TIME-FRAME FOR MINE DEVELOPMENT AND RECLAMATION

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The overall sequence of activities in modern mining covers five stages: **reconnaissance** (*prospecting* in international terminology), **prospecting** (*exploration* in international technology), **development**, **exploitation** and **reclamation**. Closure and reclamation of a mine site is a necessary part of the mine life from the point of view of environmental friendly and sustainable mining.

PRE-REQUISITE FOR SUSTAINABLE MINING

2. For sustainable and scientific mining, it is necessary that the area should be such as would permit eco-friendly and environmentally sustainable mining. The mining leases granted so far in the country do not bear this out. In India, 67% of the mines of major minerals covering 7% of the area are between 0-10 hectares; 9% of the mining leases covering 3% of the area are between 10–20 hectares; and 10% of the leases covering 8% of the area are between 20–50 hectares. In other words, 86% of the leases covering 18% of the area are between 0–50 hectares. Balance 14% of the leases covering 82% of the area are above 50 hectares.

3. In order that mining activity is economically viable, environmentally friendly and socially acceptable, it is necessary that the area of mining lease should be such as many lend itself to be worked on sizeable scale. Sustainable mining is possible when an area is worked in such a way as to drive economy of scale to make its product(s) competitive and viable vis-à-vis imports. Economy of scale is also necessary for smelting to make the cost of the products reasonable and competitive for consumers. 'Mining operations' and 'smelting' are functions of scale to drive economic benefits and making the products competitive in domestic and international markets. Scale also applies for rehabilitation of mined out areas for future sustenance. Unless the size of a deposit is itself small, an area for mining lease should therefore not be less than 5 sq. kms. (500 hectares). There

should be no bar for a person or a company to get any number of areas of 5 or more sq. kms. in a State. Hoda Committee recommended 50-100 sq. kms of area of mining lease in a State to a person or company.

MINE DEVELOPMENT AND RECLAMATION

(a) Resource-rich countries

4. In resource-rich countries such as Australia, Canada, Brazil, etc., specialised bodies undertake various stages of operations. Prospecting and exploration operations are mostly undertaken by, what are commonly called, ***junior exploration companies***, who depend mostly on venture capital and hedge funds to finance their operations. The Governments in these countries do not prefer to spend tax-payers' money on exploration which is risky and hazardous. The development of a mine is done by another **specialized agency** before ***real*** exploitation starts. A typical broad time-frame for mine development and its reclamation in a resource-rich country can broadly be summarised in the following flow–chart **(Figure-1).**

Figure-1
Flow-chart for mine development and reclamation

State (Project Name)	Procedure	Time
	Precursors to Mining	
1. Prospecting (Mineral deposit)	Search for ore a. Prospecting methods Direct: Physical geologic Indirect: geophysical, geochemical b. Locate favorable loci (maps, literature, old mines) c. Air: aerial photography, airborne geophysics, satellite d. Surface: ground geophysics, geology e. Spot anomaly, analyze, evaluate	1-3 years
2. Exploration (Ore body)	Defining extent and value of ore (examination / evaluation) a. Sample (drilling or excavation), assay, test b. Estimate tonnage and grade c. Valuate deposit (Hoskold formula or discount method): present value = income – cost Feasibility study: make decision to abandon or develop.	2-5 years

	Mining Proper	
3. Development (Project)	Opening up ore deposit for production a. Acquire mining rights (purchase or lease), if not done in stage 2 b. File environmental impact statement, permit c. construct access roads, transport system d. Locate surface plant, construct facilities e. Excavate deposit (strip or sink shaft)	2-5 years
4. Exploitation (Mine)	Large-scale production of ore a. Factors in choice of method: geologic, geographic, economic, environmental, societal safety b. Types of mining methods Surface: open pit, open cast etc. Underground: room and pillar, block caving, etc. c. Monitor costs and economic payback (3-10 year)	10-30 years
	Post-Mining	
5. Reclamation (Real estate)	Restoration of site a. Removal of plant and buildings b. Reclamation of waste and tailings dumps c. monitoring of discharges	1–10 years

Source: Introductory Mining Engineering by Howard L Hartman and Jan M Mutmasky

(b) Indian context

5. In the resource-rich countries cited above, whole process from prospecting to its exploitation is seamless with freedom to sell. Junior exploration companies will prospect and explore and if the deposit ***turns*** out to be economically viable and world-class (success rate is 1:100)*, these companies will sell the deposit to mining companies for development and exploitation. Till the ore in the deposit lasts, the company is assured of its association. However, the mining company has freedom to sell the concession to anybody if it desires to sell. Till the MMDR (Amendment) Act, 2015 came into operation, more or less same situation existed in India. In fact, Hoda Committee recommended for amending MMDR Act, 1957 to provide for seamless transition from reconnaissance to prospecting and from prospecting to mining and freedom to sell.

*The exploration work is extremely risky : if during aerial survey, 1000 anomalies are observed, it may be that only 100 anomalies are worth ground prospecting and it may again be that only one out of these 100 turns out to be worth economic exploitation. The Governments do not therefore prefer to spend the tax payers' money on exploration because it does not want the tax payers' money to be invested in risky and hazardous ventures like exploration.

6. After MMDR (Amendment) Act, 2015, effective from 12.01-2015, prospecting-cum-mining leases (PL-cum-ML) as well as mining leases (ML) are to be given through auction route. A mining lease, before being auctioned, will have to be explored till G-2 level; for PL-cum-ML, it is G-3 level. Though there is little practical experience in so far as non-fuel minerals are concerned, it is felt that since India has opted for auction route for PL-cum-ML as well as ML, the procedural hurdles that the industry used to face earlier may not be there.

7. Almost all the ingredients (narration) as delineated in Figure-1 are followed in Indian mining industry as well. The flow-charts in Indian context will therefore work out something like in **Figures 2 and 3**.

Figure-2
India : Flow-chart for mine development and reclamation : Auction of PL-cum-ML

	Procedure	Time
1. Prospectring (Ore)	(a) Acquire PL (b) Forest clearance under FC Act, 1980 (in case forest land is involved)	2-5 years
	(c) Defining extent and value of ore (examination / evaluation) (i) Sample (drilling or excavation), assay, test (ii) Estimate tonnage and grade (iii) Valuate deposit	2-5 years
2. Development (Project)	(a) Acquiring surface rights / land acquisition (b) Environment clearance (c) Opening up ore deposit for production (i) Construct access roads, transport system (ii) Locate surface plant, construct facilities (iii) Excavate deposit (strip or sink shaft)	2-5 years

3. Exploitation (Mine)	Large-scale production of ore a. Factors in choice of method: geologic, geographic, economic, environmental, societal safety b. Types of mining methods Surface: open pit, open cast etc. Underground: room and pillar, block caving, etc. c. Monitor costs and economic payback (3-10 year)	10-50 years
4. Reclamation	Restoration of site a. Removal of plant and buildings b. Reclamation of waste and tailings dumps c. Monitoring of discharges d. Restoration to original shape as far as possible	1–10 years

Figure-3
India : Flow-chart for mine development and reclamation :
Auction of Mining Lease

	Procedure	**Time**
1. Development (Project)	(a). Acquire mining and surface rights (b) Environment clearance and Forest clearance (c) Opening up ore deposit for production year (i) Construct access roads, transport system (ii) Locate surface plant, construct facilities (iii) Excavate deposit (strip or sink shaft)	2-5 years 2-5 years
2. Exploitation (Mine)	Large-scale production of ore a. Factors in choice of method: geologic, geographic, economic, environmental, societal safety b. Types of mining methods Surface: open pit, open cast etc. Underground: room and pillar, block caving, etc. c. Monitor costs and economic payback (3-10 year)	10-50 years

	Procedure	Time
3. Reclamation		1–10 year
	Restoration of site a. Removal of plant and buildings b. Reclamation of waste and tailings dumps c. Monitoring of discharges d. Restoration to original shape as far as possible	

8. By its very nature, mining and metal industries are cyclical in nature, subject to frequent booms and depressions. As per MMDR (Amendment) Act, 2015, only public sector mining units are entitled for renewal of mining leases after their initial term of 50 years is over. Private sector has been deprived of this benefit. Question of reclamation of a mine after 50 years in the case of private units will therefore be a question mark if after the end of 50 years, the mineral is still not exhausted. If reclamation is still insisted upon after 50 years and the ore is still existing, in that case the balance ore in the area will be lost forever.