6. Economic Viability of the Suggested Techniques

6.0 Introduction

Executability of any LUMP depends to some extent upon its cost-effectiveness. Hence in the suggested LUPg system a provision has been kept for assessing economic viability of the suggested scenario. Hence arises the need of conducting Environmental Impact Assessment (EIA) for impacts of mining on land and LU and also for the suggested reclamation techniques. The concept is that if the cost benefit analysis of any suggested reclamation technique indicates lesser cost requirement than the environmental cost of the impact (which is expected to be mitigated by the technique suggested), the technique should be considered as "economically viable" and hence "cost effective".

6.1 The concept of environmental impact assessment (EIA)

EIA is a common term in todays condition. EIA is a systematic process undertaken to assess in advance, the likely consequences of a proposed or planned human activity (Sinha, 2001). Thus it basically means assessment of likely consequences of a proposed activity. EIA requires the following activities (c.f. Jain *et al*., 1993).

1. defining the action
2. identifying
   a. the components of environment likely to be changed
   b. the extent of change
3. determining the impacts (based upon 2a & b)
4. reporting the results.

The impacts may be:

a) direct, short term, reversible or
b) indirect long term, irreversible

6.2 EIA for impacts of mining on land

A thorough study of field conditions on LU and LUP changes in and around the mining areas and the related facts reveal that, impacts of mining on land can be broadly of three groups, i.e. most direct immediate, indirect longterm and much long term as listed next.

- ➢ The **most direct** immediate damages by mining are caused to
  - land and land-use (LU)
  - the other components, much concerned with LU, are topography, topsoil, greenery and water resources
- ➢ **Indirect longterm** impacts of mining on land related environmental attributes are

  - filling up of surface water bodies by siltation
  - loss of topsoil due to getting
    - ⇨ mixed with sub-soil and rock,
    - ⇨ transported from the soil profile to the water bodies and
    - ⇨ washed down to quarry base while spread on backfilled quarries
  - lowering of water table due to
    - ⇨ pumping of mine water and
    - ⇨ aggravated evaporation through barren land surfaces generated.
- ➢ **Much long term** damages/impacts are
  - loss of aquifers due to
    - ⇨ excavation
    - ⇨ compression
  - expenditure for biological reclamation of the lands degraded in terms of topsoil and water resources.

EIA for direct damages becomes an easy process, by comparing the mining plan and LU map of the area, by preparing a check list, which may say, X amount of Y variety LU will be disturbed by Z activity e.g. excavation, OB dumping etc. This is generally studied in EIA.

Regarding EIA for long term impacts

- ➢ the land degradation cycle (Ghosh 2002) identifies
  - the effected components but
  - not the extent of effects
- ➢ standard EIA technology can not do this
- ➢ cumulative effect assessment (CEA) (Clark, 1994, Canter, 1996) considers
  - the incremental effects of past, present & future
  - these are individually minor but collectively significant as mentioned in US Code for Protecting Environmental Quality, 1987) (Anon, 1987)
- ➢ the impacts noted in land degradation cycle are cumulative
  - and also gets compounded (like compound interest in bank account)
- ➢ the four qualities, i.e. indirect, longterm, cumulative and compound make these INTANGIBLE. These can be assessed only by parallel case studies.

This total concept has been summarised in the table 6.1 A & B

Table 6.1A: The visible impacts of mining on the surrounding land & LU

Type of mining	Impacts
OC mining on flattish surfaces	Complete deforestation in and around the mining site, gross modification of topography, loss of toposoil & subsoil, reduction in agricultural area, shifting of habitats, behading of aquifers, damage to surface water resources, water logging.
OC mining on slope	Deforestation at, above and below the excavation site, modification of topography, slide of land from and above the excavation site to the slope base, damage to LU there.
UG mining	Same as on-surface OC mining, but to a lesser extent, added with damage to topography due to subsidence, and associated effects.
Liquid mining	Almost alike to UG mining.

Table 6.1B: Land and LU damage by mining

The controlling factor	Damage type	Assessed by
* Space availability	Direct, immediate	Change detection analysis, & check list
* Aesthetics	Direct, immediate, also long-term	Visual & to some extent technical
* Land quality depends upon the following	Direct, immediate, also semi-direct & long-term	Land capability/ suitability analysis
A. bearing strength & stability	Same as above	Direct measurements
B. smoothness	Same as above	Hypsometric analysis (Strahler, 1952) & drainage density analysis
C. Soil quality	Direct & indirect	Laboratory analysis
D. Water availability & quality	Direct & indirect	Water balance study & laboratory analysis
E. Degree of erosion & erosion potential	Direct & indirect	Nature of land cover, gully formation etc.
F. Cumulative effect	Indirect long term INTANGIBLE	Parallel case study

6.2.1 Intangible impacts

The visible (tangible) impacts of mining are already known and in most of the cases are attempted to care. This study tries to highlight the INTANGIBLE impacts so that these get recognition and care which they deserve, because these may be minor for a small time span but aquires a serious volume over years as they get compounded and acumulated.

Some confirmation to the existence of such intangible impacts can be made from the observations as listed below.

- Nearly 22% of global green land have been degraded in the last 50 years (GLASOD in Anon 2000, pp.3).
- There are instances of subsidence of ground supporting vegetation due to clay mines of Pali district in Rajasthan (Anon, 2000, pp.4).
- Mining of sandstone in Bijola area, Western India has effected the hydrogeological regime, blocking the channels and lowering of water table. This has stagnated water bodies in the mine pits and labour colonies (Anon, 2000, pp.4).
- 2/3rd of the world's sediment transport to ocean is from southeast Asia (Mohanty, 2001).
- Among the five rivers in the would carrying maximum amount of sediment load to ocean, three are pass through India (Agarwal & Narain, 1991).
- India is heading towards severe water scarcity (Mohanty, 2001).
- In spite of serious effort to grow more greenery in coal mining areas of India, green cover on these is decreasing significantly (Ghosh & Rani, 1999).
- Jharia coalfield (JCF) originally a forest-cum-agricultural land is not having any real forest now.
- In JCF, length of tributaries to the river Damodar was 365 km in 1925, which decreased to 143 km in 1993. (Ghosh, *et al.*, 1997).
- Inspite of being a sedimentary terrain the JCF does not have any continuity of water table. (Ghosh, 1993)
- Areas adjoining to coal mining areas of West Bengal (Birbhum-Bankura region) which were originally having

natural lush green vegetation, now suffer from water scarcity in every summer.

In the previous chapter strategies have been suggested for

- preserving and reusing topsoil
- growing green cover without using topsoil
- preventing lowering of water table
- regeneration of aquifer lost by mining.

6.2.2 Assessment of intangible impacts of mining on land

It has been clarified that impacts of some damages to land are "intangible", and can be assessed only through parallel observations or case studies. For such assessment mention may be made of the following facts.

- India is loosing about 600M tons of topsoil/year. In terms of NPK only it costs Rs.70 crores/year (Sharma 1982) at 1972 price. (it must have gone much high now)
- Present cost of greening such lands is about Rs.3 lakhs/ha.

The suggested techniques if followed,

- will negate all the above costs. Further, an experimental plot could earn Rs. 14,000/ha in 1st year and showed provisions for earning more in later years table 6.2 (Ghosh, 1999a).
- a properly reclaimed land can be sold at higher cost than in premining days.

Thus the cost benefit analysis of the total set of land reclamation technologies suggested can be summarised as in table 6.3.

Table 6.2: Cost-benefit analysis of greening barren lands (without topsoil)

Item	Expenditure incurred	Production obtained	Amount could be earned (approximately)	Net calculated benefit
Labour	Rs.6250/ha/yr. (125 man days)	--	--	--
Straw and compost	Rs.400/ha/year	--	--	--
Cowpea seeds	Rs.100/ha/year	4 kg/ha/year for 90 days/year, i.e. 360 kg/ha/ year	@Rs.20/kg - Rs.7200/ha/ year	Rs.450/ha/year
Grass seeds	Rs.200/ha/2 years	2 big sackfulls of grass/ha/day for 10 months, i.e. 600 sackfulls/year	@rs.5/sack - Rs.3000/year	Rs.2900/ha/ year
Cactus and agave bulbs, babul and jalebi seeds	Rs.100/ha one time expenditure, i.e. Rs.50/ha/year	Will form a living hedge, that will negate the need for fencing.	Will avoid the expenditure of Rs.10000/ha/ year	Rs.9950/ha/ year
		Further, agave will provide erosion protection.	Benefit is intangible (Figure 1)	Intangible
		Agave can produce threads to be used in door-mattress	Cost could not be calculated	Will accrue in future
		Cactus has decorative value	Cost could not be calculated	Will accrue in future
Other seeds	Rs.100/ha one time expenditure, i.e. Rs.50/ha/year	Would produce fruits after some years	Rs.700/ha/year (approximately)	Rs.650/ha/year
Total	Rs.6950/ha/ year		Rs.20900/ha/ year	Rs.13950/ha/ year = Rs.14000/ha/ year + intangibles approximately

After Ghosh, 1999a

Table 6.3: Cost-benefit analysis of suggested reclamation techniques

Cost being spent now	Benefit of following the suggested technologies
1. Tangibles • Cost of land being aquired (case specific) • Cost of reclamation, @ about Rs.3.00 lakhs/ha (present cost) • Cost of topsoil lost in India/y in terms of NPK only Rs.700 crores/yr (Sharma, 1982) **2. Intangibles** • Loss of topsoil • Loss of surface water resources • Loss of aquifers • Loss of greeneries • Damage to ecosystem Note: The country is heading towards severe water scarcity and towards desertification (in the long run) (Mohanty, 2001).	• Cost of land reclaimed (considering price escalation through the life of the mine) is the amount which can be earned by selling it. Note: Legal provision for selling the land is required as an incentive. • Income accrued out of the reclaimed land, e.g. @Rs.14,000/ha in a tested area (Ghosh, 1999a). • Saving topsoil with biolife. • Generation of substitute of topsoil. • Protection of surface water resources. • Regeneration of aquifers. • Protection and regeneration of greeneries. • Protection of ecosystem. • A habitable earth for the future generations.

6.3 Conclusions

If legal provision be made for selling reclaimed lands, the earning may motivate the mining management to use dozers and scrappers, to separate topsoil, to follow “continuous and concurrent reclamation mining” (Ghosh & Ghosh 1990), “strategies for growing greenery without topsoil” Ghosh, 1999a), “techniques of aquifer regeneration” (Ghosh 2000c) during backfilling of quarries and “water resource management in mining areas” (Ghosh 2000a, and Saxena, 1999) as per case suitability.