----------Pedimentation/Peneplenation----------
Vihara Surface
(340 to 360 m. above m.s.l.)

----------Dissection/Pedimentation----------

Singrauli Surface
(360 to 380 m. above m.s.l.)

----------Peneplanation----------

Barokhar Surface
(400 to 430 m. above m.s.l.)

----------Dissection / Pedimentation/Partial/Aggradation----------

Gondwana / Precambrian Plateau
(430 to 500 m. above m.s.l.)

----------Dissection and Penneplenation----------

Muber Surface (High level Plateau)
(500 m. above m.s.l.)

Landuse and Environmental Aspect:
The study of land use and land cover, both existing as well anticipated, forms one of the primary requisite to assess and evaluate the geoenvironmental situation directly related to geology, geomorphology, geohydrology, morphometry and pedology. In the present study of Singrauli coal Field area, five aspects of land use viz (i) Forestry, (ii) Agriculture, (iii) Mining, (iv) Industries and (v) Land Degradation have been taken into consideration with special reference to mining activities, coal based industries and urbanization. The study has been carried out with the help of Air photos, LANDSAT imageries, survey of India top sheet and data collected from area from the field observations.
(Plate No_I)

Forest:
The area around Singrauli Coal field is covered by thick forest. This area can be categorized as: (i) Reserved Forest (ii) Protected Forest and (iii) Open Shrubs

This different category of forest includes dense jungles, open mixed jungles and fairly dense jungles of Bija, Mohua, Amla and Salpalash. The total area under forest cover is about 335 sq, km. which is about 33.5% of the total area.

The Singrauli Coal Field which is known as energy belt of India has one of the largest coal reserve in the world. The estimated coal reserve is about 9000 million tones. The coal mining activities, establishment of various super thermal power stations, fertilizer plants, other coal based industries.The collective impact of development and industry based settlements in the area in the last two decade has significantly reduced the forest reserve and has adversely deteriorated the eco-system. The anticipated area of deforestation is about 58 sq. km which is about 23% of existing forest reserve.

Impact Of Deforestation:
The impact of deforestation can be grouped into the following:
1. Deforestation has rendered the topography barren which in turn has increased soil erosion and consequently silting of Govind Ballabh Pant Sasar Reservoir and reduction in its catchment area.
2. Forest eco-system contributes a lot of organic matter to soil for increasing the fertility of land in form of leaf fall, branches, fruits etc thus deforestation has reduced the fertility of land.
3. The deforestation has increased the run off and decreased the infiltration of water.
4. The deforestation has adversely affected the wild life of the area. The rich variety of fauna like Rewa Tiger, Wild Boars, Leopards, Sambhar, Panthar are no longer seen in the area. These animals either have migrated to the dense jungles or getting extinct.
5. The deforestation, mining activities, industrial smoke dust clouds to some extent are responsible for increase in temperature in the area, thus affecting microclimate.
6. The deforestation has considerably reduced the reserve species like sal, teak, eucalyptus, mahua, bija and soil in the area thus causing the botanical imbalance in the area.

As a measure and to keep the balance in various factors of eco-system, an area of about 190 sq. km is suggested for environmental forestry. It is estimated that it will help in overall increase in total forest reserve in the area in future, even after anticipated deforestation of 88 sq, km. (23% of existing forest) after mining of all proposed coal bearing blocks of about 100 sq, km of Singrauli coal field.

The proposed environmental forestry/plantation in the area will assist in preventing excessive erosion and consequent siltation in Govind Ballabh Pant Sagart. It will also help in reclaiming the area of about 75 sq. km. of ravines (bad land area) which has posed serious problems of erosion to fertile agriculture land.

Agriculture:
In the area around Songrauli Coal field agriculture forms the main occupation of most of the population. Under existing landuse practices, an area about 475 sq, km. is used for agriculture purposes; it is about 47.5% of the area studied. The agriculture area is divided into two categories viz (i) The area of dry cultivation (single crop) and (ii) The area of wet cultivation (double crop).

The area of dry cultivation (single drop) is covered by clayey and silty soil with appreciable amount of rock fragments. It has occupied an area of about 265 sq, km on the Singrauli surface (360 to 380 m. above m.s.l.) and Barakar surface (400 to 430 m. above m.s.l.). The main crops of dry cultivation are Jawar, Bajra, Tuwar and Moong.

The area of wet cultivation (double crop) is covered by loamy soil consisting of clay, silt and sand and has occupied an area of about 210 sq. km. south of Muhar plateau on Waidan and Jaitpura surfaces (270 to 300 m. above m.s.l.). This area forms fertile agriculture land and has good surface and sub surface, water potential as compared to the northern part. The main crops of the area are Wheat, Rice, Jawar, Bajra, Tuwar, Moong and vegetables.

The mining activities, establishment of super thermal power station, other industries and new settlements have adversely affected the agriculture production and land and soil pollution and constantly displaced agriculture based population in the area. The total area of fertile agriculture land reduced by industrialization and developmental

activities is about 200 sq, km. which is about 13.20% of the total area. It also includes the area of proposed site of super thermal power plants, fertilizer plants, coal conversion plants and other supporting structures of coal based industries.

Geohydrology:
The area of study falls within the catchment of Rihand river, a tributary of Ganga. It is drained by semi - perennial to perennial streams viz. Kachan, Mayar, Matwani, Bijul and their tributaries. These streams originate from Gondwana upland in central, north western part and pre -Cambrian up land in the northern part area of the study.

The area experiences a tropical sub-humid climate with mean annual rain fall varying from 150 – 100 cm. a hot summer having a mean temperature of 45°C. The principal precipitation is received between July to September, of which much of rain fall comes between July and August.

The Govind Ballabh Sagar is a large surface water body which came into existence by damming the Rihind river (not in area). It has an area of about 350 sq. km and only part of this reservoir laying in western and northern head water region constitute the area of investigation. It is fed by net work of streams originating on ridge valley land system and plateau – pediplain land system. In addition the wash flow from the surrounding high land feeds the reservoir.

Groundwater:
The groundwater occurs in four distinct geological formations viz. the older metamorphic, Bijawar group, Gondwana Group and Quaternary deposits.

The older metamorphic and Bijawar Group consist of meta sedimentary rocks like schist, granitised gneisses, phyllite and quartzite. These rocks do not form good aquifers due to very low porosity and permeability. These rocks have porosity 0.001 – 1% and permeability 0.00001 to 0.001 gal.day/sq.ft. These rocks are highly folded, fractured. sheared and faulted and contain potable groundwater. The depth of water level in metamorphic terrain varies from 5 to 15 m. and an average depth is about 12.5m.

The Gondwana Group of rock consists of sandstone, coal, shale, siltstone and clay. These rocks form good aquifer due to their high porosity and permeability. The sandstone shows porosity 20 – 25%, permeability 0.0001 – 1.00 gal/day/sq.ft., clay porosity 50-60%, permeability 0.0001 – 0.001 gal/day/sq.ft and silt stone porosity 5 – 20% and permeability 0.0001 – 0.001 gal/day/sq.ft. These rocks are highly fractured, faulted, jointed and sheared and consist of good ground water potential zones in the area. The depth to water level varies from 5 to 10 m. average depth is about 6.5 m. An artesian well is also recorded at Singrauli Railway Station at the contact of Gondwana and metamorphic rocks in the area. The Ground water from these rocks is utilized by various mining projects, super thermal power stations, heavy industries and for irrigation and domestic purposes.

The Quaternary sediments comprise of sand, silt and clay and have occupied the area south of Maher plateaus over the Ripra-Almori surface (300 – 340 m. above m.s.l.) Waidan surface (280 -300 m. above m.s.l.) and Jaitpura – Jawari surface (270 – 280 m. above m.s.l.). These unconsolidated sediments have primary porosity which is on the higher side, the porosity of alluvial sand is known to be 30% - 40% while the clay 50-60% and their permeability is 10,000 – 1,00,000 gal/day/sq.ft and 0.00001 – 0.001 gal/day/sq.ft.

In Quaternary sediments, un-confined water table is noticed and water is mainly encountered in gravelliferrous and sandy horizons. These sediments form good aquifer at the depth of about 3.5 to 15 m.. it is one of the reason that these surfaces are thickly populated and show highest density of open dug wells, tube wells and are used for extensive cultivation, inhabitation and for the establishment of super thermal power station, coal conversion plants fertilizer plants and other industrial complexes in the Singrauli area.

Hazards Due to Coal Mining:
Environmental hazards associated with the coal mining as observed and / or anticipated in the mining blocks mentioned above are described in the following paragraphs.

Quarries and associated spoil dumps:
In the area studied for environmental appraisal large open cast projects are spread over to entire northern part from east to west. The important working projects are (a) Khadia, (b) Dudhichua, (c) Jayant, (d) Nighai and (e) Amlohri. The active quarries are being developed more or less in a rectangular shape alongwith their spoil dumps as shown in plate I. The size and shape of the quarry being developed, depends upon the coal seam, mining method and the size and capacity of dumper-shovel- dragline being used. The detailed colliery - wise data are not available. Almost all the quarries are fairly big in size and are being operated mechanically by various types of heavy machineries. The Jhingurda mines with its special problems of thick seam mining has dumped some of the spoils at the initial stages of mining behind the outcrop, more or less at the outcrop zones of the Jhingurda bottom seam and have created level ground for railway siding, play ground etc. The quarry is in elliptical shape. In Jayant mines quarrying is being done in two blocks i.e. east block and west block. Here Turra seam is being worked, thickness of Turra seams is 17 m. mining is done by a combination of Dumper-shovel-dragline and bottom dump coal layer. Maximum height of dumps / overburden is maintained at 40 m. approximate. Draglines with 15 m^3 and 24m^3 capacities and 90 m. and 96 m. boom length are used.

In almost all the quarries the stripping ratio is more than 1:1.75. The associated spoil dumps are made up of burnt coal of coal seams, loose boulders of sandstone, lumps and granules of sandstone and shale, held together by a sandy soil rising in height up to about 50 – 60 m. The slopes are very unstable ranging up to 60°. The shape and size of the dumps frequently change with the onward progress of the quarries. According to down and stocks (1977) if an open pit mine were to be back filled with waste rock and over burden there will be a surplus of waste if the stripping ratio exceeds 1.75 depending upon the pit topography, bulking factors and compaction achieved during back filling. Taking the stripping ratios (2,60 for Yajanti), 3.50 for Dudhichua, 4.08 for Khadia etc. and more than 1.75 in all the mining projects a sizeable excess of mine spoils are likely to be generated besides 8 million, 3m^3 caste work for SSTP and an equivalent earth work for VSTP. As per the environment management plan of the mines the initial overburden is to be accommodated with external dumps and is not proposed to be re-handled. For back filling, the remaining overburden is proposed to be utilized in backfilling de-coaled areas. This initial overburden form huge spoil heaps has problems of slope stabilization and has developed gullies in the spoil heaps by rill erosion.

Thus the huge amount of waste are going to create many problems unless a comprehensive waste management plan with careful forward projections is chalked out by all the agencies in consultation with each other so that its disposal creates minimum problems to the quality of the land, water, air pollution and ground water pollution. Slope stabilization of spoil heaps by plantation is proposed along with the roll out side. The unreclaimed areas, associated spoil dumps and abandoned quarries will also pose danger of surface fires ad land subsidence.

Land subsidence:
Though no major land subsidence is reported in the area, nor there are any data to show land subsidence but prolonged and deep quarrying and associated abandoned quarries and spoil dumps are likely to create void spaces beneath the ground surface which will create tension cracks, which may further attain sufficient length and width and the overlapping of these cracks may give rise to land subsidence. Once this process starts, there will an undulating relief. It may also give rise to surface or underground fires and cracks in the adjoining buildings and cultivable land, ultimately leaving the land as derelict land.

Mine Fire:
In Singrauli area seams are burnt at their outcrop position. Mine fires resulting problem and consume millions and millions tones of coal. Surface fire is caused either due to direct burning of coal seams or when the fire in the under ground working travels to the surface through some ground fractures.

Water demand for fire fighting operation of the mines in Singrauli area is approx 2.00 MGD.

The mine fires are generally found in the following forms.

Fire in the seam outcrop:
All along the Singrauli Coal field area, coal seams are burnt at their outcrop positions. The burnt coal seam is brownish, grayish and whitish in appearance. Jayant, Khadia & Almorhi, Nighai and Dudhichua burnt coal seams are noticeable.

Fire through surface fracture:
In this case smoke or heat from subsurface fire is radiated through the surface cracks causing simmering effects. Flames come out when such areas are dug up by means of Bulldozer as a first steps for blanketing operations.

Fire in spoil dumps:
One of the main causes of the above mine fires is the spontaneous combustion of the coal seams. In this process it is believed that a coal seam when coming into contact with the atmospheric oxygen in the main faces and underground galleries over a prolonged period was heated up and caught fire. This fire in course of time, traveling through fractures and fissures, spread over to the entire seam and the other seams if the parting between the seams is not much and even to the ground surface. Selective mining in thick seams also favours the chances of long exposures of coal to the atmosphere. Presence of highly volatile gases aggravates the fire to a larger extent. The spontaneous combustion may also occur within the left over coal portion and the carbonaceous shale fragments in the spoil dumps.

Impact on land use pattern:
Extensive land use mining activities by open cast method have made significant changes in the land use pattern in the Singrauli area. Vast areas of forest and agricultural lands have been sacrificed for developed of quarries, expansion of collieries, colliery colonies, offices, schools, playgrounds and parks. Barren lands and the lands under non agricultural use occupied by the collieries, colliery offices, schools, parks, playgrounds etc have increases at the expense of cultivable and forest lands.

Extra data for each mining project are not available. Last 10 years of data on land use will reflect the changes in land use pattern due to mining and allied industries.

Impact on hydrogeological conditions and hydrochemistry:
The groundwater in the area occurs mainly in the unconfined water table conditions within the weathered, jointed and fractured zone of various litho-units of the Gondwana Group and the Bijawars and the Older Metamorphics. The Waidhan surface is potential zone for groundwater. Here depth to water is low and there are numerous wells within a short distance, most of them are being operated by different agencies and local bodies. A few wells were selected for studying the groundwater pollution in and around coal mining areas and N.T.P.C depth to water level in the selected wells ranges from 1.50 m. to 10.20 m. Total depth of the wells ranges from 2.10 m. to 12.80 m., diameter of the wells ranges from 1.10 m. to 1.5 m. as collected in the area and a few water samples of GBPS reservoir, mine soap water and a tube well near Jayanti mines carried out in CMPDIL laboratories. A huge quantity of groundwater is being pumped out daily from a large number of open cast mines in the Singrauli area. The major part of this mine water is drained out through Balia and Bijul, Matwani and Mohar nallas and through other tributaries of Kachan and Mayur rivers. Some of this water goes through these nallas in the GBPS reservoir. These mine waters are generally hard in nature and contain unwanted elements which are likely to change the geochemical characters of the surface water. These changes are further aggravated by the effluents like bottom ash and fly ash and other waste disposal from the super thermal power plants in the area which ultimately goes in the GBPS.

Environmental hazards of Noise, Dust & Smoke:
In Singrauli are lot of noise, dust and smoke are created due to heavy machinery, blasting and coal transportation and coal handling at mines and in various Super thermal Power Plants. Tough mine authorities and NTPC authorities claim that they are maintaining noise level below 90 db, however a lot of noise accompanied with vibrations beyond the tolerance limit is created due to operation of various heavy machineries in the coal mines and super thermal power plants and movement of heavy vehicles and from merry go around railway system for coal transportation and coal handling pose a constant problem of noise, dust and smoke pollution in the area. A cumulative effect of all these is the noise level going well above 90db value. As per an estimate by CMPDIL, Singrauli for Dudichua mines total quantity of dust generated during explosion of rock blasted is 2426 kgs. For the volume of 69300 cum of the mine mass to the blasted simultaneously. Initial volume of dust and gas cloud is 0.76 gm/m3. Intensity of dust emission in suspension is 8100 gm/Sec. Specific amount of harmful gases emitted per kg of explosives is: Co - 25.35 gms, NoX - 8.06 gm.

Total quantity of harmful gases emitted during explosion

Co - 798525 gms

No_x - 96390 gms

Intensity of emission of harmful gases are

Co - 13,308 gm/sec

No_x - 1606 gm/sec

Height of dust and gas cloud = 148 m. (average)

Level at which blasting is to be done - 425 m.

Level of edge of quarry 350 m.

Height of dust and gas cloud above the nearest township = (425 + 148) – 350 =273 m.

Intensity of dust carried away from open cast mine to colony area = 6616 gm/sec

Expected quantity of dust and gas in colony are

Co - 0.127 gm/cu.m.

No_x - 0.015 gm/cu.m.

Dust - 0.77 gm/cu.m.

Such emission of dust and gases in the area is increasing very rapidly with the commencement of all mining projects. The cumulative effects of all the mining projects may be alarming. To this is the added hazard of fly ash from thermal power plants. The 220 m. high stacks of SSTP and VSTP are said to be 99% efficient, however high ash content 20 – 30% of Singrauli coal field area generated lot of fly ash and spreads it in a wider area. 20% of the ash content of the coal comes as bottom ash (wet disposal) while 80% is fly ash. Out of this 80%, 99.6% is wet disposed through electrostatic precipitators, while only 0.4% comes through chimneys as fly ash and spreads over a wide region due to high stacks provided. It is claimed that suspended particulate matter (SPM) generated from SSTP plant boiler is $\angle$150 mg/normal m^3 which is considered on safe limit.

The recognized hazards of noise pollution:

The study of local inhabitants and their medical inventory in the area around Sigrauli coal field collection of health data and analysis indicate due to intensive and extensive mining/ activity and associated power generation through the net work of Supper Thermal Power projects and associated coal based industries there is significant dislocation in the ecology of the area . The following health impacts are identified:

a. Loss of hearing
b. Emotional distress
c. Blood Pressure fluctuation
d. Sleeping distress
e. Increased hear beats
f. Unusual development of tension

The known hazards due to dust and air pollution:

a. Silicosis
b. Asthama
c. Allergies
d. Non visibility / Poor vision e. .Anthrocosis. g. Fluorosis

As a result of mining activity in Singrauli area thick clouds of dust and gases always persist in the atmosphere over the entire region resulting in very poor visibility.

i. Land Degradation:

In Singrauli area two categories of land degradation are identified as:

a. Natural land degradation
b. Man made land degradation

These different types of land degradations are described below.

a. Natural land degradation:

This category of land degradation is characterized by badland area, mass wasting activities, such as retreating scarp, rock fall, scree, rill and, gully erosion and accelerated headword erosion. Among these various natural land degradation activities the development of badland area is most prominent, it has threatened agriculture land, railway line and other built up area. These zones are identified in the western, northwestern and southwestern part of area of study around Manihasi, Kanhai, Bhalagard.

b. Man made land degradation:

In Singrauli area, vast stretches of forest and cultivable land have been scarified for setting up various mining projects, super thermal power stations, coal based industries, fertilizer plants, transport corridors, colonies, school, playgrounds etc. There will be further man made land degradation in the area when other proposed super thermal

power plants, coal washery, coal conversion plants and other establishments come up. The proposed sites for air strip south west of Waidan, transport corridors in northwest of Waidan, proposed super thermal power plant around Pipra, south of Waidan and proposed alternative sites of two new township around Pipra and Lotan will further aggravate the land degradation, in the area. The coal mining activities in all eleven blocks of coal will further aggravate the problem of land subsidence, loss of top soil and land degradation in the area.

ii. Built up areas:

In the Singrauli coal field, since the commencement of coal mining in 1964-65, it has significantly developed as many super thermal power stations and other coal based industries have been established in the area. The mining activities and rapid industrialization of the area has attracted sizeable population from remote places for employment, this has considerably increased industrial based settlements and have developed new township on the southern part of the area around Waidan. There are about 485 villages of different sizes and dimension in the area built over all types of surfaces and land from elements from (270 m. to 500 m. above m.s.l.) The Singrauli surface (360 m. to 380 m.), Waidan (9280 m. to 300 m.) and Jaitpura – Jawari (270 m. to 280 m.) show highest density of villages and township in the area. The railway line connecting Jabalpur – Howrah passes through the area. Singrauli is important railway station after which coal field is named. There is also network of railway line in the mining area which is used for transportation of coal. There are many criss - crossing roads all over the area connecting various townships and villages.

iii. Other Environmental Aspects:

a. Migration of Population:

The coal mining activities and rapid industrialization of the area around Singrauli coal field has resulted in shifting of population from remote areas to Waidan and Singrauli for want of employment, which has created many problems, for shelter, water, food, and traffic etc.

b. Migration of Tribal Society:

The Singrauli was once the area of the habitat of primitive tribal society like Gonds. The developmental activities and rapid industrialization of the area has caused migration of tribal people to remote areas. This tribal society needs rehabitation to protect their culture and identity.

c. Migration and Extinction of wild life:

The mining and other developmental activities in Singrauli area have caused migration of rich variety of animals like white rewa tiger, wild boars, leopard, antelope, sāmbhar and hyena. They all have either moved in deeper and dense jungles or are getting extinct.

d. Extinction of rare botanical species:

The mining and other activities have significantly reduced the forest cover and as such the reserve of rare botanical species of sal, teak and eucalyptus etc which are getting extinct. The special efforts and massive aforestation is needed to protect these species in the area Singrauli and adjoining area.

e. Paucity of water:

The whole of the Singrauli area including all mini projects, super thermal power plants and other industries both in M.P. and U.P. meet their water requirements mainly from Rihand or GBPS reservoir with increasing industrialization and urbanization and shifting of population water requirements are increasing day by day. On the other hand, with human activities like mining, construction of railway lines, roads industries etc. have caused diversion / blockade of some of the feeder streams debouching into Rihand. It has resulted progressive shrinkage in the catchment area and have considerably reduced the GBPS reservoir.

The water requirements of industrial based colonies for different purposes is likely to be of order of 25 m.g/d., when the coal production is anticipated to touch 46 million tones and at full rated capacity of 76 million tones the total consumption of water for different purposes may be of order of 30-35 million gallons/day. The water requirement for NTPC, SSTPP cooling system alone is of 8 lakes m^3/day for 2000 MW stage which is all proposed to be met from Rihand reservoir with the commencement of VSTPP and other Thermal Power Plants and coal based industries in the area the water requirements is going to be very high. The live storage capacity of reservoir is 775′ with H.F.L. at 880′ Due to continuous drought situation the water level has fallen drastically.

The water requirements of the area are proposed to be met with implementation of an integrated water supply scheme from GBPS. However, these needs to be examined closely and other dependable sources like groundwater should be tapped. The Waidan surface is to be a potential zone for trapping groundwater.

iv. Pollution:

The pollution due to mining activities, industrialization and urbanization in the area around Singrauli coal field are of different kinds, such as water, soil, and noise pollutions.

v. Water Pollution:

In the area around Singrauli coal field, 23 water samples were collected from open dug wells, stream reservoir and canal to assess the pollution if any. The samples were analysed at Geological Survey of India, Regional Laboratory at Nagpur. The analytical results of Govind Ballabh Pant Sagar, Tube wells and Mine Pits were also collected from CMPDI are summarized. The analytical results of some water of Jayant Quarry and tube well water of Dudhichua of Singrauli Coal Field area from CMPDIL source show the value of BOD 5 days at 20° C (Biological oxygen demand), 3.2, 4.85, 2.05 and 0.9 ppm and COD (Chemical Oxygen Demand), 360.9, 340.6, 342.5 and 3.0 and oil and grease 29.0, 19.0 and 22.0 ppm which is beyond the tolerance limit. The other elements like cyanides (CN), Fluorides (F), Arsenic (AS), Copper (Cu), Lead (Pb), Mercury (Hg), Selenium (Se), Nickel (Ni), Zinc (Zn), Ammonia Nitrogen (N), Total Chromium (Cr) are within tolerance limit (Table No.4) The water samples collected during the present investigation were analysed for elements like copper (Cu), Cobalt (Co), Lead (Pb), Chromium (Cr.), Cadmium (Cd), Nickel (Ni), Zinc (Zn). Iron (Fe), Manganese (Mn), the values of copper and cobalt in most of samples is ∠0.25, Iron ∠0.25 to 0.30 and Manganese ∠0.25 which is within the admissible limit. I.S.I. (1982)

The calcium (Ca) values varies from 9 – 108 ppm, Chloride (Cl), 8-219 ppm, Nitrates 3-28 ppm and fluoride (F) ∠0.50 ppm which is within the tolerance limit as per I.S.I. standard 2296 (1982)

vi. Soil Pollution:

In the area around Singrauli Coal Field, coal based industries and Thermal Power Station 19 soil samples were collected to assess the soil pollution. These samples were analysed at Geological Survey of India, Regional Chemical Laboratory at Nagpur for copper (Cu), Cobalt (Co), Lead (Pb), Chromium (Cr.), Cadmium (Cd), Nickel (Ni), Zinc (Zn). Iron (Fe), Manganese (Mn). The results show presence of Chromium, Nickel, Copper, Manganese and lead above permissible limits which appears to be due to dumping of mine waste and tailing and industrial effluents. The Chromium value of ash pond, south of Jaitpur (S1), cast of Paraswar (S6), around Jayant Quarry (S10), west of Paraswar (S11) show higher values of 30, 75, 30 and 75 ppm respectively. The values of Nickel varies from 10-60 ppm and the highest value 60 ppm is recorded from (S11) west of Paraswar values of copper varies from 10 to 100 ppm. The highest value 100 ppm is recorded in sample (S11) west of Paraswan. The Manganese recorded in samples show highly variable values ranging from 75 – 700 ppm. The highest concentration of this element 700 ppm (S6) is noticed east of Gharwara in the river sediment, Kachan river 500 ppm (S2) and west of Paraswar 500 ppm (S11) which are beyond tolerance limit as per Indian standard (1968 – 1976) The contamination of lead in the soil and the sediments samples of the area show its values from 10 to 30 ppm which is at higher side and absolutely above the permissible limit, Log (1988).

Broadly the area around Singrauli coal filed shows high pollution which form the part of Rihand Sub-basin. The continuous increase of toxic metallic elements above the tolerance limit in the top soil is hazardous to health as it gradually gets into the grass, vegetables and fruits grown in the area which finally affect adversely the human being and animal life in the area.

vii. Air Pollution:

Air pollution is defined as the presence of one or several substances introduced by man in the external atmosphere to such an extent as to adversely affect health and welfare of human system and the life particularly on the respiratory system. The pollutants in the air may be in the form of solids, gases and liquids.

In the Singrauli Coal Field area, large scale coal mining, various Thermal Power Plants, coal washery, Heavy Machinery, coal handling and coal transportation creates heavy amount of dust and smoke daily into the air and thus pollute the atmosphere by way of making the significant change in dust fall, suspended particle, matter (SPM), SO_2, NO_2, CO and hydrocarbon. The transportation of railway, trucks, vehicles are the other sources of air pollution due to consumption of considerable amount of coal and fuel oil. In addition, large numbers of surface and under ground fires in the coal belt area also emit a great amount of smoke and flames in the atmosphere. The problem of air pollution in Singrauli area has been studied by various agencies. As per CMPDIL sources in Singrauli, for Dudhichua mines total quantity of dust generated during the explosion of rock blasting is 2426 kgs, for the volume of 67, 300 cum of mine mass to be blasted simultaneously. Initial volume of dust and gas cloud is 0.76 gm/m3. Intensity of dust emission in suspension is 8100 gm/sec The specific amount of gases like Co and NO emitted per kg

of explosives is 25.35 gm and 3.06 gm respectively. The intensity of emission of these gases (CO) is 13.308 gm/sec and NOx96390 gms. The height of dust and cloud generated during explosion is 148 m. out of total generation of dust and gases by way of blasting in open cast coal mine in the Singrauli area the expected quantity of dust and gases carried away from mines to colony area is dust 0.77 gm/cum, o 0.127 gm/cum and NOx 0.015. The intensity of dust migration from open cast mine to residential area of various mining projects is 6616 gm/sec .

The air pollution in Singrauli area is increased very rapidly with the commencement of all mining projects and commissioning of various Super Thermal Power Station and their industries. The cumulative effects of mining activities and with the existing and proposed installation of Super Thermal Power Projects, coal washery, coal conversion plants and fertilizer plants may lead environments towards further deterioration.

viii. Noise Pollution:

The Noise pollution which may be defined as sound having undesirable effects on recipients. In the Singrauli coal belt area, it is the out come of mining activities, operation of heavy machinery, blasting, coal handling and mines and in various super Thermal Power Plants. Though mines authorities and NTPC authorities claim that they have been maintaining noise level below 90ds, however, a lot of noise accompanied with vibrations beyond the tolerance limit is observed.

Conclusion and Recommendation:-

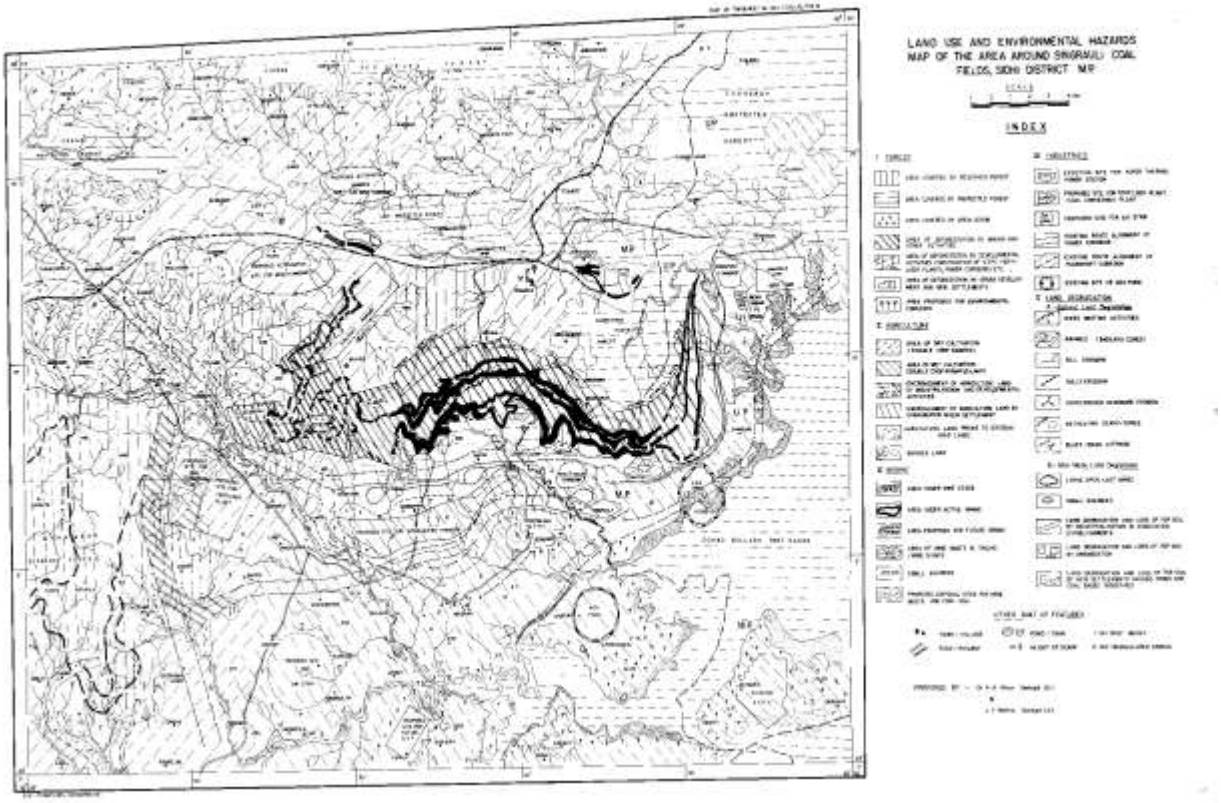
The Geoenvironmental studies carried out in the area around Singrauli Coal Fields have revealed the following:-

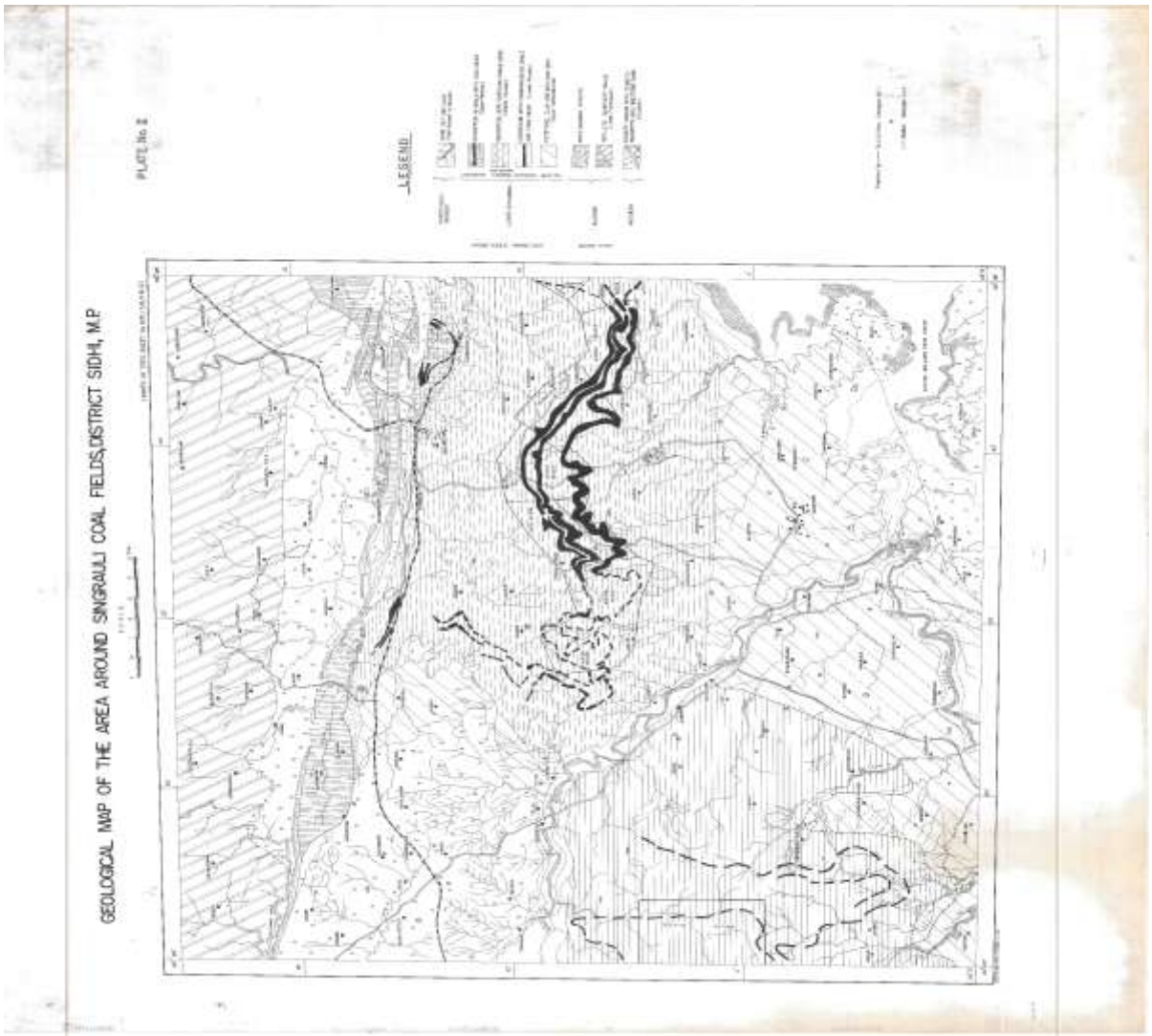
1. The area is occupied by Archaean, Bijawar (Sidhi Group) Gondwana Super Group of rocks and Quaternary deposit.
2. The area is comprised of ten geomorphic surfaces between elevations 270 to 500 m. above m.s.l. Among these two are Quaternary surfaces and eight are prequaternary surfaces. These surfaces represent different stages of peneplation.
3. The groundwater occurs in there distinct geological formation viz, Bijawar, Gondwana Super Group and Quaternary deposits. The Gonswana and Quaternary deposits from good groundwater aquifers in the area and are tapped by open dug wells and tube wells for water supplies to various mining projects, super thermal power station and industry based township.
4. The study of land use aspects in the area indicates that an area of about 335 sq. km (33.5%) is occupied by forest, 475 sq. km (47.5%) by agriculture land, 100 sq. km. (10%) by mining (Coal bearing mine lease area), 75 sq. km (7.5%) by industries, 54 sq. km (5.4%), 255 sq.km. (25.5%) by dissected land / Land degradation and an area about 160 sq. km (16.00%) by water bodies.
5. It is anticipated that an area of about 88 Sq. Km will suffer deforestation by over all mining industrialization, urbanization and other associated activities. It is about 23% of extinction forest reserve. As a measure for Environmental protection and to keep the balance in various factors of ecosystem, an area about 190 sq. km. is suggested for environmental forestry. It is estimated that it will help in overall increase in total forest cover in the area in future even after anticipated deforestation of 88 sq. km. (23% of existence forest) after mining of all proposed coal bearing blocks of about 100 Sq. Km. of Singrauli coal field.
6. It is anticipated that an area about 200 sq. km. of fertile agriculture land will be encroached by mining activities, industrialization industry based town ship and other establishment, is about 14.50% of existing agriculture land and will adversely affect agriculture based population in the area.
7. The proposed target of coal production by 2020 is about 210 million tones and in ideal condition it is expected to be order of 250 million tones annually. The quarriable area of coal fields of 70.9 sq. km is anticipated to generate over burden of order of 3400 million cubic metres. The generation of over burden and mine waste is going to be staggering and it needs advance planning of waste management.
8. The mining projects and coal based industries in the energy belt of Singrauli area has resulted in the loss of top soil of an area about 75 sq. km it is about 7.5% of the area investigated and has aggravated the problem of land degradation. The encroachment of fertile agriculture land and loss of top soil may effect adversely the agriculture production in the area.
9. The land degradation both by natural and man made activities has posed serious problems of erosion, land dissection, loss of top soil and siltation. The various tracts (Bad land area) is of progressive nature and has threatened to fertile agriculture land, road, railway line and other built up features. The total area of land degradation is about 225 sq, km. it is about 22.5% of the area investigated it includes an area of about 75 sq. km of revines, 100 sq, km of quarriable mine, 75 sq. km. loss of top soil by mining and industrialization and 5 sq. km. by mass wasting activities. The excessive land degradation by natural processes has increased the siltation problem of Govind Ballabh Pant Sagar, due to ready availability of sediment load for the streams

draining the watershed of Rihand whereas the land degradation by man made activities has encroachable agriculture of infiltration of water and has adversely affected the recharge of subsurface water in the area.

10. As a measure for Environmental protection and to reclaim the very near areas and bad land zone, it is suggested that these zones may be utilized as disposal sites for damping the overburden debris generated by coal mining activities. These sites may subsequently be used for environmental forestry and other plantation. The plantation and development of green belt in these barren lands will assist to prevent further land degradation and erosion, to arrest excessive sediment generation and sediment load for draining stream and will ultimately reduce to rate of siltation in Govind Ballabh Pant Sagar, a reservoir of Rihand river. The systematic scheme of disposal of over burden and subsequent Environmental forestry / plantation in this area will enable to reclaim and area of about 75 sq. km simultaneously with the mining and other developmental activities.
11. The surface and subsurface water and top soil of the area is being polluted by mining activities, industrial effluents, disposal of mining waste, ash ponds and other pollutants.
12. The air around Singrauli coal field shows high concentration of So2, No2, CO suspended particle matters (SPM) and hydrocarbons. It is due to coal mining activities excessive emission of smoke and fly ash, from Super thermal power station and other coal based industries. The excessive contamination of these gases in the air is serious matter of concern and need immediate measure to protect the environmental from further deterioration.
13. The noise level is maintained below 90 dx as observed by NTPC and mining activities. It appears to be at higher side as it is substantially increased beyond the tolerance limit due to excessive mine blasting, coal transportation and coal handling, operation of industries, super thermal power station and vesicular traffic.
14. The coal mining activities rapid industrialization and urbanization of the area around coal fields has resulted migration of wild life habitudes and local tribal population.
15. The mining activities increasing industrialization and urbanization have tremendously increased the water demand in the area. The present consumption of water may be order of 30-35 million gallon day with the commencement of VSTRP, other proposed Super Thermal Power Station and coal based industries the water requirement is anticipated to be very high. To meet the water demand of Singrauli energy belt it is suggested that an integrated water supply scheme should be made from GBPS groundwater and other dependable sources before the commencement of proposed super thermal power station and other coal based industries.
16. The mining activities and extraction of coal over period have caused permanent defacing of natural landscape in the area. The present conclusions have been drawn on the basis of preliminary studies to recommended at first instance, that further detail studies in Singrauli coal fields area should be taken up in mining in all eleven blocks to achievable target of 250 million tones of coal production by 2020 installation of super thermal power stations, fertilizer plants, coal conversion plants and other coal based industries rapid urbanization and industry based settlements in the energy belt of coal field area.
17. The detailed study should include.
18. The systematic geological, geomorphological, geohydrological and pedagogical studies and prepared of thematic maps on large scale preferably on 1:250000 with the aid of Air photos.
19. The system of study of basin in morphomrtry and preparation of morphometry maps on large scale preferably on 1:2, 50, 000 scale with the aid of Air Photos to evaluate proper measure for Environmental protection.
20. The detailed study and monitoring of forest reserve, rate of deforestation vis – a – vis the development of green belts through Environmental forestry and plantation to keep the balance in various factors of eco-system to avoid the adverse impacts of deforestation like excessive erosion, sedimentation, siltation, microclimatic changes, increase of run off decrease in the areas of infiltration.
21. The detailed study and monitoring of encroachments of agriculture land, loss of top soil, reduction in filtration areas of ground water by mining activities industrialization and urbanization and its impact on surface and sub surface water regime, agriculture based population, agriculture production.
22. The detailed study and monitoring of coal mining activities block wise, generation of overburden, land subsidence mine fires, emission of poisonous gases and deterioration defacing of natural land scape to assess the measure for mine safety and Environmental protection.
23. The systematic detailed study of various mass wasting activities and preparation of land degradation maps on large scale preferably on 1:2, 50, 000 or 1:15,000 with the aid of Air photos to evaluate the proper measures for land reclamation and Environmental protection.
24. The detailed monitoring of water level, chemical quality, pollution and siltation of Govind Ballabh Pant Sagar and other water bodies in the area.

25. The detailed monitoring of water table, chemical quality of water and contamination of toxic elements at least for five years to understand the impacts of mining activities, industrialization and urbanization on subsurface water regimes.
26. The detailed monitoring of dispersal of toxic elements may be done by periodic sampling of surface and sub-surface water from fixed stations on grid pattern in the area.
27. The detailed monitoring of dispersal of toxic elements may be done by periodic sampling of top soil from fixed and predetermined stations on grid pattern in the area.
28. The preparation of Environmental protection plan




GEOLOGICAL MAP OF THE AREA AROUND SINGRAULI COAL FIELDS,DISTRICT SIDHI, M.P
LEGEND

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