

Mining, Development and Environment: A Case Study of Bijolia Mining Area in Rajasthan, India

Surender Singh Chauhan

*Indira Gandhi Centre for HEEPS, Department of Environmental Science,
University of Rajasthan, Jaipur, Rajasthan, India*

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ABSTRACT Mining is essentially a destructive development activity where ecology suffers at the altar of economy. Unfortunately in most regions of earth, the underground geological resources (minerals) are superimposed by above ground biological resources (forests). This is particularly more prominent in India. Hence mining operations necessarily involves deforestation, habitat destruction and biodiversity erosion. The extraction and processing of ores and minerals also lead to widespread environmental pollution. However, mankind also cannot afford to give up the underground geological resources which are basic raw materials for development. An unspoiled nature can provide ecological security to people but cannot bring economic prosperity. Scientific mining operations accompanied by ecological restoration and regeneration of mined wastelands and judicious use of geological resources, with search for eco-friendly substitutes and alternatives must provide the answer. A case study of Bijolia Mining area in Rajasthan, India, gave some sensational revelation of the impact of mining on human ecosystem.

INTRODUCTION

India is rich in mineral deposits and Rajasthan ranks second only to Bihar. Some minerals like Wollastonite and Jespar are found only in Rajasthan. It has 97 per cent of Zinc, 93 per cent of Gypsum, 96 per cent of fluorite, 70 per cent of sandstone and limestone, 89 per cent of asbestos, 90 per cent of marble, 70 per cent of calcite, 80 per cent of lead, 56 per cent of tungsten, 75 per cent of soapstone deposits of India. In spite of such large deposits of minerals, Rajasthan ranks only fifth in production of minerals. Bihar contributes 13.09 per cent, Madhya Pradesh 9.68 per cent, Gujarat 8.55 per cent, Assam 7.03 per cent and Rajasthan only 5.74 per cent of total mineral production in India. Most of these minerals, except limestone, gypsum and phosphorite shall last for 50 to 100 years at the current rate of production and use.

Mining Activities in India

Since time immemorial, India did mining of various minerals. Zinc mining on a commercial scale began at Zawar mines in Rajasthan centuries ahead of Europe. Rajasthan has earliest dated lead-zinc mines in the world. India developed strong technology of mining and smelting, which is rather older than Harappan civilization. Zinc technology was first started 2000

years ago. However, mining for most of the other minerals is of recent origin and some minerals like rock phosphates were discovered after independence.

At the end of March 1994, there were 1,324 mining leases for major minerals and 10,521 quarry licenses for building stones which indicate the extent of mining in Rajasthan. Mining leases are spread over an area of 9,00,000 ha of which 1,00,000 ha is in forest land which should be a cause for environmental concern. Mining activity employs 3,25,000 persons in the State. In 1993-94, minerals worth rupees 645 crores were mined and the Government of Rajasthan earned revenue of 161 crores. These figures could be much higher if illegal mining was accounted for. Most of the minerals mined go out of the State in the raw form. Only a few mining based industries, including cement factories have been established in the State.

The advent of independence of India in 1947 added a new dimension of expectations, leading to rapid development activities to raise the standard of living through over-exploitation of natural resources. Accelerated economic development and globalization process have now penetrated the remotest part of the State. This started supplanting and superimposing the western value system on Indian culture, which laid stress on consumerism based economic development.

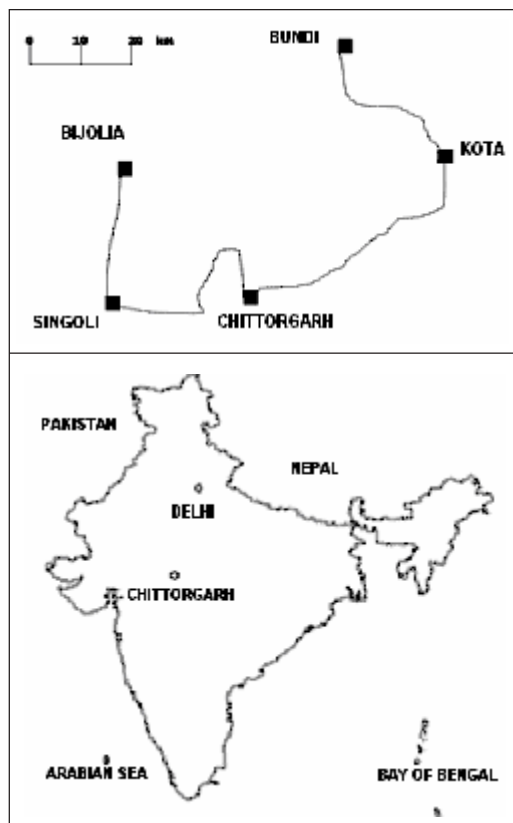


Fig. 1. Location map, Bijolia mining area, India

Mining in Rajasthan – A Case Study of Bijolia Mining Area

In order to evaluate scientifically the effect of mining on environment, a study sponsored by Department of Environment and forest, Government of Rajasthan, was carried out in Bijolia Mining area. The findings were sensational and revealing.

Bijolia is one of the largest mining areas of Rajasthan where mining on large scale commenced nearly three decades ago. Since then, environment has been adversely affected, but no systematic evaluation has been carried out to assess its impact on the nature and socio-economic system of the people working in and around the mines. Satellite remote sensing data have been used during this study as the time-varying properties of imageries provide valuable basis for discrimination.

Mining activity in Bijolia area is spread over

an area of about 61.7 km² and covers parts of Bhilwara, Bundi and Chittorgarh districts of Rajasthan and Mandsaur district of Madhya Pradesh (Fig. 1). Splitable sandstones of Vindhyan Supergroup are extensively mined for roofing as well as rough flooring purposes mainly near the villages of Nayanagar, Jharoli, Aroli, Gopalpura, Shambhupura, Pachanpura, Kansia, Banio-Ka-Talab, Champapur, Gudha, Makreri, Nala-Ka-Mataji, Budhpura and Lamba-Kho (Prasad 1984).

(a) Land Degradation in Bijolia

The mining activity in Bijolia has progressively increased from 1971 when it covered only 0.84 km² which increased to 12.045 km² in 1984 and further to 30.839 km² in 1991 (Fig. 2), generating employment from a few hundred workers in 1971 to nearly 50,000 mine workers in 1991. With the increase in mining activity the forest wealth was indiscriminately destroyed as the fire wood requirement increased both for cooking purpose and sharpening of the tools of mining. The forest cover decreased from 237.819 km² (38.516%) in 1971 to 174.274 km² (28.385%) in 1984 and then to 127.770 km² (20.714%) in 1991. This amounts to a decrease of nearly 110 km² (47%) in just 20 years. In 1971 the entire 237.819 km² area was classified as dense forest, whereas in 1991 of the 127.77 km² under forest only 27.955 km² was under dense forest, 26.900 km² under average forest (Fig. 3). Similarly, land under agriculture has decreased from 350.919 km² (56.875%) in 1971 to 323.970 km² (52.507%) in 1984 and further to 308.101 km² (49.935%) in 1991 (Fig.2). Some of these lands have gone under mining whereas a major part of it has become wasteland which has increased from 17.256 km² (2.796%) in 1971 to 87.146 km² (14.157%) in 1984 and further to 133.711 km² (21.671%) in May, 1991 (Fig.2). This amounts to an increase of 116.455 km² in just 20 years. Thus, wasteland has increased by 675 per cent. Of the 30.839 km² covered by mining activity in 1991, about 8 km² lies in forest area, 14 km² in agricultural land and only 8 km² in wasteland (Fig.4), which should be a matter of great concern (Sinha 1994).

Mining activity has significantly added to the degradation of prime forest land and development of wasteland. Mining despoliation (spoiling) of land is most destructive. In 20 years time nearly 30 km² of land has been directly

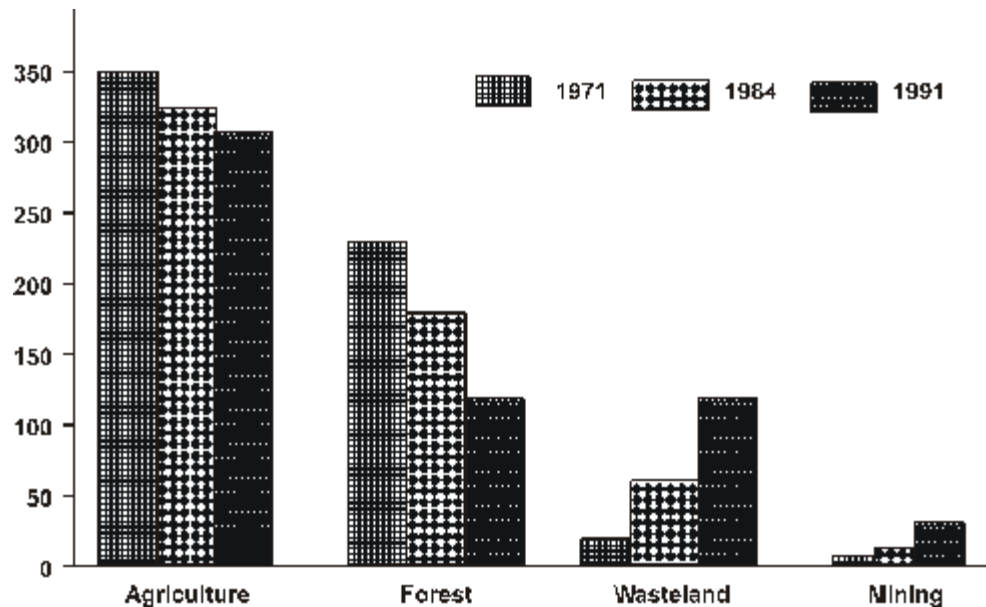


Fig. 2. Histogram of land use patterns vis-a-vis mining over 20 years in Bijolia

destroyed by mining activity leaving a big scar on the mother earth as no systematic mining was ever attempted and no effort has ever been made for reclamation of mined areas. Huge artificial hillocks have been created as eye sores as no attempt was ever made to vegetate them with plantation. The mine owners are under no obligation to do so since no administrative or legislative act exists in this respect. Apart from 30 km² of the area deciphered on imageries large tract of narrow strips on both sides of roads have been covered by mine waste dumps.

(b) Dust and Air Pollution

Mining and its associated activities of drilling, blasting and transportation increase the suspended particulate matter in the air which is harmful to the health of the workers exposed to the mine environment.

A high volume sampler was used for collecting air samples from different mines, which gave SPM values ranging from 411 to 467 mcg/m³. One sample was collected far away from the mining area to obtain the background figure of fresh air which gave SPM value of 199 mcg/m³. Though the value of 411 to 467 mcg/m³ is well within Central Pollution Control Board (CPCB) standards for areas coming under industrial and mixed use (i.e. 500 mcg/m³), it is more than double of 199 mcg/m³ coming from fresh air which the villagers would be exposed to but for working in the mines. The maximum SO₂ and NO_x values varied between 30 and 70 mcg/m³ while CO levels were below detectable limits. Results show that all the values for SO₂ and NO_x and CO are well within the CPCB standards for areas coming under industrial and mixed use (i.e. 120 mcg/m³ for SO₂ and NO_x and 5000 mcg/m³ for CO). Fine dust inhaled by workers leads to diseases related to lungs and liver such as "silicosis", "bronchitis", "asthma" and "tuberculosis". Figure shows that nearly 75 (25%)

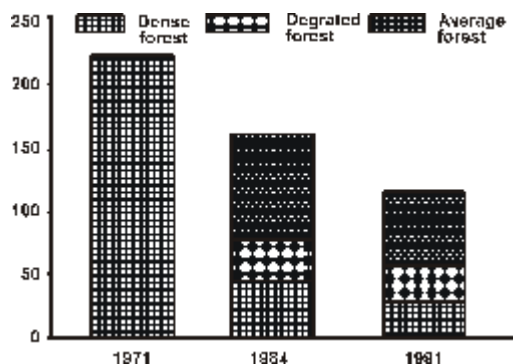


Fig. 3. Histogram showing change in categories of forest over 20 years

of the 300 workers interrogated show dust related diseases as mentioned. Nearly 161 workers felt that the mining has caused air pollution affecting their health slowly. 173 mine workers felt that mining is the cause of increase in diseases and misery (Chauhan 2004).

(c) Water Pollution

12 samples of water were collected from different points which serve as sources of drinking water to mine workers to analyze quality and assess the impact on the health of the people. Analysis is compared with IS standard for potable water. It is noted that most of the elements are well within the prescribed standard. Since the material mined is sandstone, it generates dust particles composed only of "silica" which is not soluble and being heavy settles down at the bottom of water reservoirs like ponds, wells and mines and does not affect the potability. Most of the mine workers live around these stored stagnant waters on which breeds mosquitoes. Water borne malarial disease is quite common among mine workers. More than 25 per cent of the workers suffer from the disease (Sinha 1994).

(d) Noise Pollution

Data reveals that noise levels are comparatively higher in the active zones like drilling, blasting and mine service stations, which are intermittent in nature and form point sources only. Truck transport, tractor-trolley transport and heavy machinery like shovels and compressors also generate noise levels beyond tolerable limits.

The noise levels measured by using digital decibel meter were found to be in the range of 96 to 125 dB. These are much above the limits of 75 dB prescribed by WHO for day time industrial area. The exposure for longer periods to these higher levels of noise is likely to affect the ear diaphragms of the workers.

(e) Hydro-geological Disturbances

Hydrogeological survey shows that the mining has affected the course of main stream near Banio-Ka-Talab. This has affected the water table in the wells up to 2 to 3 m downwards. Mining and consequent deforestation has reduced the rainfall over the years and hence quantum of recharge of the ground water. The ground water table fell by 5m in just two years between 1987 and 1989 (Dhiman 1990).

(f) Loss of Biodiversity

According to District Gazetteer of Bhilwara, the main species occurring in the forests during 1969-70 was *Anogeissus pendula* (Dhokra). The other species in the forests were *Acacia leucophloea* (Aranja), *Acacia catechu* (khair), *Holoptalia Spp.* (Chural), *Butea monosperma* (Palas) and *Zizyphus jujube* (Ber) etc. However, during 1992 main species found in the area were *Anogeissus pendula*, *Acacia catechu* and *Butea monosperma* (Sinha 1994).

The rare species of wild animals found in the area in early 70's, as reported in the District Gazetteer include tigers, panthers, chinkaras and cheetals, jackals, hares, blue bulls, deer and foxes.

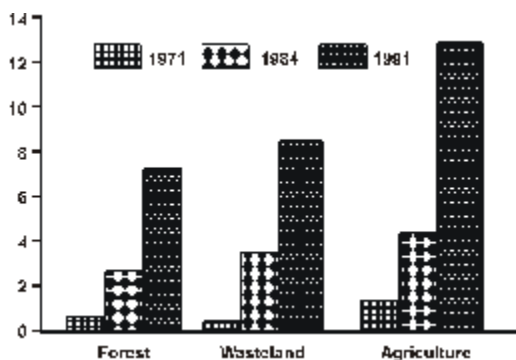


Fig. 4. Histogram showing mining in different categories of land over 20 years

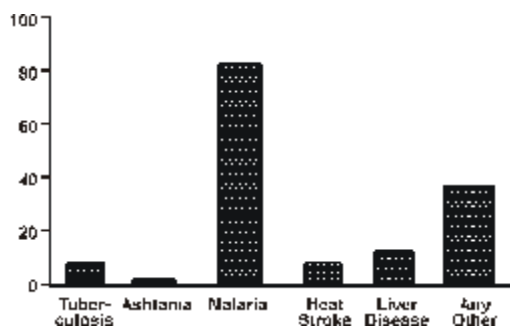


Fig. 5. Histogram showing nature of disease among workers at Bijolia mining area (Rajasthan)

However, during 1992 when field visits were made only jackals, deer and foxes were seen. In one instance panther was seen in the forest, to the east of Bijolia. No other wild animals were reported by the local people.

(g) Human Ecological Impact of Mining

Mining constitute a major hazard to man and environment. It damages 20 times the lease area including forest land, pasture land and agricultural fields by way of overburden deposits and drainage (Valaiya 1990). Though it generates employment, workers become disabled at the age of 40 due to mining related diseases, air, water, and noise pollution. In the families surveyed, more than 70 per cent workers suffer from some disease. In 63.2 per cent cases the respondents themselves have been the victims. The reported types of diseases from which the workers have generally suffered were tuberculosis (4.8%) asthma (0.6%), malaria (49.7%), heat stroke (5.5%), liver disease (15.5%) and other diseases (23.6%). Number of workers reported that mine workers after working for few years become physically handicapped and invalid to work at the age of 40 to 45 years. It is, therefore, essential to adopt scientific and systematic mining methods, which should include regeneration of the mining blights and minimizing the damage to the environment both natural and social.

Environmental Auditing and Accounting of Geographical Resources Excavated from Mines

In terms of environmental auditing and accounting, there is great environmental cost of resources exploitation particularly those of geological and biological resources of earth

(Titenberg 1968). Extraction of minerals is often accompanied by severe environmental destruction by way of deforestation, earth-cutting, overburden, soil erosion, disruption of underground water circulation, air and water pollution and waste generation (tailings) when the ores are processed in the metallurgical industries. The cost of environmental destruction is even much greater when a forest cover is removed for mining of resources. And this is the loss of "biological diversity" and the "extinction" of elusive plants and animal species which existed for millions of years in the course of biological evolution. This loss is permanent and irreparable (Table 1).

With the loss of trees and forest to retrieve underground resources we have to take into account the amount of "Carbon dioxide" (green house gas) those trees must have absorbed and "Oxygen" (life sustaining gas) produced (by photosynthesis) while they existed on earth for years to come. And who knows some of the trees, shrubs and herbs might have yielded valuable drugs like anti-cancerous and anti-AIDS drugs worth millions of dollars. Next to be accounted for is the invaluable "germplasm" with diseases resistant genes found in the wild relatives of some of our valued crop plants which are disappearing with the destruction of forest and vegetal cover. Those disease and drought resistant genes could save millions of dollars worth of crop plants from destruction by pests.

An Environmental Management Plan (EMP) for Sustainable Mining Activities

Environmental management for sustainable mining operations is relatively a new concept in this country. The economic growth and development depends not only on the "resource

Table 1: Ecological destruction caused by extraction of mineral ores from mines

<i>Activity</i>	<i>Potential impact</i>
1. Excavation and Ore Removal:	(i) Destruction of forest; loss of habitats and biodiversity. (ii) Soil erosion and overburden. (iii) Land subsidence. (iv) Crippling effects on workers. (v) Ecological diseases – Silicosis, Tuberculosis etc.
2. Ore Concentration:	(i) Waste generations (Tailings). (ii) Organic chemical contamination. (iii) Acid drainage. (iv) Water pollution.
3. Smelting:	(i) Massive air pollution – Emission of Arsenic, Lead, Cadmium and other heavy metals. Fluoride (in case of Aluminum).

Source: World Watch Institute (Washington), WWI Paper No. 109, July, 1992.

management” but also on the “environment management”. The force of development should be on “sustainable resource utilization”. This aspect of industrialization was not envisaged by our planners in the past. The problem became acute with the increased demand on resources with the population growth resulting in the uncontrolled exploitation of minerals, particularly in the past 20 years. Fortunately, the Government as well as public at large, became quite aware of the pollution problems and hence the pollution control became an important issue in the development projects, including mining. However, the environmental laws are not forced on the mining of minor minerals including building stones such as marble, sandstone, limestone and granite and hence causing, unhindered, immense damage to the environment.

Mining is one of the most destructive environmental activities. Environmental damages by mining are enormous as brought out by this study in Bijolia mining area of Rajasthan. Environmental Management Plan (EMP) should be prepared before commencement of a mining project which, as a first step, should involve improving of the extent and reserves of the deposit. Mining has to be very systematic from one end to the other. The entire area should be divided into large blocks. Since in Bijolia area the plots of lease holds are very small the mine owners are not in a position to either carryout systematic mining or follow environmental management scientifically. Thus, it is necessary to evolve a mining policy and administrative regulations which would encourage mine owners as well as force them to follow sustainable and scientific environmental management of mining operations. A cooperative society of genuine small scale mine owners may be encouraged to operate in larger blocks.

Wasteland Reclamation

Wasteland reclamation is key to environmental rehabilitation and is a well-recognized procedure for environmental management. Concurrent reclamation is one of the new approaches. Most of the mine owners are unable to take extensive restoration, rehabilitation, revegetation and afforestation measures for amelioration of environmental hazards resulting from mining operations. The owners neither have experience nor expertise to carry on with such environmental measures. Hence, the Departments

of Forest and Mines in the States should fill up this gap as they are the competent agencies to take up such work which is highly technical. The cost must come from the mining agencies themselves. Various measures suggested for improvement include –

1. All dump material stacked on either side of roads should be removed to reclaim the land.
2. All dump hills should be vegetated by native plant species like *Azadirachta indica*, *Withania somnifera*, *Aloe vera*, *Commiphora Wightii*, *Dendrocalamus strictus* (bamboos) which are of high economic value and can thrive on all kinds of habitats.
3. The exhausted mines should be refilled with dump material and reclaimed for agricultural purposes.
4. Where the mined-out pits are deep and filled with water they should be developed for “pisciculture”.
5. Dump material should be taken away for construction purposes. Even some subsidy in transporting the material to construction sites may be given.
6. All mining activity in the agricultural fields and forest areas should be stopped immediately.
7. In future mining leases should be granted in wastelands only and the areas for dumping the waste material be specified on wasteland only. Approach of concurrent reclamation of mined out areas by backfilling and spreading of top soil and sub-soil so as to restore it to agricultural land should be adopted.
8. Plots of wasteland should be leased out to mine lesser simultaneously with afforestation being an obligatory condition attached.
9. Though mine leases are allotted in small size plots, in practice, it is only a few big mine owners who are working as proxy and hence these big mine owners should be held responsible for regeneration of land and environmental management under the control of Forest and Mines Departments.

Other Remedial Measures

Though the SPM in air measured at 411 to 467 mcg/m³ are below limits prescribed by CPCB (500 mcg/m³), it is more than twice that (199 mcg/m³) found in the fresh air which the villagers otherwise would inhale. The WHO considers only 55 mcg/

m³ as acceptable and above 90 mcg/m³ as unacceptable. Hence, it is necessary to have control measures such as wet drilling and blasting by effective stemming and millisecond delay detonators. Plantation of wide-leaf trees around the mines, on waste dumps, in mine worker villages and on both sides of the mine as well as village roads should be undertaken. Wide leaf trees intercepts dusts more rapidly. Sprinkling of water on the mine roads settles dust and reduce dust particles in the air. If such measures are adopted SPM in air which affects the health of mine worker, would be considerably reduced and have positive impact on the health of mine workers.

Further, control measures would be to install noise control treatment on existing equipments or to design inherently quiet equipment. Personal hearing protection devices like “ear plugs” and “ear muffs” are most effective and easy to use. Thick green belts along road sides and in townships works as acoustic screens and help in reduction the noise intensities.

Judicial Interventions on the Mining Activities in Rajasthan

In spite of ban on any mining activity in forest land envisaged in Forest Act, 1980, Government of Rajasthan granted nearly 400 leases of marble mines in and around Sariska Tiger Reserve. This mining activity caused havoc to the environment by way of deforestation, degradation of agricultural land, pastures and hydrology of the area resulting in loss of conventional employment and hence income of the local people. Air and noise pollution due to mining activity affected the health of the mine workers. Noise due to blasting accompanied by deforestation affected the habitat of the tiger and other wild animals in the Sariska Tiger Reserve (Chauhan 2001).

Local people led by Tarun Bharat Sangh (NGO), went to the Supreme Court of India against this illegal mining activities which threatened to jeopardize the ecosystem of the Tiger Reserve and its inhabitants. The highest court ordered for closer of 262 mines falling within the buffer zones of the national park. Government of India consequently used notification declaring the entire Aravali region (in which also falls Bijolia) as an eco-sensitive area in general and banning mining activities in Sariska area in particular. Since then mining activities has come to a close but the

mining lobby is still active to get the stay vacated and carry out mining illegally at some place. Political leadership of Rajasthan is also keen on reopening of the mines.

CONCLUDING REMARKS

There is still time to reverse the exploitative model of development and to evolve an Indian indigenous culture based developmental economy. Let the camel, tree, tourism and solar energy go together. All shall be well if “economy and ecology”, “development and environment” go hand in hand.

Minerals are the basic raw material for all industries other than those which are based on agricultural produce. Rajasthan has basic raw material in the form of minerals for ceramic refractories, abrasives, chemical and fertilizer, glassware, fire proof and grinding material etc. It has base metals like lead, zinc and copper which can form foundation of many industries. It has large reserves of building and ornamental stones such as sandstone, Kota stone, marble and granite are available.

Minerals are wasting asset. These are non-renewable resources and hence once mined, cannot be replaced. This calls for their judicious use keeping in view the long term requirement of the State and the people. Minerals should not be mined for immediate gain only. Present generation has to act as trustees of these natural resources for posterity. Mining of minerals for non – essential purposes which do not add to the development process and have devastating effect on the environment must be stopped. Karoli stone is a glaring example of such wasteful non – essential mining. These stones are used only for facing the walls of buildings constructed by rich people and is not essential. On the contrary, mining of these stones, spread over an area of 200 km² caused deforestation resulting in significant rise of temperature in the areas of Dholpur in 1994. Similarly, mining should not be done for export, in raw form, to earn foreign exchange at the cost of environment.

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