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Employment generation through environmental management in mining areas of Orissa, India: A novel approach

[1] Pramod Chandra Sahu, [2] KC Mishra
[1] Department of Geology, MPC Autonomous Colleges, Baripada, Odisha, India
[2] Department of Economics, MPC Autonomous Colleges, Baripada, Odisha, India

Abstract
The present study is conducted through two stages; the first stage related to various dimensions of mineral resources and economic development of Orissa; while the second stage is concerned with the employment generating activities involved in the reduction of the adverse impact of mining, rehabilitation of mined land and the reuse of mine wastes. A critical analysis points out that the revenue receipt from mining sector showing an increasing trend during the last 20 years. But the number of people employed directly in major mineral activities has a declining trend. Employment generation using minerals/ metals has been low in Orissa. The mining and associated processing units have potential negative impacts environmental sphere, that impose significant economic burdens on the growth process. The health index, education index and HDI value of mineral rich districts of Orissa is not encouraging which indicates that the revenue does not translate into development of mining districts. Vegetative methods of reclamation of mined land, soil conservation practices, conversion of mining waste into wealth, efficient use of degraded land, water harvesting and artificial groundwater recharge structures have been suggested as employment generating activities through environmental management in mining belts of Odisha.

Keywords: employment, environment management, conservation, reclamation

1. Introduction
Evolution of civilization and industrialization have been built on the foundation of minerals. Minerals and mineral based industries have macro-links with the economy. The foreign exchange earnings from the export of minerals are substantially boosting the domestic economy. Minerals give rise to fright earned by railways and to the earnings on export and import cargo handled by ports. They are important sources of tax revenue and contribute to national income. The efficiency of a particular sector in an economy is assessed, besides other things, on the basis of its employment generating capacity. Mining activities generate employment opportunity. The level of employment is an important parameter of economic development of the state. Orissa is well endowed with vast and extensive mineral resources. Rich mineral resource has placed Orissa in a conspicuous place in the mineral map of India. The state is gifted with abundance of mineral resources like Iron ore, Manganese ore, Coal, Bauxite, Chromite, Limestone, Dolomite, Fire clays, Nickel ores, Mineral sands and precious and semi-precious Gemstones etc. The other economic minerals that occur in the state are pyrophyllite, serpentine, dimension stones, quartz etc. These minerals constitute a vita raw materials for many industries. Revenue receipts from mining sector in Orissa is encouraging. But exploitation of mineral resources for economic return is not the whole story. There are other important aspects of mining too. Mining has adversely affected the environment in the mineral rich districts of Orissa. Environmental issues have become an area of concern for mining and mineral based industries. We need to prevent the process of degradation of environment. We need to generate employment oriented projects. At the same time we need minerals for economic development. Keeping in view the above facts, an attempt has been made to identify different areas in which employment opportunity can be created in the process of environmental protection.

2. Methodology
The present study is conducted through two stages; the first stage is related to various dimensions of mineral resources, impact of mining activities on environment and socio economic development in mineral rich belts of Orissa, while the second stage is concerned with the employment generating activities involved in the reduction of the adverse impact of mining, rehabilitation of mined land and the reuse of mine wastes. Data relating to minerals, environmental condition in mining belts and employment opportunities have been collected from various organization.

3. Result & Discussion
Minerals and Mining Aspect
Orissa's resources of Bauxite, Chromite, Coal, Iron and Manganese ores and Nickel constitute approximately 50%, 98%, 25%, 35%, 27% and 91% respectively of the total resources of the country. Adequacy of available resources of suitable commercial grades would lead to increased exploitation and development of large size mines, to meet the demand of proposed industries in future. Reserve of ores and minerals in the state as on 1.4.2014 is given in table 1. Out of 155707 sq. km. geographical area of the state of Orissa, as on

1.4.2014 about 98177.647 hect. area is covered under 595 nos. of mining leases (Table 2).The working leases with operating mines are only 102 nos. covering about 46788.37 hect. Area.

Table 1: Mineral resources of Orissa

Minerals/Ores	Total Reserve(In million Tons)	% of Total State Reserve of all Minerals
1	2	3
Bauxite	1878.808	2.16
Chian clay	280.912	0.32
Chromite	176.749	0.20
Coal	75073.000	86.48
Dolomite	676.384	0.78
Fire clay	170.076	0.20
Graphite	8.608	0.01
Iron ore	5737.142	6.61
Lead& Zinc ore(Base Metal)	13.48	0.02
Lime stone	1768.509	2.04
Manganese ore	190.350	0.22
Heavy minerals	226.00	0.26
Nickel ore	219.67	0.25
Pyrophy lite	12.267	0.01
Mineral sand	240.341	0.28
Vanadium ore	6.48	0.01
Quartz and quartzite	134.341	0.15
Tin ore(Tons)	0.0155	0.00
Total	86813.1325	100.00

Table 2: Minerals Wise Leases, 2013-14

Minerals/Ores	Total Leases		Working Leases	
	Nos.	*Area in He.*	*Nos.*	Area in Hectares
1	2	3	4	5
Asbestos	1	117.350	-	-
Asbestos&Pyroxenite	1	49.22	-	--
Bauxite	7	6630.404	3	5060.131
China clay	16	1557.352	1	76.575
China clay and F.Clay	2	93.161	-	-
Chromite	24	6906.781	11	1585.752
Chromite& Pyroxenite	1	406.000	-	-
Serpentinite,Manganese&Chromite	1	187.03	-	-
Coal	30	18685.995	28	17495.738
Dolomite	5	521.649	3	408.405
Fireclay	24	2675.984	-	-
Fireclay & Sandstone	1	192.175	-	-
Fireclay & Silica sand	1	255.160	-	-
Galena	1	5.261	-	-
Gemstone	16	271.184	2	3.895
Graphite	104	2834.076	2	24.730
Iron ore& Manganese	63	14930.593	13	5343.636
Iron ore	76	20847.679	21	11084.630
Iron ore & Bauxite	2	480.163	2	480.163
Iron, Dolomite &Lime stone	1	134.733	-	-
Iron Ore, Quarzite &soap stone	1	92.895	-	-
Kyanite	1	55.49	-	--
Lime stone	9	2850.404	1	502.215
Lime stone&Dolomite	37	5330.075	5	1912.165
Manganese ore	40	5943.535	2	224.881
Manganese Bauxite	2	95.243	-	-
Mineral Sand	1	2464.054	1	2464.054
Nepheline Syenite	1	14.277	-	-
Pyrophlite	3	198.294	-	-
Pyrophlite &Quartzite	6	299.978	1	3.920
Quartz	67	1131.452	-	-
Quartz &Felshper	1	8.127	-	-

Quartz &Gemstone	2	60.141	-	-
Quartz &Quartzite	7	148.583	1	4.653
Quartz & Silica sand	1	111.980	-	-
Quartzite	23	541.254	5	112.794
Sand	5	502.885	-	-
Sand stone	2	9.921	-	-
Silica Sand	1	17.446	-	-
Soapstone	6	465.377	-	-
Soapstone &Pyroxenite	1	50.646	-	-
Soapstone, Stiatite & Talc	1	3.640	-	-
Total	595	98177.647	102	46788.337

Economic Aspect

The state collects mineral revenue from the mines in form of royalty, cess, dead rent etc. The production and value of all minerals/ores in Orissa during the period 2001 to2014 is given in Table 4. The overall trend in revenue receipt from mining is increasing. It is indicative of the growing importance of the mining sector in the economy of Orissa.

Table 3: Production and Value

Year	Production(in lakh tons)	Value(Rs. in Crore)
1	**2**	**3**
2000-01	689.24	2776.15
2001-02	749.81	2910.47
2002-03	873.62	3694.17
2003-04	1080.00	3877.75
2004-05	1270.48	6130.93
2005-06	1396.78	6604.41
2006-07	1614.45	7629.63
2007-08	1784.23	10627.05
2008-09	1889.55	15122.90
2009-10	1988.40	15317.10
2010-11	1995.46	28286.87
2011-12	1852.20	30204.38
2012-13	1866.80	34994.55
2013-14	2017.57	54511.87

Mining provides employment to different sections including tribal groups. The total number of people employed in the mining sector in Orissa was 58448 in 1998-99. Thereafter it has shown an declining trend up to 2003-04. The employment situation in the sector improved slightly during 2004-06 because of expansion of mining activities in the state. The employment in this sector during the period of last fifteen years has shown a declining trend. The decrease in employment is attributed in part to induction of higher technology and automation of mineral exploitation. It may further be noted that 80% of the employed work force get engaged in iron and coal sub sectors. The abstract of year-wise number of workers directly employed in major mineral activities in given in table 4.

Table 4: Number of Workers directly employed in major mineral activities

Mineral ores/district	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-2012	2012-2013
1	2	3	4	5	6	7	8	9
Bauxite	839	866	678	634	664	564	932	895
Chromite	8236	8452	9816	6528	7826	7571	7053	6030
Coal	14500	13985	12747	13467	13875	15389	16330	14320
Dolomite and lime stone	2378	1822	1843	2206	2312	2441	496	1760
Iron ore	20782	16677	18912	16838	14679	20071	17257	32901
Manganese ore(	1505	2612	2655	2294	2538	4069	2641	2186
Others	7524	2962	2525	2200	1811	1772	3530	1325
Total	55764	47376	49176	44167	43705	51877	48263	59417

It is reported that employment generation scenario is not encouraging[5]. For 1 crore investment in mines 7 units of employment has been created and the corresponding figure for large and medium industries is 40 and 282 for small scale industries and 4475 in cottage industries. Therefore, employment generation using minerals / metal has low in Orissa.

Environmental Aspect

The mining and the mineral based industries have potential negative environmental impacts that can impose significant economic burdens on the growth process[7-8,] two major

industrial belts namely at Rourkela and Talcher and new establishments downstream around Dubri and Sukinda belt along the bank of the Brahmani river are polluting the water by discharging domestic, mining as well as industrial toxic effluents. Today Brahmani is considered to be one of the polluted rivers of the country. Hence, there has been hue and cry about the deteriorating river water quality and its adverse impact on human health and aquatic life reported that the exploitation of the chromite ore and its beneficiation at Sukinda area is causing serious damage to the regional water environment, nearby vegetation, crops and agricultural fields.The hexavalent Chromium enriched water, when used directly or used through the contaminated source for domestic purpose may cause health hazards.The mining and mineral based industries have twin effects on human life[4]. On the one hand, it contributes immensely to the enhancement of living standard of men. On the other hand, it pollutes the air and water and has an hazardous effect on the socio-economic and socio-cultural values. Problems that people in different mineral rich regions of the state face have been highlighted to sharpen the issue. In the mining areas of Keonjhar district, the air is filled with iron ore dust. The plants are covered with a layer of such dust and the leaves do not look green. Many domestic animals die when they consume the grasses and leaves of plants covered with a layer of dust emitted by crushers. Continuous inhaling of iron ore dust by the workers has caused TB and other kinds of respiratory diseases to them. The disease of T.B. is widespread in Jajang village. The walls of the primary school in Kashia village has developed cracks because of the dynamite explosion in the nearby places. Women of upper Kadakala village under Bansapani block in Keonjhar district inhabitating near the famous Khandadhar waterfall are worried about the drinking water problem. The perennial streams work as lifelines for nearly 20 tribal villages. The indiscriminate mining activities has led to water scarcity in many parts of Keonjhar district. Water pollution and water scarcity is a problem of great concern in many areas. Women of Palasa and Jurundi villages walk miles for collecting drinking water. The people of these area drink mud water which causes several diseases like Jaundice and skin ailments. The Central Ground Water Board has brought it to the notice of state government that the ground water level has already fallen by nearly four meters in Keonjhar and the large scale mining activities may further deepen the groundwater level. The large left over mining pits are filled with rainwater and become the breeding places for mosquitoes. This ultimately spreads malaria. The coal mining areas in Angul district have turned into dust bowls due to the process of extraction and exploration of coal. Agricultural and grazing lands become unusable due to pollution. The Health, Education and Human Development Index of mineral rich districts are presented in table 5.All these depict the poor socio-economic and environmental conditions in the mineral rich districts of Orissa.

Table 5: Development in mineral rich districts, Orissa

Sl. No.	Districts	Health index	Health index Rank	Literacy rate	Education Index	Education Index rank	Income Index	HDI value	HDI rank
1	Angul	0.481	12	69.4	0.760	12	0.748	0.663	06
2	Dhenkanal	0.468	15	70.11	0.773	09	0.534	0.591	12
3	Jajpur	0.333	24	72.19	0.786	07	0.499	0.540	22
4	Jharsugda	0.635	09	71.47	0.773	08	0.757	0.722	02
5	Keonjhar	0.340	22	59.75	0.704	18	0.547	0.530	24
6	Mayurbhanj	0.782	01	52.43	0.647	22	0.489	0.639	09
7	Sundargarh	0.692	06	75.22	0.740	14	0.618	0.683	04
8	Koraput	0.218	27	36.20	0.535	27	0.539	0.431	27
9	Sambalpur	0.436	19	67.01	0.742	13	0.590	0.589	13
	Orissa	0.468		63.61	0.723		0.545	0.579	

***Source*:** Compiled from Orissa Human Development Report 2004.

A critical analysis of the above research studies point out that the overall trend of employment generation is gradually decreasing but revenue receipt in increasing. Environmental scenario mining area is deteriorating. The revenue does not translate into development of mining districts.

Employment generation through environmental management

The level of employment is an important parameter of economic development of the state. The efficiency of a particular sector in an economy is assessed, besides other things, on the basis of its employment generating capacity. The study indicates that the direct employment in major mineral activities does not show an encouraging trend and mining activities has serious threat to the environment. Hence there is a urgent need to adopt sensible strategy for use of mineral resources to promote job-led economic growth through the adoption of employment generating, economically-viable and environmentally acceptable technologies. The different areas in which job opportunities can be created through environmental management are as follows:

Reclamation of mined land

Vegetative methods of reclamation of mined land may emerge as a significant, economically viable and employment generating activities in mining belts of different districts of Orissa (i.e. Keonjhar, Sundargarh, Dhenkanal, Angul, Koraput, Jharsugda, Sambalpur, Koraput and Jajpur). Forestry, being a labour-intensive enterprise, can generate more employment opportunity for local people irrespective of their skill, level of literacy, age, sex and other considerations. Forestry involves a number of activities such as nursery development, pit/ trench digging, planting, maintenance and

after care etc. A significant contribution of forestry development projects is to provide a sizable amount of person days of gainful employment to local people and to reduce the adverse impact of mining activities on environment. Plant species like Agave, Eucalyptus, Acacia, Erythrina, Bamboos would be useful[9]. Vegetation barriers along the periphery of mining area would be obviously useful. Plantation should be undertaken extensively along road and minor township as they not only provide shade and better climate but also help in reducing noise and dust pollution. Many trees like Neem, Silk cotton, Indian laburnum, Gulmohar, Pipal, Jacaranda, Indian lilac, pagoda tree, Java pulm and several others are suitable in town and streets because these plants are efficient in filtering particulate dusts[3].

Use of mining pits

The horrendous consequences of mining are evident in different parts of mining belts in Orissa. The landscape is pockmarked with gigantic pits. Abandoned open pits, if suitable, can be converted into fish ponds to create job opportunity as practiced in Zambia. Quarry pits can be filled with rock debris and sands to create an artificial groundwater resources.

Soil Conservation

Soil conservation is another area to generate employment opportunity in mining area. The lands are susceptible to soil erosion, making the land unsuitable for agriculture. Soil conservation projects like land leveling, removal of silts, land reclamation, terracing and bunding can be undertaken extensively to generate employment opportunity and to protect the environmental degradation.

Use of mining wastes

The use of mining wastes for backfilling, recycling, and the large scale use of wastes for the construction of roads, buildings and other civil engineering works are some of the ways by which the waste can be used beneficially and employment opportunity can be created through the downstream activities[1].Fly ash and red mud generated from coal and aluminum industries respectively can be used in making bricks. Clay may be mixed with fly-ash for making bricks. The CSIR Laboratories in India have developed innovative approaches for the use of fly-ash and red mud wastes. Bricks made from red mud waste have a good architectural value as facing bricks due to its pleasing orange or golden yellow color. The above mentioned activities not only generate employment opportunity but also help in cleaning the environment in mining belts. Clays can be used for toy-making and country bricks etc. It will be very useful to the rural artisan for self-employment.

Artificial groundwater Recharges structure

The groundwater depletion in the mining belt is likely to be due to decrease in the groundwater recharge potential which is attributed to excavation of ores from the mine, deforestation and other factors. The Iron ore bearing hill ranges which once acted as ground water recharge zones are being depleted rapidly by mining activities. Hence adoption of artificial ground water recharge structures in mining area would not only raise the water table but also generate job opportunity through these activities.

4. Conclusion

Orissa is endowed with vast amount of mineral resources for which it is considered to be a potentially rich state. At the same time it is experiencing massive poverty and slow economic growth. Exploitation of mineral resources without concurrent health care for both the people and environment will not help the state to accelerate the pace of socio-economic development. We need to generate employment opportunity in mining sector. We need minerals for economic development. We also need fresh air and water, trees, forests etc. We need to prevent degradation of environment. This being so, it is essential that environmental improvement projects are taken up and implemented with the same zeal and enthusiasm as production of minerals and metals. A sensible strategy is to use minerals to promote job-led (but not job-less) economic growth through the adoption of employment generating, economically viable and environmentally acceptable technology. Vegetative methods of reclamation of mined land, soil conservation practices, conversion of mining waste into wealth, efficient use of degraded land, water harvesting and artificial groundwater recharge structures have been suggested as employment generating activities through environmental management in mining area. A multi-task, multi-disciplinary approach encompassing Geology, Geography, Geo physics, Geochemistry, Bio-Sciences, Environmental Sciences, Mining Engineering, Remote sensing and GIS. Economics, Social Science etc. is needed to customize the use of minerals in a given biophysical and socio-economic setting. Much more research on minerals, mining environment and socio-economic development is needed for sustainable development of Mineral Resources.

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