Environmental Impact Assessment of Iron Ore Mine in GOA

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Abstract: *The Mining industry in India is a major economic activity which contributes significantly to the economy of India. Though mining is an essential factor in economic growth, it does have a significant effect on the environment which can't be refuted. In essence of preserving the environmental aspects, government of India has put on huge restriction on mining in the country. Here environmental impact assessment (EIA) can be very helpful for mining industry to maximize the production with respect to minimizing environmental damage. EIA also helps assist governing body of the region to maintain mining regulations. EIA is helpful in other industrial sectors as well. Here EIA terms are observed using a case study.*

Keywords: EIA; MoEF

1. Introduction

The need for a systematic method of evaluating the environmental effects of a project or a plan has been recognized for several decades. EIA has been applied to projects and plans of various scales. It is used in local projects and development, but also for regional and even global issues. The early EIAs were often focused on inventory of a possible environmental load and the impact due to this. EIA is a decision-making tool, which guides the decision makers in taking appropriate decisions for proposed projects. It aims predicting environmental impacts at an early stage of project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision makers. By using EIA, both environmental and economic benefits can be achieved. By considering environmental effects and mitigation early in the project planning cycle, there are many benefits, such as protection of the environment, optimum utilization of resources and saving overall time and cost of the project. The Ministry of Environment & Forests (MoEF), Govt. of India, made environmental clearance (EC) for certain development projects mandatory through its notification of 37/01/1994 under the Environment Protection Act, 1986. Keeping in view of the experience gained in environmental clearance process over a period of one decade, the MoEF came out with Environment Impact Notification, SO 1533(E), and dt.14/09/3006. It has been made mandatory to obtain environmental clearance for different kinds of developmental projects (Schedule-1 of notification).

2. Meaning and Process

The phases of an EIA from screening to follow-up are illustrated in Figure 1 below.

A. Screening
The decision to perform an EIA may be based on various grounds, depending on the aim - policy or project development vs. legal requirements etc. The process to decide whether an EIA is required or not is generally called screening. Screening is performed in order to ensure that proposals that will have a significant impact on the environment will undergo an EIA. The decisions taken during the early stage of the EIA are of fundamental importance to the process.

B. Scoping
The EIA process is preliminary concerned with identifying environmental changes that will be of primary concern for individuals, public interest groups and communities. The term scoping is used to describe the process of deciding what should be included in an EIA. It may be seen as a means for identifying the main public concern about a proposal and for organizing the scientific work for the assessment.

C. Impact identification
Impact identification is establishing the basis for designing appropriate and efficient EIA studies, focused on particular impact areas. The purpose of impact identification is not to produce definitive statements about the nature, magnitude and significance of possible impacts.

D. Checklist
These can be of different types.
- Simple checklists list the components or aspects, usually of the environment, which might be considered by the assessor, but no other assistance is provided to guide the impact identification process.
- Descriptive checklists provide additional assistance by indicating, for example, the specific variables to be measured to characterize each component.
- Scaling checklists go a step further and include simple devices for assessing importance or significance of suspected impacts. This might be through the use of letter or numeric scales, assigned after comparison with criteria supplied in the checklist, to indicate the importance of an impact.
- Questionnaire checklist is a form of scaling checklist but uses a series of carefully directed questions to elicit information about possible impacts and their likely importance.

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E. Matrices

Matrix methods identify interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities.

F. Networks

These are called as effect flow diagrams, used to help in tracing the web relationships that exist between different activities associated with action and environmental system with which they interact. They are also important in identifying direct and cumulative impacts. They are more complex and need expertise for their effective use.

G. Consultations

- With decision-makers, affected communities, environmental interest groups to ensure that all potential impacts are detected.
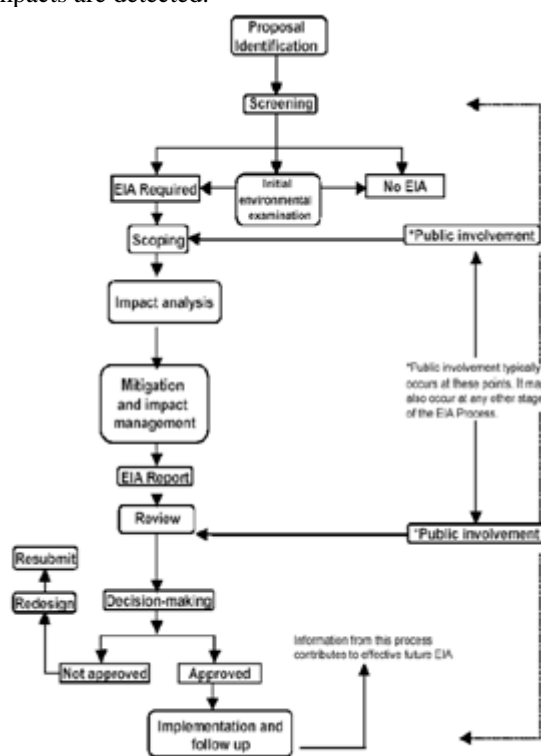

Figure 1

3. Objectives of EIA

There are different aims of EIA that will influence the choice of method and the scope of the study. The aim is dependent on who is the user as well as on the use of the result. Some of the aims may be regarded as more or less formal like:

a) Project development
The use of EIA in project development may be regarded as a way of avoiding environmental impacts by using EIA at as early stage as possible in the development. This is also a way of avoiding costs due to these impacts. This may be used for different projects e.g. construction or reconstruction of industrial plants, construction of roads, construction of municipal waste or water purification plants.

b) Development control
Here the EIA is a tool for authorities to prevent adverse environmental impact from the kind of projects mentioned above. This kind of EIA has been introduced in national legislation. The performer may be the authority but also it may be the task of the performing company. Also here consultants may be used for the work.

c) Plan development.
This EIA is a tool for authorities in planning of resource or land use, infrastructure like roads, railways etc.

d) Policy development
Policy can be evaluated by a government. As an example a government may evaluate the consequences of promoting a specific type of industry as a major primary industry. Also here the work may be performed internally or by consultants.

4. Case Study

As a case study, an Iron ore mine in Goa (India) is considered. This case study will show the implementation and the impact of the EIA.

1) Site Location

The Gotukwadecho Tembo Iron Ore Mines is located at Collem village of SanguemTaluka of south Goa district of Goa state. The mining was granted by the Portuguese Government as a concession over an area of 33.35 hecters at Collem Village. The mine is being actively operated for the last 47 years. The ore is exported to Japan, China and other European countries. Mining is a site specific industry and mining has to be done in mineralized areas as per the mineral policy of the Government within area leased for mining purpose. Collem region is an active mining belt for last 50 years forming part of Iron Ore formation with cluster of active mines.The mine is situated about 4 kms from Mollem and 34 kms from Ponda Town. The nearest railway is Collem situated about 3 kms from the mine towards south. It is proposed to produce annually 1 lakh ton. The grade of Iron Ore reserve at this mine varies from powdery high grade ore of FE content 59% - 60% to low-grade siliceous magnetite having FE contents of 30% - 55%. The Low grade Iron Ore is transported by Tipper trucks to the beneficiation plant of M/s Dempo Mining Co. situated at Surla, Bicholim which is about 15 kms from mine. Present case study area of Mining concession was granted on 13.09.1958 for an area of 33.35 Ha. Working in the mine started on 13.09.1958. Work was carried out by manual means from 1958 onwards. During the year 1987 (33.11.1987) all the concessions in

Goa were abolished and converted into leases. Work was suspended during the period 1987 to 1993 (during which dead rent was paid). Work is going on in the mines from 1993 onwards without any problem. Mine is being worked now by mechanized means. Exploration in the form of core drilling (total No. of holes S1) was carried out in the past at various stages. The details have been shown in Mining Plans/ Schemes submitted earlier. NOC from State Govt. and EC from MOEF are obtained. Application for forest clearance is made. Clearance is expected at any time in near future (as file has gone to Bangalore office).

2) Details of the area-

District and state	South Goa, Goa
Taluka	Sanguem
Village	Collem
Khasara No.	37,39/3,38/3,38/4,39/1
Lease Area (Hectares)	33.3500 ha

Whether the area is recorded in forest -
Area is partly falling in forest and partly in private (non-forest) area. Nearest wild life sanctuary is Mahavir Wild Life sanctuary. The shortest distance of sanctuary is 1.5kms.
a. Nearest Village is Collem and is 3 kms away.
b. Nearest Railway station is Collem. It is 3 kms away.
c. Nearest Seaport is at Marmagoa. It is 73 Kms.
d. Nearest Powergrid is in Shigao village. It is 3 kms away.

5. Impact Analysis

With respect of collected base line data followings impacts are observed.
a) Flora And Fauna
As discussed before forest is found in vicinity of study area. Major portion of Gotukwadecho Tembo (Collem mine) mine is under active mining operation. Mining process and Drainage pattern influences the vegetation and ecological status of crop along with various Flora and faunas discussed below.
Injuries to which the crop is liable
1) **Man**
   Natural tree growth is frequently cut by the surrounding villagers for meeting domestic requirement of fuel wood, green manure fencing material and fodder.
2) **Animals**
   Domestic cattle regularly graze in the buffer and damage young regeneration besides trampling the ground.
3) **Wild animals**
   Damage by Wild Animals is not conspicuous. Wild Boars move around during cashew harvesting season, besides porcupines also are common but damage to vegetation is insignificant.
4) **Fauna**
   Major portion of Gotukwadecho Tembo (Collem mine) mine is under active mining operation besides the core area is devoid of natural trees barring few shrubs, climbers and bamboos. The core area has been rehabilitated with Coconut, Mango, Jack fruit, Cashew, Bheras, Cumayo, Acacia, Madatti, Banana and other miscellaneous trees on over burden and worked portion

of the lease. Major herbivorous like Deer, Sambar, Gaurs and Carnivores like Leopard are not seen in the Core area.

b) Temperature & Humidity
No major increase in temperature & humidity is found in vicinity towns due to proposed project.

c) Air Quality
Ambient air quality was studied during the last season, Monsoon. Since it was monsoon and no work was going on in the mines the values are very less and area not the representative one.

d) Noise Level
The main sources of noise in the area are movement of heavy machinery's, loading and transportation of iron ore by trucks. The noise level was measured at a distance of about 5 to 10m from the source for different locations in the mine site and in the buffer zone. The noise level measurement was carried out during the peak working hours of daytime. But it can be concluded that the average noise level are less than the prescribed maximum permissible limit of 90 Db (A) for the shift of 8 hrs working in an industry.

e) Water Quality
To assess the quality of water in the core zone and buffer zone of 5 km radius, water samples were collected during monsoon. Samples were collected in a season on three consecutive days. In all, five samples collected. The physico – chemical characteristics of surface and ground water revealed that Ph of water is slightly acidic to neutral. The water quality belongs to low electrical conductivity category (E.C. <500 micromhos/cm). The average electrical conductivity of pit water (KNWI) was 64.41 micromhos/cm with lowest being 37.40 micromhos/cm and highest of 84.40 micromhos/cm. Hardness of water discharged from the mines was 30.96 mg/l which indicates that water quality belongs to soft category.

f) Soil Quality
The color of the soil samples varies between reddish brown to brown having salty loam texture with good drainage. The soils are acidic in nature with traces of total soluble salts. The soils are low to medium in available nitrogen and medium to high in available phosphorous and low in potash. Heavy metals are within the limit of toxicity. Total iron content is very high (14.4 to 31.30%).

g) Climatic Conditions
The rainfall data for the year 3003 has been collected from the local meteorological department. The meteorological data such as temperature, relative humidity, wind direction and wind speed were obtained by setting up own meteorological equipment.

h) Socio – Economic Impact
1) **Social and demographic profile:**
   Lease area is in the remote and backward part of the state. Work in the mines and allied activities will generate employment to the local people, this will improve their life standards. Infra structural facilities will be developed in the area due to group of mining activities being carried out at the site.

2) **Occupational health and safety:**
Workers exposed to noise level and dusts are periodically taken for routine medical checkup. Safety precautions are observed as per the mine safety act. The mines safety committee holds regular meetings to educate and inform the workers about the safety precaution while wording. Safety posters are displayed at various strategic points. Safety equipment's such as goggles, helmets, earplugs etc. are provided to the workers.

3) **Human settlements:**
There are two houses in the area. They need not be shifted in coming five-year period. Settlements outside the lease area will not be affected by mining activities.

i) Positive Impact

Along with negative impacts project has positive impacts also such as:-
1) Employments opportunity-There are approximately 30 local people employed as workers.
2) Project authority contributed to development of nearby villages through donation.

6. Mitigation Measures

a) Strategy For Conservation Of Endagered Flora And Fauna

Rapid industrialization, rise in population and increasing developmental works have virtually driven the Wild Life inside remote forests for safety and security. Yet for food and shelter frequently wild animals stray into adjoining areas and wherever dense tree cover and undisturbed environment exist they prefer to stay. A safe habitat could be created, in the mined area by planting large number of fruit bearing, fodder and flowering trees to attract herbivorous, birds, insects and butterflies. Careful selection of tree species is necessary to maintain the ecological balance of adjoining forest area. Variety of species is planted in the core zone.

b) Efforts Towards Restoration of the Lease Area

Till now tree plantation has been raised over an area within the lease and plantation outside the mining area in order to restore the ecology of the area. The project aims at prevention of metal leaching from mine dumps/stacks and enhancement of vegetation productivity through the use of organic manure. Under the project an area of five hectares of over burden has been planted with 31 tree species. The saplings were pre-treated with Rhiizobium and Azaetaobacter besides inoculation of Micorrhizae. Growth of plants and habitat studies were monitored for three years. For improving the bio-diversity of the lease area heterogeneous composition of species was aimed at and species like Neem, Shivan, Cassia siamea, Khair, Jambol, Sissoo, Bamboo, Mango, Lagerstroemia parviflora (Nano), Terminalia chebula (Harda), T. paniculata (kindal), T. tomentosa (Marat), Ficus glometata (Rumbad), F. bengalensis (Vad), F. religiosa (Pipal), Pongamia pinnata (Karanji), Mimusops elengi (Onvol), etc.

c) Creation of Green Belt

The Ministry of Environment and Forests while conveying the environmental clearance for expansion of Gotukwadecho Tembo Iron Ore (Collem mine) Mine stipulated a special condition at a (xii) for raising a plantation in an area of 11.9338 ha. Including a green belt of adequate width around ML area, OB dump sites, roads etc. by planting native species in. Mine is bounded by other active mines on northern side and western side. As such for creation of green belt an area of 1.0000 ha has been identified towards western side of the mining leases. Further all along the internal mining roads avenue plantation of suitable tree species will be raised. Around office buildings green belt will be created with sufficient width for minimizing air, dust and noise pollution.

d) Avenue Plantation

Internal mining roads are used for transportation of iron ore as well as over burden from various mine pits to dumping/ stacking ground. On either side of mining roads avenue plantation of board-leaved tree species is proposed to be raised for dust suppression. Suitable plantation as per the area available would be carried out along the mine roads. Pits for planting will be of 60cm X 60cm X 60cm size filled with topsoil, Farm Yard Manure and vermin-compost Two-year-old tall plants or root trainer nursery seedlings of few selected species will be planted with the onset of monsoon. Tall seedlings will be provided with a stake support for guarding against wind velocity.

e) Dump/Stack Area Plantation

The existing dump/ stack is already settled. There will not be any waste generation as lateritic stratum also contains reasonable proportion of FeO and can be used for blending. .There will be temporary stacks of such material between the two pits. (This material will be handled as and when opportunity comes). These stacks will have limited height. If height increases sets will be made in it. A stone wall is already built at the foot of the dump. It will be repaired every monsoon. An additional will ahead of the present one, will be built, if required. Drains will be made around the stacks and along the road going to the stacks.

7. Environmental Management Plan

a) Proposal for reclamation

Proposed workings are in the pit area only. There won't be generation of any quantity of top soil. Backfilling will be started from fourth year of the plan period. Waste generated from the mine workings will be directly backfilled. Details of the backfilling are given below.

Year	Waste	Volume	Length m	Width m	Height m	Co-ordinates
2013-2013	30,156	30,104	100	50	4.0	N-730-N-800/W-330-W-300

b) Program of Afforestation

An area along the road will be preferred for plantation purpose. It has less density of vegetation and will serve as a barrier. A strip of 35m parallel to the road will be afforested. This strip is between N 630 and N 340. Dump located on the south side will also be taken up for plantation. It is old one and part of it (southern slopes) will be taken up for plantation. This area falls between N 100/140 – W 40/E 60. Fast growing saplings will be planted, as this will happen at the earliest. Saplings will be obtained from the local forest department. One competent person will be given charge of plantation and post – plantation care.

c) Stabilization and Vegetation of dumps

The existing dump is already settled. There will be very less generation of material. This will be put on the top of the dump (and not along the slope). Thus major foundation of the dump will remain as it is. A step dumping will be followed. A stone wall is already built at the foot of the dump. It will be repaired every monsoon. An additional will ahead of the present one, will be built, if required. Drains will be made around the dump and along the road going to the dump. Plantation will be carried out on the slopes of the dead portion of the dump. All these features will stabilize the dump and avoid flow of silt.

d) Treatment and disposal of water from the mine

Water, which gets stored in the pit, is because of the rains. No work was carried out during monsoon and pumping is not done during the period. Most of the water seeps into the strata. Only some quantity of water is required to be pumped out. This is clean water. It is taken to the plantation/vegetation on the western side of the lease. Seepage rate is very low. One hour pumping in a day is sufficient to work. It is also taken to vegetation. A sump and stone wall will be made near the outlet before it is let to the vegetation. Size of sump will be 3m x 3m x 1m. Stone wall will be 3m x 1m x 0.8m in size. Considering less quantity of water these dimensions are reasonable.

8. Conclusion

The data collection in the process the EIA is the crucial factor to be included in the project management plan. It will save the time, any complications with the government authorities and the local crowd, helps in right investment at right time, makes mining environment salubrious and most important helps to conserve the environmental factors nearby. Database management software systems can help collect and arrange the data as well as for the computation purposes to get most efficiency out of the management plan. Not only are the factors mentioned in this paper included in EIA, but also other important factors like economic state of the mining company and the strategies implemented by them. EIA is a vast concept and data factors are of iterating behavior.

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