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ENVIRONMENTAL DEGRADATION DUE TO EXPLOITATION OF MINERAL RESOURCES: A SCENARIO IN ORISSA

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Orissa

Minerals

Mining

Environment Degradation

Management

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ABSTRACT

Orissa, a major state of India has enormous mineral potential. It is one of the major producers of Chromites, Nickel, Iron, Manganese, Tin, Graphite, Bauxite and Lead in India. Among the fuel minerals, the coal of Ib-River and Talcher coalfields continues to play a dominant role among the domestic energy resources in this state. Orissa has also enormous industrial mineral and gem stone potential. Hence a strong economic growth of the state is expected in near future. However, it should not be at the cost of environmental sacrifice leading to a serious public health risk and ecological imbalance. Substantial zones of mining activities come under open forest areas of the state. Mining is responsible for large scale of land subsidence due to extensive excavation, removal of top soil, dumping of solid waste, cutting of roads and creation of derelict land. Mining activities in the state have resulted in disruption of existing drainage patterns and river courses. The effluents from the mines are discharged to near by water bodies causing acid mine drainage. The impact of mining on the quality of atmospheric air around Sukinda, Joda and Barbil blocks is also alarming. Moreover, excessive noise due to mining is also adversely affecting the health of local inhabitants.

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INTRODUCTION

Exactly 100 years ago, *i.e.* in 1909, coal was excavated (first modern mining in the state, Orissa) in the Rampur area of the Ib Valley. Then TISCO operated iron ore mine at Gorumohisani and manganese mine in Goriajhar in 1910, dolomite mine at Panposh and limestone at Bisra in 1914. Chromite mining at Baula started in 1942. Consequently after independence, there is rapid growth in mining sector of this state. Gradually, the mineral resources of Orissa form a very important constituent of India's mineral wealth. Many of the minerals are known to be in abandon supply. Orissa produces enormous minerals including non-metallic, metallic and fuel minerals. It stood one of the major producers of Chromites, Nickel, Iron, Manganese, Tin, Graphite, Bauxite and Lead in India. Orissa's resources of Bauxite, Chromite, Coal, Iron ore, Manganese and Nickel ore are formidable constituting approximately 50%, 98%, 25%, 35%, 27% and 91% respectively of the total resources of the country (Noronha *et al.,* 2009; Dash, 2005). The coal of Ib-River and Talcher coalfields is the key domestic energy resources of this state. Besides metallic and fuel minerals, Orissa has enormous industrial mineral potential viz., china clay, fire clay, graphite, limestone, dolomite, pyrophyllite, kyanite, sillimanite, andalusite, soapstone, steatite, talc, quartz, quartzite and some dimension and decorative stones such as granite, sandstone, laterite and khondalite etc. Industrial minerals of Orissa and their reserve are depicted in Table 1 (Das and Goswami, 2009). Besides, gemstones like ruby, sapphire, aquamarine, heliodor, garnets chrysoberyl cat's–eye, sillimanite cat's–eye, topaz, zircon, iolite, tourmaline, etc. occurring in the Eastern Ghats Granulites Belt of the state (16 mining blocks in the western districts of Orissa) are superior in quality by virtue of their color, transparency, size, internal reflection and flawlessness. Orissa state has emerged as a major source of colored gemstones in India for the last two decades. Gemstones and their district wise location in Orissa are presented in Table 2. In terms of geographical distribution of mineral resources of India, about 10-14 % of mineral production comes from the state of Orissa. Besides, there are reported occurrences of vanadiferrous magnetite (Mayurbhanj and Keonjhar), tin ores (Koraput), diamond in western Orissa, gold (Mayurbhanj and Keonjhar), Platinum group of elements (Jajpur and Keonjhar) and lead and zinc ores in western Orissa. These deposits may prove to be economically potential in future. Latest reserves of ores and minerals of Orissa State are presented in Tables 3 and 4 (Source: Indian Bureau of Mines; Directorate of Geology, Orissa; Ministry of Coal). Export Value of Minerals in the state Orissa is given in Table 5.

Expansion within the mining and metallurgical sector leads to the development and economic growth of our country. The products of the sector (including metallic and non-metallic minerals, construction materials) are not only essential for construction activities and many industrial processes, but are also often a valuable source of foreign exchange earnings. However, mining operations frequently involve a high degree of environmental disturbance, which can extend well beyond the extent of mineralized areas such as Joda-Barbil, Sukinda, Damanjori, Bolangir, Talcher, Ib valleys of the state. The environmental impacts of a mining operation commence with exploration activities, extend through extraction and processing of minerals,

Table 1: Industrial minerals of Orissa and their reserve

S.N.	Name of the industrial mineral	Reserve of Orissa State Mineral year book 2004	% of all India as per reserve
1	Limestone	2038.35 million ton	1.20
2	Fireclay	175.79 million ton	25.29
3	Granite (Dimension stone)	1843.20 million cubic meter	4.89
4	Graphite	3.65 million ton	22.98
5	Kaolin (china clay)	276.11 million ton	11.98
6	Sillimanite	19.31 million ton	30.42
7	Dunite	4.45 million ton	2.80
8.	Pyrophyllite	3.79 million ton	20.81
9.	Quartz and silica sand	70.69 million ton	2.48
10.	Talc and steatite	0.896 million ton	0.33
11.	Dolomite	840.73 million ton	11.86

Table 2: Gemstones and their district wise location in Orissa, India (Mishra and Mohanty, 1998)

Location	Gem stone
Angul District	
Magarmuhan –Jhilli Nuagan	Quartz, Garnet
Sambalpur District	
Chabhati-Beldihi	Aquamarine, heliodor
Bagdhapa-Tabloi	Aquamarine, garnets
Meghpal-Ranchipada	Garnet, green tourmaline, aquamarine
Deogarh District	Hessonite
Jharsuguda District	Green tourmaline
Bolangir District	
Ghuchepali-Antarla	Emerald, topaz, heliodor and aquamarine
Ghumsar-Dehli	Chrysoberyl and cat's eye
Muribahal-Tentelkhunti	Orange, brown and yellow colour zircons, topaz and amethyst
Saraibahal-Suklimuri	Green beryl, aquamarine heliodor and amethyst.
Naktamunda-Siali	Rhodolite garnets.
Subarnapur District	
Badmal-Mursundi	Greenish blue to sea blue aquamarine.
Binika-Sonepur	Garnets, topaz, Cat's eye.
Boudh District	
Boudh-Ramgarh	Cat's eye, topaz, zircon, moonstone, agate, diamond.
Kantamal-Manmunda	Garnets, topaz, iolite, tourmaline and diamond.
Kalahandi District	
Jillingdhar-Hinjlibahal	Ruby.
Orhabahala-Urharanga	Iolite.
Ghatpara-Singiharan	Hessonite garnet and zircon.
Sirjapali-Tundla	Cat's eye.
Banjipadar-Sargiguda	Blue opaque corundum, apatite, aquamarine.
Nawapada District	
Sardhapur-Patialpada	Blue iolite and fibrolite.
Katamal-Babebir-Amera	Yellow sapphire.
Damjhar-Burhapara-Mantritarai	Almandine garnets, iolite.
Rayagada District	
Paikdakulguda-Hatamuniguda	Cat's eye.
Irkubadi-Tarhama	Sillimanite cat's eye.
Karlaghati-Karanjgurha	Chrysoberyl.
Phulbani District	
Bargochha	Tourmaline.
Belghar	Cat's eye.

and may continue post-closure of the operation. The social and environmental issues associated with mining and mineral processing operations are both highly significant and complex to manage. The fixed location of the mineralized zone of interest imposes constraints on all aspects of mining developments including the method of mining, location of mine facilities, requirements for new infrastructure and services and the suitability of waste management or disposal methods. This in turn profoundly influences the environmental, social and health impacts of mining developments, as well as the economic viability of developing a given mineralized zone. The challenges with environment assessment of mining projects are twofold— firstly, to ensure that environmental, social and health costs are afforded adequate consideration in determining the economic viability and acceptability of the project, and secondly to ensure that adequate mitigation or protection measures are incorporated into project design. This requires both effective environmental legislations and enforcement by regulatory institutions, and sound environmental management practices by private and public sector mine operators. In order to minimize the adverse impacts of mining it is desirable to adopt eco-friendly mining technology. Restoration of mined areas by re-vegetating them with appropriate plant species, stabilization of the mined lands, gradual restoration of flora, prevention of toxic drainage discharge and conforming to the standards of the air emissions are essential for minimizing environmental impacts of mining in such a state like Orissa having enormous mineral potential.

Mining and consequent environmental crisis

Table 3: Orissa's Stand in the ratio of mineral resources reserves

Mineral/Ore	Reserves in Orissa	Grade	Reserve in India	State Share to Country's Reserves(%)
Bauxite	1733	Metallurgical+40% A12 O 3	2911	59.5
Base Metal (Lead & Copper)	9	1.5% CU (Avg.) 6.73% Pb(Avg.)	485	2.9
Chromite	183	Metallurgical Chemical Refractory	186	98.4
China Clay	311	Paper, Rubber, Textile, Ceramics	986	31.5
Coal	49406	High Ash- Non-coking	199282	24.8
Dolomite	889	Flux Grade	4967	17.9
Fireclay	178	Plastic & Non-Plastic	696	25.6
Graphite	2.2	Foundry, Refractory Pencil, Battery	3.1	71.0
Iron Ore	4200	B.F.S.M.S & Sponge Iron +58%Fe.	12745	32.9
Kyanite & Sillimanite	1.4	——-	53.41	2.6
Limestone	1609	BF & Cement	76446	2.1
Manganese Ore	119	BF., Ferro Alloys, Battery & Chemical	176	67.6
Mineral Sands	82	——-	266	30.8
Pyrophyllite	8.6	——-	13.2	65.1
Nickel Ore	270	+0.5%Nickel	294	91.8
Quartz and Quartzite & Silica Sand	93	Metallurgical, Silicon, Carbide, Ferro Silicon, Ceramics	1350	6.9
Tale/ Steatite	0.8	——-	84	0.95
Tin Ore	0.01	+50gms/mt	28.91	——-
Vanadiferrous Magnetite	4	0.6to1.5%v305	Not available	——-

Orissa is well endowed with mineral resources, hence a strong economic growth of the state is expected. However, it should not be at the cost of environmental sacrifice leading to a serious public health risk and ecological imbalance.

Now we doubt that the continuing degradation of the natural environment by exploring above-mentioned minerals poses one of the greatest challenges to modern societies. In particular all mining activities create a burden on the environment although paradoxically at the same time the revenues gained from these activities create the basis for our well-being. Major problems include global warming, loss of biodiversity, water and air pollution, releases of persistent organic pollutants and other toxic substances and land degradation. There is an intimate relationship between mine workers and people of near by surroundings and the potential exposure to toxic substances, pollutants and wastes. Air pollution, surface water pollution, ground water contamination, devegetation and defacing of landscape, subsidence of land, occupational health hazards etc. are the major impact of mining leading to various environmental damages. Mining operations may be categorized as either surface or underground. Surface mining may be broadly defined to encompass open pit, open cast, quarry, strip, dredging and placer (hydraulic) mining. Underground methods include pillar-and-stope, shrinkage stope, block caving and longwall mining (Singh and Singh, 2004). Most mining

Table 4: Orissa's production of minerals (in million ton)

Minerals	2000-01	2003-04	No. of active operating mines
Bauxite	2.9	4.9	5
Beach sand Minerals	0.196	0.230	1
China clay	0.003	0.005	8
Chromite	1.905	3.3	18
Coal	45.0	60.0	26
Dolomite	1.0	1.27	2
Fireclay	0.036	0.05	11
Graphite	0.079	0.034	57
Iron ore	14.4	32.0	49
Limestone	2.1	2.24	25
Manganese ore	0.546	0.698	19
Pyrophyllite	0.031	0.084	7
Pyroxenite	——-	0.2	4
Quartz and quartzite	——-	0.125	56

Table 5: Export value of minerals in the state Orissa

Minerals	Quantity	Value
Mineral Exports (2002-03)	58.67	642.20crore
Chromite	11.82	267.40crore
Iron ore	46.55	374.28crore
Limonite	0.30	0.52crore

Source: IT Department, Government of Orissa

operations (whether surface or underground) share a number of common stages or activities, each of which have potentially adverse impacts on the natural environment, social and cultural conditions, or the health and safety of mine workers.

Available aforesaid resources would lead to increased exploitations and development of large size mines to meet the demand of a number of existing and proposed industries in Orissa. More than 1200 sq. km. area of the state is under mining leases, which accounts more than 0.7% of the total geographical area of the state. Out of this, 400 are operated mines with 828 sq. km. lease area. The total forest area of the state is 58,135 sq. km *i.e.* 37.3% of the geographical area of the state. Open forest spreads over 20, 866 sq .km. Substantial zones of mining activities come under these degraded and open forest areas of the state. Though afforestation has been taken up by the mines, in last 50 years, more than 10% of open forest area has been lost due to mining activities. There has been need for superimposing mining areas and mineral zones over forest map of the state to assess the impact of mining activities.

Concentration of mines, tonnage produced, quantity of excavated material and their handling etc. in a mineral-bearing zone are responsible for environmental impact (land degradation and biodiversity loss, loss of productive land, displacement and rehabilitation issues, resource consumption and water-soil-air-noise pollutions) of this state. Opencast mining is responsible for large scale of land subsidence due to extensive excavation, removal of top soil, dumping of solid waste, cutting of roads and creation of derelict land. In case of under ground mining (e.g. Ib-River and Talcher coalfields), the land surface above underground mines has become unstable and unsafe. The rocks, pebbles, murrum etc. excavated from different quarries are getting mixed up with the soil of the land around the quarries and the fertility of that soil is generally permanently damaged. Generally fertile top soil gets removed as a result of excavation. The excavated overburden and mine rejects are generally dumped on the fertile lands around the quarries (Bhattacharya, 2004). The steps should be taken so that the abandoned quarries may be converted to lakes, aquatic sanctuaries to augment the aesthetic and economic potentiality of the landscape.

Mining activities have resulted in disruption of existing drainage patterns and river courses of some major Rivers like Ib, Brahmani, Mahanadi, Baitarani and Nagavalli etc. are diverted or blocked in many parts of the state. As a result, washouts and new gullies are formed, which disturb the land use pattern. The effluents from the mines and ore dressing plants are discharged to near by water bodies causing Acid Mine Drainage. Overall hydrological system has been of modified due to over exploitation of the mineral resources of the state. This sort of water crisis affects the ultimate availability drinking water, water for irrigation and industrial consumption. Moreover, there is tremendous strain on groundwater reserve for catering to the needs of mineral processing plants of the state. The pollution of aforesaid rivers and various mining ponds ultimately affect the aquatic life. The Central Pollution Control Board, New Delhi has classified some industries as grossly water polluting when the BOD load from an industry exceeds 100kg/day or if the effluent contain hazardous chemical. Unfortunately, Orissa has 16 such mineral based industries. Brahamani (near Rourkela, Angul and Talcher), Nagavalli (near Rayagada) and Mahanadi (near Sambalpur, Cuttack) rivers are receiving highest pollution loads in the state (Dash, 2005). Therefore, cost effective treatment method with reference to different pollutants should be applied. Surface drainage should be effectively managed by constructing small dams and canals. Closed water circuit for the mineral handling and processing plants should be designed.

Similarly, the impact of intensive mining on the quality of atmospheric air around Rourkela-Rajgangpur, Talcher-Angul, Sukinda, Joda-Barbil blocks is also alarming. Air pollution load in Rourkela-Rajgangpur

area amounts to 30.2 ton/day of the Total Suspended Particulate matter (TSP) and 45 ton/day of Sulphur dioxide. The concentration of TSP is 302 Kg/ sq. km. in the local atmosphere. In Talcher-Angul area, the total TSP load is 83.33 tonnes/day and the Sulphur dioxide emissions load is 462 ton/day. The concentration of TSP is 1848 kg/sq km (Dash, 2005). These two areas are highly polluted. There are many mineral processing plants and crushers (Iron Ore Beneficiation: 5; Coke ovens: 8; Aluminum Refinery: 1; Mineral sand processing plants: 1; Iron ore crushers: 63; Coal washeries: 4, Graphite Beneficiation: 26; Chrome ore Beneficiation: 29 and Stone crushers: 914) having SPM level much above the standards in major mining belts of the state (Dash, 2004; 2005). Often they do not come under notice of statutory agency. Therefore, suitable devices like settling chambers, cyclone collectors, filters, scrubbers, electrostatic precipitators should be used by all the mineral industries. The gas can be removed by the methods of adsorption, absorption and condensation using chemical additives. Excessive noise due to mining is also adversely affecting the health of local inhabitants. Social forestry can abate air and noise pollution effectively. Noise pollution may be minimized by maintenance of machineries and planting noise attenuation plants.

Besides, intensive mining also influences the health and sanitation condition of the area creating occupational health hazards. Occupational health problems such as pneumoconiosis, silicosis, asbestosis, manganism, tuberculosis, fluorosis, molybdenosis etc. are being suffered in these mining belts. There is also considerable socioeconomic and socio-cultural impact in the tribal dominated mining areas of the state. Community development, infrastructural development of local villages, employment opportunity and vocational training for local inhabitants should be encouraged to protect socioeconomic environment of the mining belts.

On the basis of pollution potential, the Ministry of Environment and Forests (MEF), Government of India have identified 17 categories of polluting industries in the country and out of these, 12 categories (Thermal power plants: 10; Integrated steel: 2; Aluminium: 2; Cement: 10; Sugar: 5; Distillery: 3; Pesticide: 3; Chloro-Alkali: 1; Dye and Dye intermediate: 1; Pulp and Paper: 6; Fertilizer: 1; Bulk Drug: 1) are located in Orissa. These industries have also been categorized on the basis of their pollution potential as red, orange and green. The industries in Orissa are classified accordingly (64%: Red; Orange: 11% and Green: 25%). Highly polluting red categories industries (integrated steel plants, aluminum smelters, thermal power plants, cement industries and other mineral based industries) are prolifically located in different parts of the state Orissa (Dash, 2005; Pattanayak, 2005).

RESULTS AND DISCUSSION

Extensive chromite mining around Sukinda, coal mining around Talcher-Angul, Belpahar-Brajarajnagar and Gopalpur areas, iron and manganese mining around Mayurbhanj and Keonjhar districts, limestone mining around Baragarh District, graphite mining around Bolangir and bauxite mining around Damanjori have been affected the state badly since many years. In addition, there is really problem of fly ash and red mud disposal in the state.

The measures taken by mining authorities for reclamation, rehabilitation and afforestations cannot bring back normalcy. Though Indian Bureau of Mines (IBM) approves the mining plan with scheme for mine closure, there is no strict mechanism to monitor the same. Satellite imagery may help periodical assessment and future planning. This is an area, which requires policy intervention by the Government for restoration of the ecosystem and sustainable development of the state. In order to avoid scarcity of water, rainwater harvesting in mine pits and digging more tube well would be desirable. More precautions has to be taken to suppress the dust by sprinkling water at regular intervals, black topping the mine and mine colony roads and undertaking plantation (of especially dust absorbent plants) in and around the mine area. There is deforestation and consequently loss of canopy cover in forests around the mining belts of the state. Therefore, the sink factor for absorption of carbon dioxide has not been adequately looked into. Some of the pollution tolerant species (Table 6) should be grown in and around the mining premises. These are resistant to SO_2, fly-ash and particulate matters and can even reduce the noise around the area (Table 6). The State Pollution Control Board, Orissa has prepared district-wise Zoning Atlas in which environmentally compatible sites for

Table 6: List of pollution tolerant plants with their vernacular name and family

A.	Pollution tolerant trees	Vernacular name	Family
1	*Acacia Arabica*	Babul	Momosaceae
2	*Ailanthus excelsa*	Mahal	Simaroubaceae
3	*Albizzia lebbak*	Siris	Mimosaceae
4	*Alstonia scholaris*	Chhatiana	Apocyanaceae
5	*Artocarpus heterophylla*	Panas	Moraceae
6	*Azadiracta indita*	Neem	Meliaceae
7	*Butsa frondoea*	Palas	Fabaceae
8	*Butea monosperma*	Palas	Fabaceae
9	*Cassia fistula*	Sunari	Caesalpiniaceae
10	*Casurina equisetifolia*	Jhaun	Caswinaceae
11	*Citrus medica*	Jambira	Rutaceae
12	*Dalbargia sissoo*	Sisoo	Fabaceae
13	*Diospyros melanoxylon*	Kendu	Ebenaceae
14	*Eucalyptus citriodora*	Eucalyptus	Myrtaceae
15	*Kigelia africana*	Sausage tree	Bignoniaceae
16	*Mangifera indica*	Mango	Anacardiaceae
17	*Mimusops elingi*	Baula	Sapofaceae
18	*Peltophorum ferrugenum*	Radhachuda	Caesalpiniaceae
19	*Pongamia glabra*	Karanja	Fabaceae
20	*Tectona grandis*	Teak	Myrtaceae
21	*Syzzigium cumini*	Jamun	Myrtaceae
22	*Samanea sanan*	Chakunda	Momoceae
23	*Terminalia arjuna*	Arjun	Combretaceae
24	*Terminalia alata*	Asana	Combretaceae
B.	Pollution tolerant shrubs	Vernacular name	Family
1	*Bougainvillea spectabilis*	Kagajphula	Nyctaginaceae
2	*Calotropis gigantea*	Arakh	Asclepiadaceae
3	*Calotropis procera*	Arakh	Asclepiadaceae
4	*Cassia sophera*	Chakunda	Caesalpiniaceae
5	*Ipomoea fistulosa*	Amari	Convolvulaceae
6	*Lantana camara*	Naguari (Putus)	Verbenceae
7	*Murraya exotica*	Kamini	Rutaceae
8	*Thevetia nerifolia*	Kaniar	Apocyanaceae
9	*Ricinus communis*	Jada	Euphorbiaceae
C.	Pollution tolerant herbs		
1.	*Croton sparsiflourous*	Gandhatulasi	Euphorbiaceae
2	*Solanun xanthocarpun*	Bheji-baigana	Solanaceae
3	*Solanum virgianum*	Ankaranti	Solanaceae
D.	Noise attenuation plants	Vernacular name	Family
1	*Azadiracta indica*	Neem	Melinaceae
2	*Bauhinia accuminata*	Kanchana	Caesalpiniaceae
3	*Bauhinia variegate*	Kanchana	Caesalpiniaceae
4	*Bombax malabaricum*	Shimuli	Malvaceae
5	*Cassia fistula*	Sunari	Caesalpiniaceae
6	*Cassia recemosa*	Chakunda	Caesalpiniaceae
7	*Cassia sophera*	Nalichakunda	Caesalpiniaceae
8	*Erythrina indica*	Paldhua	Fabaceae
9	*Ficus bengalensis*	Bara	Moraceae
10	*Ficus glomerata*	Dimiri	Moraceae
11	*Ficus religiosa*	Peepul (Aswattha)	Moraceae
12	*Jacaranda mimosfolia*	Krushnachuda	Bignoniaceae
13	*Lagerstroemia parviflora*	Sidha	Lythraceae
14	*Madhuca indica*	Mahul	Sapotaceae
15	*Millingtonia hortensis*	Nagamalli	Bignoniaceae
16	*Pithecolobium deluce*	Bilatikoina	Mimosaceae
17.	*Saraca indica*	Ashok	Caesalpiniaceae

industrilisation are identified. However, there is no government policy to follow the Zoning Atlas provisions strictly.

Excess manganese, fluoride, arsenic etc. from water in mining areas should be removed executing treatments such as phosphate compound treatment, oxidizing filters, pressure-type aeration followed by filtration and chemical aeration followed by filtration.

The Water Act 1974, The Air Act, 1981, The Environmental Protection Act, 1986 and all the mine regulations [The Mines Act, 1952, The Mines and Minerals (Regulation and Development) Act, 1957 (MMRD), The Coal Mines Regulations, 1957, The Mines Rules, 1955, The Coal Mines Regulations 1957, Metalliferous Mines Regulations 1961, Mineral Concession Rules (MCR), 1960; Mines Creche Rules, 1966. The Metalliferous Mines Regulations, 1966The Mines Rescue Rules (MMR), 1985; Mineral Conservation and Development Rules (MCDR), 1988 and the Circulars issued by the Directorate General of Mines Safety (DGMS) from time to time] should strictly be followed. Pollution Control Boards should be vigilant that the recommended airborne exposure limit and water effluent standard should not be exceeded at any time. The Maternity Benefit (Mines) Rules, 1963 should be facilitated to all pregnant women workers; otherwise, newborns will be seriously affected from different health problems. Mine authorities should be careful that the respective prescribed sound level should not be exceeded at any time in core zones, residential areas and sensitive areas.

As the mining at and around the state Orissa is confined to the tribal belts, hence a regular social impact analysis (SIA) is required through out the life of the mines, particularly those, who are displaced by mine management. EAP (Environmental Action Plan) such as Domestic Effluent Treatment Plant, Workshop Effluent Treatment Plant, and Mine Water Discharge Sedimentation Plant should be set up and run. Moreover, other EAP viz., dust suppression majors, tree plantation, overburden dump reclamation, top soil storage and spreading for bio-reclamation, environmental monitoring should be undertaken. Similarly RAP (Rehabilitation Action Plan) should be carried out successfully by the Mining authorities.

Hence, Government, mining authority and public should take remedial measures for reduction of the adverse impact of mining, rehabilitation of mined land, reuse of mine wastes and mine water etc. in this mineral rich state. Acid mine drainage has damaged the soil and water so acidic; the nearby area will be deserted. Mineworkers and the people of near by surroundings are exposed to a number of physical, chemical, biological, technological and mental hazards. A mining project should be developed as a part of much wider, multi activity regional development. All the material extracted by the mining company should be put to productive use. Waste rock, mine tailings, excess mine water can be used as raw material for a variety of ancillary industries. Tailings should be used for underground back fill, embankments and production of construction materials for mine use. All excess tailings can be used for soil development. Excess mine processed water (after use in recycling) is treated for being used in fish farm ponds and crop irrigation (Dunhamn and Scott, 1994; Aswathanarayana, 2003). Hence, a sagacious strategy should be implemented in mining industries of Orissa to promote job-led economic growth through the adoption of employment generating, economically viable and eco-friendly technologies.

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