

Environmental Impact Assessment of Mining Projects

Dr. Gurdeep Singh*

1.0 Screening

Mining projects fall under Schedule-I of EIA Notification 1994 and are required to obtain environmental clearance from Ministry of Environment and Forests (MOEF) as per the screening criterion. Forest clearance under Forest (Conservation) Act is also specifically required if the project involves the forest land. Mining projects being site specific projects, will also have to obtain separate site clearance from the Government as specified in the EIA Notification.

2.0 Environmental Policy/Legislation

Environment clearance of development projects including mining is done by the Government, with the following objectives:

- optimal utilisation of finite natural resources through use of better technologies and management packages, and
- increasing suitable remedial measures at the project formulation stage.

The Policy Statement of Pollution issued by the Ministry of Environment and Forests Govt. of India in 1992, provides instruments in the form of legislation and regulation, fiscal incentives, voluntary agreements, educational programmes and information campaigns in order to prevent, control and reduce environmental pollution. The establishment and functioning of any industry including mining will be governed by the following environmental acts/regulations besides the local zoning and land use laws of the States and Union Territories :

- i) The Water (Prevention and Control of Pollution) Act, 1974 as amended from time to time (Water Act)
- ii) The Water (Prevention and Control of Pollution) Cess Act, 1977, as amended (Water Cess Act)
- iii) The Air (Prevention and Control of Pollution) Act, 1981 as amended (Air Act).
- iv) The Environment (Protection) Act, 1986 (EPA)
- v) The Wildlife (Protection) Act, 1972 as amended
- vi) The Forest (Conservation) Act, 1980 as amended
- vii) The Public Liability Insurance Act, 1991
- viii) The Mines and Minerals (Regulation and Development) Act, 1957, as amended (MMRD Act)
- ix) Circulars issued by the Director-General Mines Safety (DGMS).

Once the mining industry has been set up during the process of its life cycle, it is required to meet the standards of emissions, effluents and noise levels besides the compliance of other environmental acts/regulations including mining safety regulations. There also exists Guidelines for Integrating Environmental Concerns with Exploitation of Mineral Resources which identify some of the vital aspects relevant to environmental protection. These guidelines highlight the salient aspects of the various problems and briefly indicate some of the steps that need to be incorporated during the planning and various stages of the mining operations. The need for evolving certain tolerance standards/limits by the appropriate agencies, has also been emphasised.

* Professor and Head, Centre of Mining Environment, Indian School of Mines, Dhanbad – 826 004
email: s_gurdeep2001@yahoo.com

3.0 Mining Technology - Alternatives

Mining projects are site specific and location of the proposed mine is restricted to the geology and mineral deposits in the area. Geological, engineering and technical constraints determine the mining methods to be employed. The various alternatives/options available to mine the mineral are :

- Alternative mine locations (this is mainly limited by geological parameters)
- Alternative methods for obtaining the mineral (underground Vs opencast mining)
- Alternative Mining Methods (Bord & Pillar/Longwall shovel-dumper/Dragline-Shovel-dumper etc) and use of raw materials (different transportation systems, overburden removal, handling techniques and reclamation methods)
- Alternative site configuration including different locations for haulage roads, overburden and soil mounds, site access points and site buildings.
- Alternate landuse for site after mining operations have ceased.
- Alternate mitigation measures e.g. restoration plans, different control techniques for air, water, soil and noise pollution
- Scheduling alternatives e.g., application of phased or staged mining and restoration plans to avoid the seasonally sensitive areas.
- The alternative of postponing the proposal pending further study
- The no action alternative in which a proposed mine does not proceed.

All viable alternatives should be given due consideration while planning mining operations. Details about the proposed mining technology should be furnished. It has been noticed that the mining technology is finalised on economic and technical considerations without taking into account the environmental and social implications. Mining technology in conjunction with the restoration plans (mitigation measures) during construction, operation and post-mining phases should be carefully selected not only on the basis of yielding the highest possible production and profitability but also the environmental enhancement and positive socio-economic impacts. It should also consider to minimise miner's occupational exposure time and associated risk and safety factors.

4.0 Scoping

Components of Development and Associated Environmental Impacts in Mining projects are well known and major development components associated with these are tabled below :

* Land Acquisition	* Site Development - Construction camp, creation of infrastructure including roads etc
* Top soil removal and storage	* Drilling and blasting
* Overburden removal and storage	* Toxic waste treatment
* Mineral extraction	* Mine water pumping
* Disposal	* Mineral transport
* Heavy earth moving machinery (HEMM) use and maintenance	* Site restoration/reclamation - backfilling, treatment, spreading of top soil, revegetation.
* Mineral processing	

Mining projects, in general, give rise to potential environmental impacts and in scoping exercise, the following environmental components (attributes) which are usually impacted as result of above listed activities must be considered :

1. Landuse	6. Landscape
2. Socio-economic	7. Water resources/hydrology
3. Water quality	8. Air and dust
4. Noise and vibrations	9. Ecology (flora & fauna)
5. Risk/hazards	10. Public health and safety

Scoping is useful in initiating a mechanism for consultation amongst the project developer the affected people, NGOs, public representatives, planning authorities. All aspects of environmental socio-economic and particularly compensation for settlement and rehabilitation package and other issues as required by the decision-makers, should be dealt with in scoping exercise. A typical scoping matrix is presented (as encountered in some of the opencast mining projects) in Annexure 1 showing the scoping of environmental impacts with the components of development.

Description of environmental setting with respect to above environmental impacts in the project area requires the collection of baseline (pre-mining) data. The upcoming project site is usually surrounded by existing coalfields, the impacts of which already exist in the baseline (background) environmental quality of the area. The socio-economic profile of mining areas indicates very rapid growth of population (70-80% per decade) due to availability of better employment opportunities, higher literacy rate (40-70%), improved infrastructure (communication, transport, roads etc) but generally associated with lack of adequate facilities for water supply and sanitation.

5.0 Anticipated Environmental Impacts

Anticipated (predicted) environmental impacts should be based on the experience gained in similar type of mines under similar conditions. Scientific data from the working mines to substantiate the anticipation shall also be furnished. The major anticipated impacts generally encountered in various components of development (as already listed in scoping) are summarised below.

5.1 Land use

The major direct impacts on existing land use during the pre-mining phase are the removal of vegetation and resettlement of displaced population. There may also be landuse changes with respect to agriculture, fisheries, recreation sites, housing, forestry areas etc. Land reclamation/restoration of mined out lands may give rise to enhanced beneficial land use.

5.2 Landscape

There exists major environment impacts due to landscape disruption particularly visuals (unsightly huge dumps, voids, mine structures, subsidence, mine fires etc.). During mining and post-mining phases drastic changes in landscape with landforms take place. The major associated impacts are soil-erosion, loss of top soil, change in complete geology, creation of huge dumps & voids, disposal of wastes, deforestation etc Land reclamation/restoration may provide better landuse and landscape with considerations to environmental management

5.3 Socio-economic

The major beneficial impacts of mining projects are change in employment & income opportunity, infrastructure, community development, communication, transport, educational, commercial, recreational and medical facilities. The major adverse impact, however, is the displacement and rehabilitation/resettlement of affected people including change in culture, heritage

& related features. The crime and illicit activities also prop-up due to sudden economic development of the area.

5.4 Hydrology/water resources

The major adverse impacts are changes in ground water flow patterns, lowering of water table, changes in the hydrodynamic conditions of river/underground recharge basins, reduction in volumes of subsurface discharge to water bodies/ rivers, disruption & diversion of water courses/drainages, contamination of water bodies, affecting the yield of water from bore wells and dugwells, land subsidence etc.

5.5 Water quality

The major impacts are water pollution due to erosion, oil & grease, contamination of water bodies due to discharge of mine water/effluents, pollution from domestic & sewage effluents, sedimentation of rivers and other stored water bodies, leachates from wash-off from dumps, solid waste disposal sites, broken rocks, toxic wastes, salinity from mine fires, acid mine drainage etc.

5.6 Air Quality

The major adverse impact is the high intensity of dust nuisance problems such as visuals, soiling and degradation of materials etc. The major sources activities of dust emissions are drilling & blasting, overburden removal, haul roads, coal extraction, transportation, reclamation activities and also erosion from dumps, coal yards, waste disposal areas.

Other impacts are gaseous emissions, exhaust from HEMM & other transport vehicles.

5.7 Noise and Vibrations

The major adverse impacts during pre-mining and mining phases are generation of obnoxious levels of noise & vibrations which also spread in neighbouring communities. The other impacts are occupational health hazards, damage to structures, disruption in wildlife etc.

5.8 Ecology (flora & fauna)

The major adverse impacts due to pre-mining and mining phases are loss of habitat, biodiversity, rare flora & fauna, fisheries & other aquatic life, migration of wildlife and overall disruption of the ecology of the area. During post-mining phase after land restoration, ecology may effectively improve.

5.9 Risks and hazards

Risks and hazards arise mainly from blasting and mine occupational activities and are well established. Blasting may effect the mine workers as well as people residing in the vicinity of mine and dependent upon the type & quantity of explosives used, pit geology, topography and confinement of the blast. Various respirable diseases due to occupational hazards associated with mining operations are quite infamous. Workers are also put in various risky jobs in typified mine works. There also exists risks and hazards of mine accidents (roof fall, explosions, inundations, rock bursts etc.). Vibrations and fly rock as a result of blasting and rock fragmentation give rise to serious risk of accidents and damage to structures.

5.10 Public Health and Safety

Various respirable and water-borne diseases are cause of concern for public health and safety in mining areas due to high intensity dust nuisance and pollution of water bodies and contaminated water supply. Health care centres (medical centres) are usually distantly located and provision of medical facilities by project developers results in beneficial impact. There is a general cause of concern for safety due to blasting/explosions, noise & vibrations etc.

There also occurs other environmental impacts such as soils and geology, material degradation, resources depletion, effect on historical and archaeological sites, aesthetic etc. To avoid double counting of the impacts, these types of impacts usually are considered in other major environmental attributes. The historical and archaeocological aspects have not been provided here as this is site specific but requires appropriate consideration for environmental assessment.

6.0 Significance of Impacts

After anticipation (prediction) of impacts, it is necessary to assess their significance. The assessment needs to reflect the particular local characteristics of the area proposed for the mining project. Some of the issues associated with the mining projects may have profound impacts on local people and their views need to be considered to avoid complications regarding the R&R package, employment opportunities, public health & safety etc. Criteria which are useful in assessment of impacts may be based on the following :

- legal requirements/environmental standards
- guidelines covering the design and construction of new infrastructure, R&R packages, compensation etc.
- need for providing mitigation measures including guidelines for the reclamation of mined out areas, dumps and other disused areas.

Specific evaluation criteria may be necessary for a specific mining project taking into account the nature of the impacts and the receptors. An environmental impact matrix reflecting the significance and magnitude of anticipated environmental impacts during pre-mining and mining (operation) phases with respect to a mining project in eastern India is given in Annexure 2. An environmental management plan specifying the specific safeguards/mitigation measures in view of this is required

7.0 Proposed Environmental Safeguards/Mitigation Measures

While providing for the environmental safeguards to mitigate environmental impacts, care should be taken to provide details about the similar kind of measures adapted in other projects. The degree of success of these measures achieved in other projects should also be considered in determining the utility of proposed safeguards/mitigation measures. These are summarised below.

7.1 Land Use/Landscape

Mitigation measures concerning landuse include following aspects :

- To ensure landuse changes happen in an optimal way so that impacts are minimised and land is reclaimed as soon as possible with predetermined land use patterns and landscape considerations.
- To minimise the impacts on the local population with provision of environmental benefits to local people Year-wise Reclamation Plan is to be prepared while considering the above aspects and consists of
- Top soil removal and conservation (bunds etc)
- Overburden analysis and selective procedures for handling requirements including ripping &

regradation

- Phased plans for overburden dump construction considering the stability, slope, contouring/gradient landscape factors

⇒ Plant materials selection for reclamation
⇒ Phased plans for plant material establishment
⇒ Nursery production procedures for plant materials

However, there is little that can help to prevent the damage to landscape during mining phase. However, during post-mining phase/restoration process, proper afforestation with layout of rehabilitation measures such as recreational will help in improving the aesthetics and landscape.

7.2 Socio-economic

Major impacts of mining projects are rehabilitation and resettlement (R&R) of displaced persons. There exists standard packages for project affected people and the package cost is considered under project cost. The Government of India, has provided guidelines for R&R package for displaced persons, as given below :

- Compensation to be paid for house and land acquired from each family
- House site 0.02 ha of developed plot to be given to each family
- Shifting allowance of Rs. 2000 to be paid per family
- Civic facilities to be provided in the rehabilitation colony will include water supply, power, roads and sanitation arrangements
- For employment, displaced persons to be given preference in recruitment to category C&D in concerned company subject to suitability and observance of laid down procedure of employment exchange.
- Training to be arranged by the concerned company for eligible persons to enable them to take up the job. Since R&R is very sensitive issue, utmost care should be taken in its effective implementation while involving the actual displaced persons, local government administrators, political leaders, NGOs etc. While initiating R&R measures, care should be taken to ensure to the extent possible, that the traditional life style of local people is not disturbed. Since some of sites are located in remote areas, the township is an essential component of mining activities. These townships shall be properly planned according to normal town planning practices and should not be allowed to grow indiscriminately. Adequate infrastructure should be developed taking care of neighborhood areas so as to avoid straining infrastructure facilities of nearby settlements.

7.3 Hydrology/Water Resources

Due to mining operations the major impact is lowering of water table and reduction in overall water quantity. Provision for creation of stored water bodies be made by putting up the pumped out mine water in these. This can provide excellent recharging facility and ensure proper quantity of available water in league with National Water Policy. Wherever possible grouting may be done to prevent particular water bodies.

Sedimentation can be checked by providing various engineering measures and stabilising dumps etc.

7.4 Water Quality

The major mitigation measures are listed below:

- Overburden run-off collection and treatment with subsequent sediment control
- Oil & grease traps/separators
- Collection/storage of leachates, seepages, wash-offs with subsequent treatment
- Proper sanitation and provision of domestic and sewage effluents treatment
- Treatment of mine water discharges.

7.5 Air Quality

Following measures generally, are practiced for prevention and control of air pollution in mining areas:

- Dust suppression through heavy dust sprinklers/road watering trucks at various sensitive points such as haul roads, mineral handling plants, crushing and screening plants etc.
- Dust extraction facilities are to be provided with HEMM, crushing, screening and mineral handling plants.
- Water sprays, hoods, dust collectors are to be used to control dusts from drilling.
- Measures such as adoption of hoods at transfer points, proper design of chutes, vulcanising conveyer belt joints, underbelt cleaning devices apart from dust suppression and/or dust extraction system for conveyers are usually introduced to minimise dust pollution.
- Mineral handling plants are to be covered with proper enclosures
- Transportation (trucks/dumpers & railway wagons) are to be properly covered and leak proof. Suitable spraying agents to be sprinkled to prevent dusts from being airborne.
- Consolidation of haul roads & other roads should be sprayed with suitable chemical additives for effective check of dust emissions.
- Stabilisation through vegetation at various critical dust generating points/dumps.

7.6 Noise and Vibrations

The nature of mining activities is such that noise & vibrations can not be eliminated. Various measures to prevent noise pollution are:

- Provision of ear plugs and ear muffs to reduce noise level exposure.
- Use of noise abatement paddings in fixed plant installations
- Use of silencers/mufflers in HEMM, noise insulating enclosures.
- Location of residential/resettlement colonies away from noise generating sources.

Vibrations can be checked/prevented as under :

- Buildings likely to be affected due to vibrations should be identified and protected by trenching or other appropriate measures to minimise vibration effects.
- Control of ground movement due to vibration can be achieved by avoiding over-charging, use of delays and improved blasting technology. Due regard must be paid to vibration transmission properties of geological formations and terrain stability (tectonism, seismicity etc)
- Vibrations due to mobile plants and equipment can be minimised by modernisation and proper maintenance.

7.7 Ecology

The methods to safeguard ecological impacts include avoiding areas of high ecological values for siting various mining infrastructure dumps, disposal sites etc.

- Providing environmental (wildlife) corridors to link adjacent habitat where mining is to be carried out in such sensitive afforested areas.
- Suitable design of greenbelts/shelter beds with selected species should be provided which can also respond to attenuate dust, gaseous emissions and noise levels.

Due to the nature of mining and occurrence of typical mineral deposits it is not possible to restore the entire ecological scenario in the mining areas.

7.8 Risk, Hazards, Public Health & Safety

Sufficient precautions to be taken to safeguard both the workforce and the local population. These include mock safety drill during blasting, stabilisation of dumps and fencing of hazardous areas. Blasting should take place during normal working hours and at fixed time intervals and people living around should be warned in advance for better safety. Mine rescue training to encounter various risks, hazards and safety factors associated with mine disasters such as explosions inundation, rock collapse etc. Mechanized opencast mining methods usually provide less exposure time and are relatively risk free than those of underground methods. Personal protective gear use by the employees minimising the risks and hazards.

As a result of better sanitation, medical facilities and other infrastructural facilities, there is likelihood of the reduction in disease. However, regular medical check up of employees particular those put on risky and occupational hazards should be done periodically rather than at three years interval as stipulated by Director General Mine Safety.

8.0 Residual Impacts

Residual impacts are usually remained in a number of environmental components even after best environmental practice is applied. These include dust, landscape, noise & vibrations, risk & health etc. These are resulted due to various technological constraints and the nature of mining. Consequently aesthetics & visuals and ecological impacts can not be avoided. The nature of mining activities is such that generation of noise & vibrations can not be eliminated.

Since R&R package is a very sensitive issue it is not possible to provide complete satisfaction particularly to project affected people despite having best possible features. Mining (Project) authorities should however, develop a monitoring and feedback mechanism to effectively implement and monitor environmental management plan. This will ensure proper implementation of mitigation measures proposed and also to effect mid-course corrections, if required. An environmental impact matrix with mitigation measures is provided in Annexure 3. Comparison of Annexures 2 and 3 reflects the residual impacts remaining particularly due to mining technological constraints.

9.0 Public Participation and Consultation

A limited public participation is provided in the country. In case of certain special/controversial projects which have aroused considerable public interest, public hearings are arranged to ensure public participation and consultation in developmental decisions. Announcements for such public hearings is usually made atleast 30 days before through newspapers. There already exists conflicts on various development projects including mining projects in view of this provision of very limited participation. This is very vital for successful implementation of the project because this will help to:

- identify local knowledge/problems/needs
- inform about the proposed development and allay fears and also to avoid complications.
- determine local response and integrate people into project
- collect information which would otherwise be missed and use experts knowledge

However, this process may allow vested interests to delay the project and give rise to increased costs. Project affected people and support groups and people with valuable information and voluntary/elective representatives, NGOs etc. should be consulted for effective participation. Print/electronic media, postal questionnaire, leaflets, official/elective representatives meetings, local language, visual aids can be used to ensure public participation and consultation. Though all stages of

EIA process are required but scoping, review and monitoring are particularly important to ensure successful implementation of the development (mining) projects.

10.0 Decision Making

On the basis of the exercise (scrutinising the EIA documents, site visits wherever necessary, consultation with experts on specific issues as and when necessary, interact with the affected people and environmental groups directly and public hearings/participation in special/controversial projects). The Environmental Appraisal Committee on Mining Projects, make recommendations for approval or rejection of particular projects. The recommendations then processed in the MOEF for approval or rejection. Once all the requisite documents and data from the project authority (developer) are received and public hearings (where required) have been held, assessment and evaluation of the project from the environmental angle is completed within 90 days and the decision of the MOEF is conveyed within 30 days thereafter.

11.0 Monitoring

Each mining company including at project level usually identify within its setup a Department/Section/Cell with trained personnel to take up the model responsibility of environmental management as required for planning and implementation of the projects. The purpose of the monitoring is :

- to ensure that no impacts are in excess of standards
- to check the predictions made in EIA
- to facilitate identification of any unidentified impacts and make provisions for their mitigation.

A monitoring and feedback mechanism is required to effectively implement and monitor environmental management plan. This will ensure proper implementation of mitigation measures proposed and also to effect mid-course corrections, if required monitoring is required during construction (pre-mining), operation (mining) and restoration (post-mining) phases. Monitoring should be carried out on regular basis using standard methods of various environmental attributes by suitably qualified personnel. However, there is a strong need for evolving the environmental management systems to ensure effective monitoring, environmental compliance and interaction with concerned and support groups and also for best practice environmental management, as per ISO : 14000.

12.0 Concluding Remarks

Coal continues to offer an economical and abundant source of cheap energy as vast resources of thermal grade coal are estimated in the country. However, the importance of the required control of the associated environmental impacts due to land use, socio-economic, ecology, pollution of air, water & noise, vibrations, aesthetics & amenities, caused by mining of coal can not be ignored. The requirements of EIA has helped the development of technologies for effective design of integrated mining and restoration systems. The EIA presents a tool for an effective design for a successful mining project on full life and relatively risk free basis. The nationalised coal mining industry seems to have suffered greatly in both developed and developing countries in the absence of EIA.

Presently case by case EIA is being carried out but many mining projects alongwith other industries are operating in the same region. To consider the overall impact, strategic environmental assessment should be applied to a cluster of such project and an overall effective advanced environment management plan should be formulated.

Monitoring and post audit reviews of mining projects for which EIA is already approved, are required for effective environmental management. There is a strong need for evolving the Environmental Management Systems as per ISO 14001.

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