MINING AND QUARRYING

The sun, the moon, the stars would have disappeared long ago... had they happened to be within the reach of predatory human hands

-Hevelock Ellis
MINING AND QUARRYING

Current Status
Issues and Impacts
Causes
Trends
Hotspots
Action Plan
CURRENT STATUS

Environmental impacts due to mining manifest as water pollution, land degradation, loss of biodiversity, air pollution, increase in health related problems, occupational noise pollution, vibrations, land subsidences and landslides. Karnataka being one of the mineral rich states of the country, mining provides substantial non-tax revenue to the state’s exchequer. Since our state is one of the most biodiversity rich states, it is all the more important to use this natural resources available with least impact on the environment.

Of the state’s total area of 1,92,000 square kilometers, more than 40,000 square kilometers of green stone belts are known to contain vast mineral deposits of gold, silver, platinum, copper, diamond, iron, manganese, chromite, lime stone, dolomite, etc. At present about 20 varieties of major minerals and five varieties of minor minerals are being exploited in the State. 568 mining leases of major minerals covering an area of 21,247 hectares, 5650 quarry leases of minor minerals covering an area of 4526 hectares have been sanctioned in the state till December 31, 2004.

Iron ore (62.61 percent), lime stone/shell (34.77 percent) including dolomite, constitute about 97.38 percent of the total mineral produced and the remaining include:

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Average annual production (million tons) #</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron ore and fines (Hematite and Magnetite)</td>
<td>18.7</td>
<td>Bellary, Chikamagalur, Chitrardurga, Bijapur, Dharwad, Tumkur and Uttara Kannada.</td>
</tr>
<tr>
<td>Lime stone, Lime shell and Dolomite</td>
<td>10.42</td>
<td>Gulburga, Chitrardurga, Belgaum, Bijapur, and Tumkur.</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.25</td>
<td>Bellary, Shimoga, Uttara Kannada, Chitrardurga and Tumkur</td>
</tr>
<tr>
<td>Magnesite</td>
<td>0.082</td>
<td>Mysore</td>
</tr>
<tr>
<td>Gold</td>
<td>1.583 (tons)</td>
<td>Raichur, Kolar</td>
</tr>
<tr>
<td>Building stone</td>
<td>2.42</td>
<td>19 districts, mainly in Bangalore(S&amp;N), Bellary, Belgaum, D.Kannada, Mandya, Mysore, Shimoga, Tumkur and Chitrardurga.</td>
</tr>
<tr>
<td>Ordinary sand</td>
<td>0.88</td>
<td>17 districts, mainly Belguam, Dharwad, Shimoga, U.Kannada Tumkur and D. Kannada.</td>
</tr>
<tr>
<td>Granite</td>
<td>109,000 (Cu.m)</td>
<td>17 districts, mainly in Bangalore, Tumkur, Bijapur, Bagalkot Mysore, Raichur</td>
</tr>
<tr>
<td>Shahabad Stone</td>
<td>5.51 (million sq.ft)</td>
<td>Mainly in Bijapur and Gulburga</td>
</tr>
<tr>
<td>Brick earth</td>
<td>1.88</td>
<td>Mainly in Bangalore, Chitrardurga, Tumkur and Kolar</td>
</tr>
<tr>
<td>Laterite</td>
<td>0.46 (lakh tons)</td>
<td>Mainly in Dakshina Kannada</td>
</tr>
</tbody>
</table>

Initiatives of the State Government

Government of Karnataka has taken several initiatives towards regulating mining activities for conserving the environment.

- Karnataka Mineral Policy-2000 envisages action plans for minimising the impacts of mining on the environment and preserving ecological balance in mining areas and providing health facilities to mine workers and the community around the mines.
- Introduction of Karnataka Minor Mineral Concession Rules, 1994 which stipulates strict conditions for regulating mining of minor minerals and quarrying and provide for rehabilitation of mined areas.
- Initiation of environmental impact assessment study by the Department of Mines and Geology in limestone and granite quarry belts
- Karnataka State Remote Sensing Application Centre has under taken a study on mining and forest cover changes in Bellary district.
- Government order dated 16th January 2004, provides for Site and Environmental Clearance for mining projects. Mandatory environmental clearance is required for mining projects (major minerals) with leases more than 5 hectares from the Ministry of Environment and Forests, Government of India. An application as prescribed in Schedule II of Environment Impact Assessment notification needs to be filed and routed through Department of Forest, Ecology and Environment after mandatory public hearing. However, public hearing is not required for mining projects (major minerals) where the lease area is less than 25 hectares. Mandatory environmental clearance is required for mining projects for major minerals with lease area less than 5 hectares and for minor minerals with lease are above 0.5 hectares from State Environmental Clearance Committee.

Source: Administrative reports (from 97-98 to 2000-01) of the Department of Mines and Geology (DMG) - Govt. of Karnataka, Karnataka Mineral Policy 2000, Department of Mines and Geology (DMG), Govt. of Karnataka.
# Average between 1996-97 and 2000-01.
Mineral map of Karnataka
manganese, magnesite, bauxite, chromite, gold, etc. Around 95 percent of minerals are produced in Bellary, Bijapur, Chikamagalur, Chitradurga and Gulbarga districts.

The important minor minerals produced are granite, building stone, brick earth and sand which are produced in most of the districts across the State. Shahabad stone and laterite are available mainly in Gulbarga and Dakshina Kannada districts. About 76 percent of stone and granite, are available in Tumkur (38.6 percent), Bangalore-North (15.2 percent), Mandya (8.7 percent), Bangalore-South (6.8 percent) and Mysore and Chamrajnagar (6.7 percent) districts.

In Bellary, open cast mining is being adopted. The iron ore variety (hematite) found in Bellary has higher concentration of iron (62 percent to 68 percent) which results in generation of comparatively lesser quantum of waste (25 percent of the ore mined). A study conducted by Karnataka State Remote Sensing Applications Centre in three taluks of Bellary district, viz. Bellary, Hospet and Sandur (constitute 95 percent to 96 percent of the total mine lease areas in the district), where large number of iron ore and some manganese mines are located, reveals that between the years 1988 and 2000, the mining area increased from 230.42 hectares to 820.46 hectares (increase of 590 hectares). This works out to be 0.21 percent of total area (3854.17 sq.km) of three taluks. As per the environmental impact assessment study carried out by National Environmental Engineering Research Institute in 2002, the forests are in highly degraded condition and no adequate revegetation and rejuvenation of degraded mine areas and overburden dumps have been carried out.

In Kudremukh area of Chikamagalur district, iron ore mining is done using the open cast method. Magnetite, which is the ore variety in Kudremukh, is of low grade having iron concentration to the tune of 33 to 38 percent resulting in generation of more waste (62 to 67 percent of the total ore mined). Out of 4605 hectares of mine lease area sanctioned till 1999, an area of 450 hectares has been utilised for mining and 572 hectares of shola forest valley for disposal of mine tailings.

<table>
<thead>
<tr>
<th>Districts</th>
<th>Minerals produced</th>
<th>% production in the above 5 year period</th>
<th>Total mine Lease Area Ha</th>
<th>Mine area Under forest Ha</th>
<th>% of mine lease area under forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellary</td>
<td>Iron ore</td>
<td>39.94</td>
<td>16973</td>
<td>11130</td>
<td>65.5</td>
</tr>
<tr>
<td></td>
<td>Manganese</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gulburga</td>
<td>Lime stone</td>
<td>23.41</td>
<td>2689</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chikamaguler</td>
<td>Iron ore fines</td>
<td>17.95</td>
<td>4679</td>
<td>4509</td>
<td>96.3</td>
</tr>
<tr>
<td>Chitradurga</td>
<td>Iron ore</td>
<td>7</td>
<td>1989</td>
<td>757</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Lime stone</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manganese</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bijapur</td>
<td>Lime stone</td>
<td>4.5</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Iron ore</td>
<td>0.52</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Other Districts</td>
<td>Other minerals</td>
<td>5.09</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Source: Administrative reports (from 97-98 to 2000-01) of the Department of Mines and Geology -Govt. Of Karnataka, and Indian Bureau of Mines, Bangalore

Directions given by the Ministry of Environment and Forests

Based on the Environment Impact Assessment study carried out by National Environmental Engineering Research Institute, Nagpur, in 2002 for the Bellary-Hospet Sector, the Ministry of Environment and Forests, Government of India has directed the State Government to initiate the following actions.

- New mining leases may be considered by the State Government only if the applied area is more than 5 ha and should accompany a detailed Indian Bureau of Mines report
- The State Government should identify common dumping areas for overburden for cluster of mines, develop and maintain proper roads, and should carry out detailed ground water resources study
Lime stone constitutes 93 percent - 97 percent of the total mineral produced in the Gulbarga district and covers an area of around 3200 sq.km in Sedam, Chincholi, Shahapur, Jewargi and Shorapur taluks. The average mine lease area sanctioned between the year 1998 and 2002 is around 2689 hectares. (26.89 sq.km) and accounts for only 0.16 percent of the total area of Gulburga district. The waste generated due to overburden soil is of the order 15-18 percent of the limestone quarried, which is comparatively lower than iron ore, as limestone is directly used for cement production. The extent of land degraded during the period between 1988 and 2001 is estimated at 354.6 hectares (0.022 percent of total area of Gulburga district.

In Chitradurga, 90 percent of mining is of iron ore and the balance is lime stone (9 percent) and Manganese (1 percent). In Bijapur 90 percent mining is lime stone and remaining is iron ore.

Production of minerals in the coastal districts of Dakshina Kannada, Udupi and Utara Kannada is comparatively much less than other districts. However, the coastal region being an environmentally sensitive zone, quarrying of sand, clay, laterite and granite has lead to localised environmental impacts in Mangalore, Udupi and Karwar districts. It is estimated that the total area affected is 290 hectares in Dakshina Kannada and 31 hectares in Uttar Kannada district.

Building materials like sand, stone and granite are quarried from several districts and the impact of this activity on the environment is significant in quarry intensive districts of Tumkur, Bangalore, Mandya, Mysore and Chamrajnagar.

**ISSUES & IMPACTS**

The key environmental problems and impacts of mining/quarrying are:

- Land degradation
- Degradation of forest and loss of biodiversity
- Air and noise pollution
- Surface water pollution
- Ground water pollution
- Environmental degradation due to abandoned and closed mines.

**Land Degradation**

Land degradation is one of the significant impact arising out of mining and quarrying activity which is mainly in the form of alteration of land structure due to excavation, stacking of top soil and loss of land due to dumping of mine waste and overburden soil. Stone and sand quarrying causes damage to property, depletion of ground water, loss of fertile top soil, degradation of forest land, adverse effect on the aquatic biodiversity and public health. Haphazard quarrying of sand from the riverbeds leads to damage to infrastructure like bridges and roads.

The estimated extent of land degradation due to mining and storage of wastes like over burden soil and mine tailings is not available. Under these circumstances, only indirect methods like remote sensing, aerial photography coupled with ground truthing can be used to arrive at realistic estimate of the extent of land degradation in any particular region.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine water pumped out during drainage operations</td>
<td>Water Pollution</td>
</tr>
<tr>
<td>Spent water from handling plants, dust extraction and dust suppression systems</td>
<td></td>
</tr>
<tr>
<td>Effluents from preparation and beneficiation plants</td>
<td></td>
</tr>
<tr>
<td>Leacheates/washoffs from waste/tailings dumps</td>
<td></td>
</tr>
<tr>
<td>Overburden and mine waste and tailings dump sites</td>
<td>Land Degradation</td>
</tr>
<tr>
<td>High level of dust and particulate matter due to mining and transport of ores</td>
<td>Air Pollution</td>
</tr>
<tr>
<td>Mineral beneficiation giving rise to emissions of fume gases</td>
<td></td>
</tr>
<tr>
<td>Fragmentation of forest land</td>
<td></td>
</tr>
<tr>
<td>Diminished green cover</td>
<td>Loss of Biodiversity</td>
</tr>
<tr>
<td>Blasting, drilling, underground mining equipment, ventilation fans, heavy earth moving machinery, drills, dumpers, crushing and cleaning equipments</td>
<td>Noise Pollution</td>
</tr>
</tbody>
</table>
Change in landuse pattern in Bellary District

As on 11-12-1988

As on 14-12-2000
Mining activity has lead to fragmentation of forest land, diminished green cover, posing a threat to conservation of species. The deforestation in the Kudremukh area coupled with the high rainfall in the region has also led to soil erosion.

**Degradation of forest and decrease in biodiversity**

Mining and quarrying, either open cast or underground, destroys landscape and forest ecosystem. The waste materials that remain after the extraction of usable ores are dumped on the surrounding land, thus causing loss of topsoil, nutrients and supportive microflora and vegetation. When the lease area is forest land, as in case of Kudremukh, Chikamagalur district, the impact on forest and biodiversity is higher compared to mixed dry deciduous forests and scrub forests situated in Bellary and Chitradurga districts.

According to the study carried out in 2000 by National Environmental Engineering Research Institute and the Centre for Ecological Sciences, compared to the relatively pristine habitats of Kudremukh, the abandoned mine areas showed paucity or near absence of several plant and animal species. There was no regeneration of Shola forest in the abandoned mine belt. In the abandoned mining area only a few species of mammals were found. Also, only common species of birds of low conservation value like crow and common myna were found and “habitat specialist species” had vanished. The virtual absence of herpetofauna that indicates habitat quality, shows the damage caused to the environment. Decreasing number of butterfly species also indicated that environmental conditions had deteriorated.

Habitat fragmentation in Banneraghatta National Park has occurred due to quarrying in the region. Till 2001, over 40 quarries were operating within the prohibited area of the National Park that obstructed free movement of the elephants and thus lead to man-animal conflict. Now quarrying has been totally stopped.

**Air and Noise Pollution**

Air pollution is a common environmental problem in all mines and quarries, especially open-cast operations. According to the Environmental Impact Assessment report prepared by National Environmental Engineering Research Institute for the Manganese mines in Sandur Taluk, Bellary district, the average suspended particulate matter concentration at various locations of mining varied between 130µg/m² and 1678µg/m². The maximum suspended particulate matter concentration observed was 4474 µg/m³. These values are found to be within the norms prescribed by the Director General of Mines Safety, of, 5000 µg/m³. However, the permissible level of suspended particulate matter for industrial area as per Central Pollution Control Board norm is 300 µg/m³. Hence, though the concentration is within the norms prescribed, it is bound have adverse health effect on the miners and on the people living in the vicinity.

<table>
<thead>
<tr>
<th>Test site</th>
<th>Range of Noise level (dB)</th>
<th>Limits as per KSPCB Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within the quarry (during blasting)</td>
<td>115.3 – 125.60</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>Near by Villages (during blasting)</td>
<td>92.74 – 115.20</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Near by villages (during normal mining operations –day time)</td>
<td>68.3 – 76.90</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>At the driller (during drilling)</td>
<td>87.21 – 105.00</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>Mining site (during shovel operations)</td>
<td>94.13</td>
<td>75</td>
<td>70</td>
</tr>
</tbody>
</table>

Air pollution spreads beyond mine sites, thus affecting the buffer zone to a large extent. In this context, the study conducted by Karnataka State Remote Sensing Applications Centre (January 2003) in three taluks of Bellary district, viz, Bellary, Sandur and Hospet shows mine dust deposits on roadside agricultural lands. Another study by the Institute for Catchment Studies & Environment Management in 2000 for three taluks of Kaladagi, Lokapur and Yadawad towns of Bagalkot district indicates impacts of dust deposits leading to water contamination of open wells and degradation of garden and agricultural lands.

Blasting, drilling, underground mining equipment and ventilation fans are the sources of noise and vibration underground. Heavy earth moving machinery, drills, dumpers and material handling, crushing and cleaning equipments are prominent sources above ground. In beneficiation plants noise and vibration are the primary occupational health problems. Ground vibrations, caused by blasting, damage structures and also cause annoyance to human beings. The studies carried out in granite quarries situated in Balkundi block (Bijapur-Raichur District) in 1997 and Kanakapura taluk in Bangalore district in 1988, indicate that the noise level during blasting hours was high within quarry sites and in adjacent areas. Though the duration of high intensity noise during blasting might be a few seconds, the noise levels would be well above the permissible limits that would cause adverse effects on health.

**Surface water pollution**

Water pollution is a major concern in mining operations, where ore is being processed in slurry form to enrich the low quality ore or extract metals like gold. Spill over/leakage of effluents containing toxic chemicals (e.g. cyanide, used in gold processing) or discharge of leachate from mine waste, surface runoff from overburden dumps during rains, result in degradation of water quality. The degradation is mainly due to contamination of water with heavy metals/toxic chemicals or siltation. In the areas where sulphides (pyrites) are present in the ore, water interacts and forms acid mine drainage which has low pH and contains high levels of sulphides, iron, and total dissolved solids. These deplete oxygen level in water, increase toxicity by rendering heavy metals, sulphides and fluorides soluble and create corrosion problems.

The Karnataka State Remote Sensing Applications Centre conducted a study in 2003 in Bellary, Hospet, and Sandur Taluks and found silt deposition in water bodies near the mining areas. The pollution problem has also been reported from Kota village, Raichur district due to the discharge of effluents from the gold mine, containing toxic organics such as cyanide from the Hutti gold mines. Gold mining causes severe water pollution due to presence of toxic chemicals like cyanide in mine tailings, though the production and mine area is comparatively lower than the other major minerals.

According to the Environmental Impact Assessment report prepared by National Environmental Engineering Research Institute in 2000, at Kudremukh, though the sediments and tailings carried in surface runoff during rains are trapped in two pollution control dams, siltation and sedimentation is still found in Bhadra river up to 35 kms down stream. The concentration of insoluble iron is found to be as high as 1.1mg/litre as against the BIS 10500-1991 standard of 1.0mg/litre. This affects aquatic biodiversity and agricultural production as well.

**Ground water pollution**

The quality and quantity of ground water may get affected through various factors like surface hydrology, soil texture and terrestrial vegetation. Though the quantity of water may be benefited by groundwater recharge in open cast mines, in places where mining is below the water table, the ground water is usually intercepted and pumped out
or lost by evaporation thereby lowering the water table. This could result in loss of head or dewatering of wells within a radius of few kilometers of the mine. Similarly even after mining and reclamation processes are over, ground water quantity can still be affected adversely. If the mine is located in a groundwater recharge area, the recharge characteristics may get affected by the backfill material which may differ from the original characteristics of top soil and overburden of leased area. The quality of ground water can get affected depending on the quality of leachates generated from the overburden material whether acidic in nature or rich in mineral content, thereby warranting adoption of appropriate control measures.

Abandoned/closed mines

Closed/abandoned mines may cause in degradation of land due to removal of top soil, health hazards due to stagnated water in the pits, threat to human and animal life, contamination of land and water bodies due to surface run off from mine waste dumps during monsoon period and air pollution due to spread of dust particles from waste dumps. The small mines after becoming non-functional create serious environmental and socio-economic impacts.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bellary</th>
<th>Gulbarga</th>
<th>Chikamagalur</th>
<th>Chitradurga</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>27</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>36</td>
</tr>
<tr>
<td>1999</td>
<td>22</td>
<td>2</td>
<td>0</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>2000</td>
<td>19</td>
<td>3</td>
<td>0</td>
<td>12</td>
<td>34</td>
</tr>
<tr>
<td>2001</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>2002</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>7</td>
<td>23</td>
</tr>
</tbody>
</table>

Source: Indian Bureau of Mines, Bangalore

Impact of mining in Bellary - Hospet region

A Rapid Environmental Impact Assessment of Mining Operation in Bellary-Hospet Region conducted by National Environmental Engineering Research Institute in 2002 revealed that due to the good quality and vast deposits of iron ore mining activity in Bellary-Hospet region appears to be a permanent feature. Also, as all the developmental activities in the region are closely associated with the mining activities, the potential adverse impacts on the environment due to both mining and developmental activities cannot be ignored.

The Bellary forests are under intense biotic pressure due to deforestation from mining activities, grazing and exploitation by local people. The medicinal plants in the region are destroyed. All the forest blocks in the region are fragmented due to mining, anthropogenic activities and the migratory paths, nesting and breeding sites of wild life and birds are disturbed. The growth of trees has been adversely affected due to excess amount of dust pollution near dust generating sources like blasting, ore processing and transportation. Important mammal species like panther, sloth bear, indian fox, jackal, stripped hyena, jungle cat, mongoose have been dwindling due to destruction of habitat and food. Birds including common peafowl, great indian bustard, spoonbill, white stork and reptiles like indian python and monitor lizard which are included in the Schedule I of Wildlife Protection Act, 1972 have been spotted in the region and are under threat.

The mines in the Bellary-Hospet region are open cast type and do not generate any wastewater as no wet process is involved. Also, the major industries namely, Vijayanagar Steel Ltd., Jindal Thermal Power Company Ltd., Jindal Praxair Oxygen and National Mineral Development Corporation have wastewater treatment plants and reuse the treated water for greenbelt development. However, during monsoon, the fine material from dump site get carried away along the hill slopes through surface run-off and enter in to the nearby waterbody. Poor water quality due to presence of iron and manganese in groundwater sources around mining areas have been found. Presence of relatively high concentration of hardness, fluoride and chloride in ground water in low mining area have been reported.

Ground water withdrawal by both domestic and mining activity is excess in Bellary watershed and is in the state of overexploitation and any expansion in mining or industrial activities would have a severe impact on the region. Faecal contamination of spring water and ground water because of insanitary conditions prevailing around the water sources has been found as there is no or inadequate sewage treatment facility.

High concentration of suspended particulate matter and respirable suspended particulate matter at Hospet has been monitored due to mining and transportation of ores on semipermanent road network and nonadoption of water sprinkling practice on haul roads.

Source: Rapid Environmental Impact Assessment for Mining Operation in Bellary-Hospet Region, Karnataka, Nationaly Environmental Engineering Research Institute,
on the region due to lack of proper environment protective measure.

The health impacts of mining and quarrying are very severe. Studies have shown that stone quarrying and crushing cause silicosis, exposure to iron ore dust may cause pneumoniosis and respiratory problems among workers of lime stone quarries.

Reduction in the ore grade and obsolete technology in high cost of gold extraction in Kolar Gold Fields has consequently led to the closure of these mines. Nearly, 20-30 million tons of mine tailings dumped for many years has created environment and health problems to the people living in Kolar Gold Field town area.

■ CAUSES

The causal factors responsible for degradation of environment due to mining/quarrying activity are:

- Manual operations / conventional technology in small mines
- Lack of cleaner production technology
- Inadequate mine restoration plan incorporating rehabilitation and reclamation measures
- Unscientific and illegal quarrying

Manual operations / conventional technology in small mines

In Bellary district around 60 to 65 percent mines are small mines. Gulbarga district too has many small mines. In these small mines, mechanisation and adoption of modern mining technology are not feasible due to the high costs. The mining practiced in these small mines involves crushing, screening and transporting the ore by conventional technology and manual operations which causes air pollution. Improper mode of transportation without adequate protective coverage of the ore, leads to spreading of dust on road side and agricultural land. The damage caused to the roads on account of movement of heavy traffic vehicles and high traffic density further aggravate the problem.

Lack of cleaner production technology

Cleaner production technologies intervene at source and help in reduction of pollution and in increasing efficiency. Surface mining, Chemical detoxification and bio degradation are adopted to have efficient waste

Cleaner production alternatives

Surface mining technology

Surface mining technology is one such technology used for mining of selective minerals for efficient exploitation of the deposits. Conventional practices like drilling, blasting and preliminary crushing cause pollution problems. Use of Surface Miners, avoids drilling, blasting and loading, thus considerably reducing the vibrations, noise and dust. In this method the material is cut into small lumps and transported on conveyor belts. This technology can be employed in iron ore mines of Bellary district and lime stone quarries of Gulburga district, where surface scratching is feasible. This technology will reduce generation of overburden and consequently reduce air and noise pollution.

Bio degradation

Biodegradation technology uses certain cultures of bacteria and fungi for processing, as well as for extraction of gold and silver from low grade ores or mine tailings. These methods can therefore be employed in the closed gold mines in Kolar district for processing large quantity of mine tailings dumped around the mine sites. Processing of mine tailings will help in reduction of waste and also recovery of valuable metal.

Chemical detoxification methods

Certain mining processes involve use of toxic chemicals in beneficiation, leaching and refining processes of minerals. Cyanide is used as leach reagent in gold and silver mining. Chemical detoxification helps in removing the toxic effects of such chemicals. Such techniques can be adopted to treat the waste at Hutti gold mine to mitigate the contamination of the surroundings.
management practices suitable for iron ore mines, lime stones quarries and gold mine. However, no information about adoption of cleaner production technologies in Karnataka is available.

Inadequate mine restoration plan incorporating rehabilitation and reclamation measures

In the aftermath of mining land looses vegetation, landscape gets altered and the ecosystem is disrupted. It is therefore necessary to reclaim and rehabilitate the affected land scientifically with well-defined post-mining land use plans during the currency of mining and after the closure. The measures should be compatible with surrounding land use, support species, bio-diversity consistent to that area. Moreover, the restoration plan should include guidelines for proper management of waste dump, topsoil management techniques, and good practices for stabilisation of dumps (active & non-active).

Unscientific and illegal quarrying

Illegal and unauthorised quarrying of building stones and sand takes place in some districts. Such activities cause severe land and forest degradation as they go unnoticed and no rehabilitation plan is implemented. However, it is stated that the percentage of such illegal quarrying is less than 1 percent.

TRENDS

Extent of land degradation is directly linked to the quantum of mineral produced in that particular location or district. To arrive at the extent of land degraded by mining, the norms evolved by the Indian Bureau of Mines are adopted. These norms give a weighted average value of 4 hectares of overburden per million ton of ore (iron ore or limestone) excavated. The extent of total land affected in Bellary, Gulburga, Chitradurga and Bijapur during the above period would be in the order of 1162 hectares. The land affected due to mining before 1996-97 has not been estimated due to lack of data.

Regulatory mechanism

Clearance is required under the Forest Conservation Act, 1980 from the Forest Department for mining activity in the forest area and no mining/quarrying is permitted within a distance of 10 kilometres from the National parks and sanctuaries.

In the case of major minerals, Indian Bureau of Mines is responsible for the enforcement of provisions with respect to environment protection as per Mineral Concession & development Rules, 1988, viz. removal and utilisation of top soil, storage of over-burden/waste rock, reclamation and rehabilitation of land, precaution against ground vibration, control of ground subsidence, abatement measures against air, water and noise pollution, restoration of flora etc.

Larger mines of major minerals come under the purview of Indian Bureau of Mines and detailed Environment Management Plan are insisted for clearances, depending on extent of land, deployment of machines, nature and sensitivity of the location. The Indian Bureau of Mines prefers to have a brief Environment management plan report for small mines.

The existing rule in Karnataka Minor Minerals Concession Rules 1994 states that no quarrying operation shall be permitted with in a distance of fifty meters from any public infrastructure like canals, bridges etc., also no quarrying operations with blasting is permitted with in 200 meters of any public infrastructure. However, enforcement of this rule is poor resulting in indiscriminate sand quarrying.

Mining activity as well as quarrying is categorized as red by the Karnataka State Pollution Control Board and requires consent. The project authorities should intimate the location of the project site to the Ministry of Environment & Forests, Government of India before initiating any investigation and surveys. The Ministry of Environment & Forests intimates the decision regarding suitability or otherwise of the project site.

The proponent is required to obtain the environmental clearance as per the Environmental Impact Assessment Notification, 1994, issued by the Ministry of Environment & Forests, Government of India, in case the mineral is a major mineral and the mining area exceeds 5 hectares. If the mining area is less than 5 hectares and if investment exceeds Rs 5 crores, the proponent is required to obtain environmental clearance from State Ecology and Environment Department. The mining projects attracts public hearing procedure, only if the mining area exceeds 25 hectares.

The mining project requires Forest Clearance, if the activity comes under the forest area under the Forest Conservation Act, 1980. If the mining area is coming under revenue land, permission and land conversion from the Revenue Department should be obtained. The proponent is required to do mining activity in accordance with the Mining Plan approved by the Indian Bureau of Mines.
As per the report, the land affected in Kudremukh area alone due to the project for iron ore mining, dam for disposal of waste, roads, electrical transmission lines, pipelines etc., is around 2000 hectares, from the year 1980 till 1999. The quality of water in the river deteriorated from class-A, to class-C (suitable for drinking with conventional treatment) down stream of Kudremukh Iron Ore Company Ltd., by 1996-97. It continued to remain at this level till 1998-99 and further reduced to class-D (suitable for wild life and fisheries) by 1999-2000. There is no further deterioration observed down stream of Kudremukh Iron Ore Company Ltd., in 2000-01. The water pollution of Bhadra River, down stream of Kudremukh Iron Ore Company Ltd. in Kudremukh area may improve in the coming years due to various environmental control measures envisaged.

Air pollution in Bellary is likely to increase due to increase in production of hematite ore. This increase can be attributed to rise in demand and sanctioning of new lease area for mining. Increased mining activities are likely to raise the suspended particulate matter and respirable suspended particulate matter levels unless better technological and management interventions are adopted. The corresponding increase in road network for transportation of ore to their respective destination will result in increase in area under roads and more emissions. Increase in the numbers and height of waste dumps are expected and add to the air pollution caused by wind erosion of the dumps. The projected increase in mining operations in Bellary region may lead to further deterioration of water quality of Tungabhadra River and various streams, reservoir and ponds of that region.

### HOT SPOTS

In western ghats area, iron ore mining activity has resulted in degradation of land and forest area and impacted the water quality in the Bhadra River on account of siltation and contamination of water by the ore. However, at present, no new leases are sanctioned for mining/quarrying and mineral exploratory work in western ghats area. However, Kudremukh area in Chikamagalur district is likely to become a hotspot in the future, if environmentally effective conservation measures like stabilisation of slopes in the mine area and appropriate protective measures for...
Mining hotspots
The mining and quarrying activities, especially in the Kolar district of Karnataka, have led to environmental problems. The mine tailings heaped in huge dumps in the adjoining areas of closed gold mine sites lack concerted efforts for reclamation and rehabilitation. This has resulted in environmental problems in terms of adverse health effects, loss of productive land due to surface runoff from waste dumps.

There are large numbers of big quarries situated at Malkhaed, Wadi, Sedam, and Shahabad, besides a number of smaller quarries spread across the district. Intensive quarrying and presence of cement factories have led to environmental problems like land degradation and air pollution respectively, in these locations.

**GUIDELINES FOR RECLAMATION AND REHABILITATION MEASURES**

The major adverse impacts of mining are land deformation and deforestation. By proper back filling, dozing, top soil spreading, and soil amelioration, the land can be prepared for biological reclamation as far as possible. Backfilling and land reclamation work should be carried on concurrently with mining. The vacant land in the mine leasehold should be utilized for tree plantation. The green belt created around the mine workings would be aesthetically pleasant and act as a dust and noise filter.

The top-soil, wherever extracted, should be used immediately for plantation work, and where it can’t be used immediately, should be stored separately to be used later for rehabilitating mined-out areas and dumps. Overburden dumps should not be created on steep hill slopes but on plain or moderately sloping ground and should be created in layers of moderate thickness of say 8 to 10 m, and each upper layer should be formed leaving a terrace at the outer edge of the lower layer. The individual layers may have slopes at angle of repose of the dump material but the overall angle of slope by this method of formation in layers would come down to around 28 degrees, making it easier for erosion control and revegetation of the dumps. Construction of check dams in gullies and rivulets will help in checking erosion and down wash of silt. If overburden dumps slopes cannot be avoided, application of geo-textiles will help the revegetation process.

If the mining project involves involuntary displacement of persons, a suitable scheme for compensating the families for their land and homestead should be made and a proper resettlement and rehabilitation scheme prepared after due consultation with the persons being displaced. Rehabilitation schemes for other project-affected persons should also be prepared.

**ACTION PLAN**

- Small mines and quarries less than 5 acres cause enormous damage to the environment. These small quarries do not come under the purview of the Mines and Minerals Development Regulation Act. Such small mines and quarries should be brought under the purview of the relevant Act/Rules. The Department of Mines and Geology, the Department of Environment and Ecology, and the Karnataka State Pollution Control Board should amend the rules to bring the small quarries under the purview of consent rules of the Karnataka State Pollution Control Board.

---

**Socio-economic / Ecological impacts**

<table>
<thead>
<tr>
<th>No.</th>
<th>Problem</th>
<th>Impact on public health</th>
<th>Loss of biodiversity</th>
<th>Impact on vulnerable groups</th>
<th>Productivity loss</th>
<th>Impact on critical ecosystems</th>
<th>Irreversibility</th>
<th>Urgency of the problem</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land Degradation</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Degradation of forest and decrease in Biodiversity</td>
<td>—</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Surface water pollution</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Air pollution due to SPM and RSPM</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Degradation due to abandoned/closed mines</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

Scale: 1 = low, 3 = medium, 5 = high

---

silt storage dam etc., are not put in place.
• Provisions of the Karnataka Minor Mineral Concessions Rules impose a total ban on quarrying of sand and blasting within 200 m from public structures like bridges, railway line, tanks and canals, etc. Considering the extent of impacts of quarrying and blasting the rules need to be amended restricting quarrying up to 500 m from public structures like bridges, railway line, tanks and canals.

• Inventorization of all the quarries (registered and unregistered) existing/ closed/ abandoned, of all sizes need to be done.

• Monitoring of various environmental parameters should be carried out not only for individual as well as cluster of mines.

• Karnataka State Pollution Control Board should evolve a cluster wise monitoring system to measure parameters like suspended particulate matter and respirable suspended particulate matter levels in the core area and buffer zones of mining and quarrying intensive districts like in Bellary, Gulbarga, Tumkur and Bangalore-north districts. In the same way ground and surface water-quality monitoring should be carried out for specific pollutants depending on the entire process of ore and mineral extraction.

• Time series data on the extent of land and forest degradation in mine-intensive and eco-sensitive areas is essential to assess the impact on environment. Data should be collected and monitored on selected parameters to assess land and forest degradation. For larger mines and quarries these parameters should be recorded annually and for clusters of quarries, once in three years.

• Mine Reclamation and Rehabilitation for mines and quarries of all sizes including closed and abandoned mines:
  • For Government lands leased for mining, rehabilitation should start simultaneously with mining activity.
  • Renewal of lease should not be considered unless the rehabilitation has taken place.
  • For renewal, Environment Clearance from Department of Ecology and Environment should be made mandatory to ensure the simultaneous rehabilitation and reclamation.

• The lease period and consent period prescribed by Department of Mines & Geology and Karnataka State Pollution Control Board respectively should be co-terminus.

• Environment Fund should be set apart to rehabilitate or reclaim the mining area. Environment Fund as a percent of the mining lease amount needs to be created for all environmental mitigation measures pertaining to mining.

• To prevent selective mining and causing environmental loss the royalty should be linked to the area of the lease. Larger areas should attract higher royalties.

• The concept of dead rent is a way to revive old lease rights of mines, not in operation. This should be totally scrapped and every lapsed lease should be treated as a new venture, for approval of the lease or concession based on fresh Environment Impact Assessment.

• Out of the royalty collected by the Department of Mining and Geology, 50 percent should be retained by the department for reclaiming and ecological restoration of the closed mines.
Quarry Area in Gulbarga district
The images depict area around Malkhed village of Gulbarga district acquired by Indian Remote Sensing Satellite, False Colour Composite during 1991 and 2003. The area is physiographically plain region with few streams running and the red colour in the image represents vegetation mainly crop land as the parcels of land can be seen. The different red colour indicates the various stages of crop growth. The ribbons like bands with white tone are areas of limestone quarry. It is seen that in the 1991 image is having less quarry area whereas compared to 2003 image. Near the quarry, the dark blue (black) colour spots are quarry pits filled with water. Analysis of temporal data can lead to estimating the land degradation due to quarrying.

Quarry area around Bannerahatta. Bangalore district
The Indian Remote Sensing Satellite, LISS III, False Colour Composite images around Bannerghatta area have been acquired during 1989 and 2002. The red colour in the images indicate vegetation and the different types of red represent different types of forest (deciduous, plantation etc.). The Bluish white colour indicates the area of quarrying. The Bluish black colour in the image are Barren / Stony rock area. The dark blue I black colour are water bodies or tank. With the analysis of multidate data, estimation of the increase in area of quarrying and the resultant land degradation can be done.
Mining Area in Bellary

Area around Sandur Mining Area of Bellary District as viewed by Indian Remote Sensing Satellite, LISS III, False Colour Composite during the years 1988 and 2000. The image shows that the area is an undulating terrain with linear ridges. The red colour in the image indicates vegetation. The light red colour in the 2000 image indicates that the vegetation is sparsely distributed as compared to the dark red colour in the 1988 imagery. The light green colour (within the circle) shows the area of mining. The mining activities mainly are carried out on the top of the ridges and can be seen in both the images. Using multi temporal data the area of degradation due to mining can be assessed.

Restoration strategies: now and future

Because of large-scale destruction of natural areas due to mining operations, a restoration strategy is needed as a part of the overall mining management plan. In restoration, emphasis is given first to build soil organic matter, nutrients and vegetation cover to accelerate natural recovery process. Reclamation is the process by which derelict or highly degraded lands are returned to productivity, and by which some measure of biotic function and productivity is restored. Tree plantations can be used as a tool for mine spoil restoration as they have ability to restore soil fertility and ameliorate microclimatic conditions. Long-term mine spoil reclamation requires the establishment of stable nutrient cycles from plant growth and microbial processes. Restoration of mine sites often entails amelioration of physical and chemical characteristics of substrate and ensuring the return of vegetation cover. If specific problems hindering eco-system redevelopment can be identified, a cure can be designed using or mimicking natural processes. This process of identification and intervention is the essence of ecological restoration. The most common response to land degradation has been abandonment or reliance on natural succession to restore lost soil fertility, species richness and biomass productivity. However, the process of natural succession on surface-mined soils is slow due to the removal of topsoil, resulting in elimination of soil seed bank and root stocks and due to soil profile disturbances. As many as 50 or 100 years can elapse before a satisfactory vegetation cover develops on mine waste. Redevelopment of advanced communities may take a millennium or more. An important goal of ecological rehabilitation is to accelerate natural successional processes so as to increase biological productivity, reduce rates of soil erosion.

Bioremediation: the challenges

In summary, a desired species for planting on mine spoils should possess the ability to (i) grow on poor and dry soils, (ii) develop the vegetation cover in a short time and to accumulate biomass rapidly, (iii) bind soil for arresting soil erosion and checking nutrient loss, and (iv) to improve the soil organic matter status and soil micro-bial biomass, thereby enhancing the supply of plant available nutrients. In addition, if possible, the species should be also of economic importance.

A N Singh, A S Raghubanshi and J S Singh, review article Plantations as a tool for mine spoil restoration