Rehabilitation of Mined-out Areas and Degraded Land

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Denudation of Forest Cover

Uneven Topography

Depletion of Water Resources & Altered Water Quality / Contamination

Waste / Spoil Piles

Air, Noise & Water Pollution

Deleterious Impacts on Human & Livestock Health

Well-being of Society

Impact of Mines and Mine-spoils and Environmental Damages
Rehabilitation

Process used to repair the impacts of mining on the environment.

Objectives

• converting an area to a safe and stable condition, to restoring the pre-mining conditions as closely as possible to support the future sustainability of the site.

Processes

• developing designs for appropriate landforms for the mine site
• creating landforms that will behave and evolve in a predictable manner, according to the design principles established
• establishing appropriate sustainable ecosystems.
Hypothesis of Rehabilitation

• Conducting post-mining soil and mine-spoil inventories define the establishment of ecosystem stability.

• Understanding successful germplasm selection, rainwater harvesting and soil moisture conservation, and evaluating plant community sustainability are important.
Mine Rehabilitation should Ensure that

• Future public health and safety are not compromised
• Environmental resources are not subject to physical and chemical deterioration
• Post-mining use of the site is beneficial and sustainable in the long term
• Adverse socio-economic impacts are minimised
• Opportunity is taken to maximise socio-economic benefits
PHASES OF A MINING PROJECT

Sustainable Development Principles

Exploration

Feasibility

Planning and design

Construction

Operations (progressive rehabilitation)

Decommissioning and closure

Closure planning and implementation

Completion
Benefits of Progressive Rehabilitation

- Reduction of the overall un-rehabilitated ‘footprint’ of the mine
- Ability to trial various options and demonstrate rehabilitation outcomes to wider community
- Showing commitment to stakeholders and employees that the mine has an active mine rehabilitation program
- Reduction of the overall closure costs
- Reduction of the risk of failure and ultimate liability
- Reduction of the ‘rehabilitation bond’ posted with regulatory authorities.
Sustainable Development Issues in Mining

Environmental
- Topography & Landform
- Flora & Vegetation

Socio-economic
- Fauna
- Surface Water Hydrology & Groundwater

Business
- Soil & Water Contamination
Sustainable Development for Mining Sector

• Investments should be technically appropriate, environmentally sound, financially profitable and socially responsible (ICMM, 2003)

• A commitment to sustainable development is critical for a mining company to gain and maintain its ‘social licence to operate’ in the community

• Reputation of mining industry is affected when mines are abandoned or long-term detrimental environmental issues emerge because they have not been appropriately addressed
Key Activities

• Selecting successful germplasms; characterizing soil/over-burden and waste/spoils; restoring land capability; landscaping and land shaping; controlling soil erosion; rainwater harvesting; soil moisture storage; profile development; soil modifications; creating plant-rooting medium; planting techniques; phyto-stabilization and phyto-remediation of mine tailings, OB dumps and backfills; and evaluating post-reclamation sustainability.
Revegetation vis-a-vis Slope Angle

Severe Eroden Hazards
Revegetation Not Sustainable

Critical Eroden Hazards
Survival Success Poor

Moderate Eroden Hazards
Zone Restoration Success Fair

Moderate Erosion Hazards
Zone Restoration Success Good

Moderate Erosion Hazards
Zone Restoration

Slight Erosion Hazards
Zone Slope Influence Almost Negligible
Concave slope profiles resemble natural landforms and reduce soil erosion by a factor of two to three relative to linear slopes of the same average gradient.
Criteria for Evaluating Mine-land Rehabilitation

• Stabilization of surface materials through appropriate landscape reconstruction, and
• Establishment of long-term, sustainable vegetation communities.

• In general, a silvi-pastoral system is being designed for reclamation as it complements the needs of local population.
<table>
<thead>
<tr>
<th>ICMM Principle/Guidance Element</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Principle 6</strong></td>
<td>Seek continual improvement of our environmental performance</td>
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<tr>
<td><strong>Element 6.3</strong></td>
<td>Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses.</td>
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<tr>
<td><strong>Guidance</strong></td>
<td>Consult relevant stakeholders and develop a closure plan that clearly defines the post-closure land use. Where appropriate, rehabilitate progressively over the life of the operation. Monitor success criteria agreed with relevant stakeholders. Report performances. Undertake and support research into land and water rehabilitation practices. Use appropriate technologies to reduce negative environmental impacts and improve site rehabilitation techniques. Manage and, where appropriate, rehabilitate historical disturbances to an appropriate standard.</td>
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Related Regulations

Chapter IV: High Technology cum Exploration License and Prospecting License

21 (1) v. Steps proposed to be taken for protection of environment which shall include prevention and control of air and water pollution, progressive reclamation and rehabilitation of the land disturbed by the prospecting operations, a scheme for the plantation of trees, restoration of local flora and water regimes and such other measures, as may be directed from time to time by the Indian Bureau of Mines or the State Directorate as the case may be for minimizing the adverse effects of prospecting operations on the environment. The license holder shall prepare and file an exploration/prospecting plan which shall include appropriate baseline information of prevailing environmental conditions before the beginning of reconnaissance or prospecting operations.
Chapter V: Mining Lease

• 32 (1) Every mining lease shall have a Mine Closure Plan prepared in terms of a Sustainable Development Framework, which shall consist of –
  • A Progressive Mine Closure Plan for each mine, and
  • A Final Mine Closure Plan.

• 32 (3) A Progressive Mine Closure Plan shall be prepared for each mine for a period of five years at a time commencing with the period of the lease, and for every period of five years thereafter, as may be prescribed by the Central Government.
• Provided that the Progressive Mine Closure Plan shall include details of closure, rehabilitation and restoration activities proposed to be carried out in the five year period and the projected investments in this respect, and except in the case of the first progressive mine closure plan, the details of activities actually carried out and the expenditure incurred in each of the preceding progressive closure plans.

• 32 (8) The Final Mine Closure Plan shall include measures to reduce hazards, improve productivity and ensures that it support the needs of the host population.

• Provided that the land use planned for the mining lease area after the closure of mine shall be decided in consultation with the Panchyats having jurisdiction in such manner as may be prescribed by the Central Government.

• (9) The Final Mine Closure Plan shall be revised for every five years having regard to the progress of mining operations and be submitted along with every Progressive Mine Closure Plan.
Excerpts from MMDR Bill, 2011 (4)

- Chapter IX Power to Issue Directions

- 4 (iii) Systematic measures needed to increase sustainability of mining operations, inter-alia

- (h) Promoting restoration and reclamation activities so as to make optimal use of mined out land for the benefit of the local communities.
GLOSSARY OF TERMS

• **Reclamation**
  Treatment of previously degraded and often contaminated land to achieve a useful purpose

• **Rehabilitation**
  The return of disturbed land to a stable, productive and self-sustaining condition after taking into account beneficial uses of the site and surrounding land

• **Remediation**
  To clean-up or mitigate contaminated soil or water

• **Restoration**
  Return of disturbed land to a former condition or position
Thank you!