International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Environmental Degradation Due to Open Cast Mining Activities in Bundelkhand and Gwalior Region of M.P., India

P.K. Jain

School of Studies in Earth Science, Jiwaji University, Gwalior (MP), PIN – 474 011, India.

Abstract: ***Open cast mining and quarrying activities are going on in and around the Bundelkhand and Gwalior regions, to exploitation of the Rocks and Minerals, which are non-renewable products of nature, once they are exhausted, cannot be grown like plants and forest. Minerals have significant importance for the development of industrial, social and economic prosperity of any nation. Keeping this in view, the need for a judicious development and exploitation of these natural resources are required without harming the environment. Generally, varied open cast mining and quarrying of Granitic and Dolerite rocks are carried out by various agencies on small to large scale, for the production of, decorative stone, dimensional stone, building stone and road metal etc. At many places environmental degradation is observed during the field survey, due to the said activities of mining methods, subjected to degeneration of the natural resources, dust generation, water, air, noise pollution and the demolition of aesthetic beauty of the precious earth. Health risk and socio-economic impacts are the common hazards as associated with the said mining activities in both the regions. Pursuing the available literature on our National Mineral Policy, it has been found that, there is no strong and clear cut provision to protect the environmental degradation due to the open cast mining activities as going on smoothly in the regions under investigation. An attempt has been made to summarize the whole mining scenario of the regions first time to assess the environmental degradation and how these activities are badly affecting the ecosystem harmony and aesthetic beauty of the region. Remedial measures have been suggested through framing a strong Environmental Management Plan (EMP), to protect the environmental degradation at the mine sites in general.***

Keywords: Environmental Degradation, Mining Activities, Aesthetic Beauty, Rocks and Mineral Resources

1. Introduction

The minerals and rocks have great importance in the development of the industrial growth, social progress and prosperity of the any nation. They are necessary for the basic human needs. Minerals are limited as well as non-renewable in the nature, on other hand rocks are the mineral aggregates. A mineral once taken out from earth is gone forever, not only for one or two generations but for all generations to come. So the proper scheme of exploration, exploitation, development and maximum best use of minerals and rocks should be adopted. Rock is the basic building material of the earth's crust used by men from pre-historic time [1].

Bundelkhand region is occupying almost 70,000 sq km part [2] of Southern Uttar Pradesh and Northern Madhya Pradesh, Gwalior region/district occupy 4,560 sq km part[3] of M.P., Whole area of investigations, covering 74,560 sq km area of Central India (**Fig. 1**). Bundelkhad region is acted as gateway in between the north and south India. Geographically, it covers seven districts of U. P. and simultaneously seven districts of M.P., Gwalior district sometimes, being a part of Bundelkhand, also considered as a part of Madhaya Pradesh.

There are about 325 nos. active mining sites in Jhansi district alone [4] of Bundelkhand region and approximately 100 open cast mining activities are going on in Gwalior district of Madhya Pradesh.

Environmental degradation is another significant factor related to the mining sector [5]. Due to greed for mineral resources, man has harmed the environmental scenario. For this, there should be strong laws and enactments to protect the environment. Our present national mineral policy is unable to fulfill on these accounts. It should be more powerful and more possessive.

Figure 1: Location Map of the area under investigations

2. Materials and Methodology

Systematic field surveys were carried out at selected mines sites. Field data and available literature on granite mining in Jhansi district were collected from various sources, regarding the mining sites under investigation. The air

samples were collected from dolerite mines at Gwalior for TSPM analysis, noise level of various activities at mine site was also recorded by dB meter. Decorative and dimensional stones were collected from the different commercial stone industries / stone cutting, grinding & polishing units. The study comprises with the collective results of aforesaid investigations.

2.1 Classification of Rocks & Stones:

Rocks are the aggregate of minerals and minerals are the part of rocks, moreover, stones are the pieces of rock. Demand of various stones is, generally depend upon their color, texture, mineral aggregates and strength of the rock in the real estate market. First they are naturally occurring materials chiefly available in the earth crust. Geologically, the availability of granite, dolerites and other stones are extensive and are inexhaustible even after several centuries [6]. Thus two fold classification of same are as under -

2.2 Scientific and Geological classification:

This classification is based on the formation and material contents of the rocks, in this manner rocks can be divided in to three classes -

2.2.1 Igneous Rock
Igneous rocks are the primary rocks, formed by the molten hot rock materials i.e. magma or lava. Approximately 95 percent part of the earth crust is covered by these rocks, generally known as primary rocks e.g. Granite, Basalt, and Gabbros etc.

2.2.2 Metamorphic Rock
Those rocks are formed from the preexisting solid rocks, due to extreme pressure, temperature and shearing stress. The constituents of minerals have been recrystallized and reoriented, new minerals grown without the whole rock melting, causes metamorphism e.g. Gneiss, Marble, Schist etc.

2.2.3 Sedimentary Rocks
It is formed by the deposition of sediments in a liquid or solution, sediments are the loose particles of preexisting rocks, these particles may be of organic or inorganic solid fragmental materials are transported and deposited by wind, water or ice in the suitable environment for digenesis and lithification, that's why said rock shows layering structure. They are known as secondary rocks also e.g. Sandstone, Shale and Limestone etc.

2.3 Commercial Classification

This classification is based on the demand of stones according to their strength, color and texture in the market. Rates of the same are also depend upon their materials quality in the real estate market, as their suitability for the construction of buildings, bridges, temples, fort, monuments etc., according to the design as fixed by the architecture engineer. In this context rocks and stones are grouped in four of the following –

2.3.1 Decorative Stone
Those stones are pleasant in color, durability, suitability and amenability of the natural substance. Indian commercial stone industries have the remarkable value in processing all the varieties of decorative stones to fulfill the requirement well, of the domestic and international real estate markets e.g. polished granite, basalt, dolerite and marble etc.

2.3.2 Dimensional Stone
Stones are specially cut and shaped to the required size as demanded by the commercial market, known as dimensional stones e.g. stone tiles and slabs etc.

2.3.3 Building Stone
Unfinished product of high strength rocks of different size and shape generally used to make any building foundation, floor and roof of any civil structure with the mixing of cement, sand and iron etc.

2.3.4 Road Metal
Generally road metal is made by the mine waste, which is automatically generated during quarrying and mining of granite and dolerites, roads are shaped by the use of these rock pieces of different shape & size, gradually decreasing in size from the bottom to top of the road. By the Crusher road metal of 'specific' sizes are made from the hard raw rock material as well as derived from the granite and dolerite mines.

3. Mining Activity and Mine Product

Open cast quarrying and mining activities are going on at various places of the Bundelkhand and Gwalior regions, to exploit the granitic and dolerites rocks, for producing the unfinished natural raw materials of different size as available in the mine / deposit. Simultaneously the raw mine product / unfinished rock pieces are sent to the stone cutting, crushing, shaping and polishing units as per demand of the market, to form and carve the decorative stones, dimensional building stones and road metal time to time, as per the demand of domestic and international market of stone. Natural stones are chosen for various purposes, based on their form and type of rock. Dimensional stones are selected on the basis of their size, durability and suitability to the weathering in respect to resistance etc. Decorative stones are also known as ornamental stones, which are generally well used in the exterior and interior decoration of the any type of building structure. The commercial stone industries or stone processing units from the said regions are producing the high quality, glazed, polished tiles and slabs such as (i) Pink Granite (**Fig. 2**), (ii) Gray Granite (**Fig. 3**) and (iii) Black Granite (Dolerite, **Fig. 4**). The stone crushers of the regions are made of it only the road metal (**Fig. 5**) of different size and shape from the granitic and doleritic material or their mine wastes.

Figure 2: Polished Pink Granite

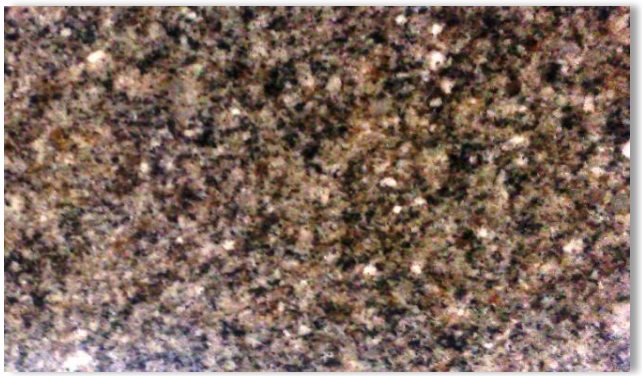

Figure 3: Polished Gray Granite

Figure 4: Polished Black Granite (Dolerite).

Figure 5: Crusher making road metals or Gitti at site.

4. Mining Scenario of Bundelkhand Granite and Dolerites of Gwalior region -

4.1 Granite

Bundelkhand granite is one of the ancient rock groups and has much similarity with basement Archaen complex of Rajasthan and southern states [7]. It is well spread up in the southern U.P and northern part of M.P. The granite (**Fig. 6**) mining in the region around Datia, Tikamgarh, Chhatarpur districts of M.P and Jhansi district of U.P., is basically quarry oriented, small mine owners take lease of the mine and develop it without consulting the geologist or environmental geologist. The rules and acts are not hard & strict, so that during the mining activity, the regional environment is badly affected by the present mining method.

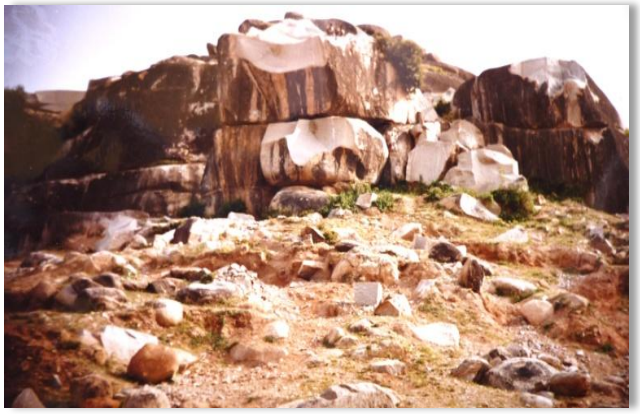

Figure 6: Granite outcrop, Baroni Khurd, Datia (M.P.).

4.2 Dolerites

Dolerite is the intrusive volcanic rock, generally formed by the doleritic composition of magma or lava. Dolerites are well exposed at the site in sill (**Fig. 7**) form, at Nayagaon village in Gwalior district of M.P. The Nayagaon is well located on the NH-3 (at Gwalior to Shivpuri road) in southern direction and approximately 15 km far from the Gwalior city. Open cast mining activity is going on for the exploitation of the dolerites (**Fig. 8**) rock; in commercial terminology dolerite is known as black granite, having great demand in the stone market to prepare the road metal and black stone slab, which is well used in kitchen platform etc.

Figure 7: Field exposure of dolerite at Nayagaon Village.

Figure 8: Dolerite open cast mine Location-Nayagaon village, Gwalior (M.P.).

5. Environmental Degradation

Quarrying and open cast mining are subjected to opening of large pits on the surface of the land to extract surficial and shallow deposits [8], stripping of exposed rock & mineral deposits involving blasting to loose the material. The degree of these operations, being mostly dependent on the value of the mineral deposits and quality & quantity of the production, involve partial mechanization also. These activities cause a notable impact on the environment. The major environmental problems associated with granite mining in Bundelkhand and dolerites mining in Gwalior region is summarized under the heads namely - **land degradation, water pollution, air pollution, noise pollution, flora & fauna, demolition of aesthetics, health hazards** and **socio-economic impacts**.

5.1 Land degradation:

The land degradation is mainly attributed to unscientific mining and disposal of quarry waste (**Fig. 9**). The quarry waste including the overburden or weathered waste rock material is dumped anywhere outside the mine area without planning, that is the main cause of land pollution. Though, these are unmarketable products, mine owners do not take interest in proper handling of these wastes.

Figure 9: Field photograph shows mine wastes encircled

5.2 Water Pollution

Water is essential for quarrying and processing of the stones. Mining activities are affected both surface and sub surface water. The drainage system and topography may be considered to influence the intensity of the pollution. The water composition of mine is basically depended upon the composition of host rock. During the exploitation of the rock, dust and suspended particles are automatically generated in huge amount, they are settled on the earth surface, covering large area of surrounding land and available surface water body too, causing one source of surface water pollution and the leachate water of toxic material may pollute the ground water. The requirement of water is met through pumping of ground water and this causes lowering of the water level in the region. The slurry from processing plants is neither suitable for human consumption nor other usage, washed off from the waste dumps causes heavy siltation in the neighboring agricultural fields and also make water reservoir dry.

5.3 Air Pollution

This is caused due to dust generation during blasting and other mining operations (**Fig. 10**), in the form RSPM (Respirable Suspended Particulate Matter) and SPM (Suspended Particulate Matter), as well as from huge crushers (**Fig. 11**) installed nearby mining areas. The transportation of men and material over unmetalled mine roads is also a serious cause of the air pollution.

Figure 10: Photograph shows air pollution.

Figure 11: Working crusher at the mine site.

5.4 Noise Pollution

Most of the noise pollution is generated due to the blasting methods, during open cast mining activities, as adopted for loosing the overburden and rocks of deposit. Various mining

operations, crushing, screening, loading and unloading of mine vehicles are also the causes of noise pollution.

5.5 Flora & fauna:

Flora & fauna are affected by various functions like – deforestation, blasting operations & other sounds, interference by the human population and electrification etc.

5.6 Demolition of aesthetics

The local scenic beauty of the towns due to the existence of hillocks, hills, mounds, ridges etc. is also being adversely affected due to the granitic and dolerites (**Fig. 12**) mining in the regions.

Figure 12: Photograph showing demolition of aesthetic beauty of the area.

5.7 Health hazards

Long and deep pits (**Fig. 13**) are developed during granite and dolerites mining in the regions. They are converted to ponds in the rainy season. Accumulation of water for longer time in these open pits, invite easily bacterial infections subjected to ground water pollution and uses of this contaminated water, may put adverse effect on the user's health. (Epidemic diseases etc). Several types of bronchial and lung diseases are also generally found in the mine workers due to dust pollution.

Figure 13: Mining pit, cause of ground water pollution

5.8 Socio – economic impact

Local population has their own social and cultural values, practices and occupations. Tribals and villagers who were busy in their occupations, kept alive many crafts through generations are likely to be disturbed due to mining activities. This may result in the migration of native people to other part and loss of traditional art & crafts from the whole regions.

6. Results and Discussions

It has been observed that, there is no clear cut and strong provision for the protection of environmental degradation due to open cast mining activities in the present National Mineral Policy [9], as going on at various places of the said regions under investigation. Air and noise samples results from the dolerite mine of Gwalior region are given in table 1 & 2 respectively for direct comparison with the results of granite mine of Jhansi from the Bundelkhand region [4].

6.1 Air Pollution

Collected, field air samples from dolerite mine are analyzed for TSPM (Total Suspended Particulate Matter), it is noticed that, results are exceeded from the limit as fixed by CPCB [10] in all the way, same type of results are also observed during comparison with the granite mine Jhansi (**Table 1**) from Bundelkhand region, causing from the same type of mining activities.

Table 1: Air Pollutants

Pollutant	Granite Mine (in µg m^3) [4]		Dolerite Mine (in µg m^3)		Normal Values (in µg m^3) [10]	
	Min.	Max.	Min.	Max.	From	To
RSPM	155	234	-	-	60	100
SPM	393	541	-	-	40	60
TSPM	-	-	179	285	-	-

6.2 Noise Pollution

Noise levels of various activities during the mining of dolerite were recorded by the dB meter, the noise level ranges from 90 dB to 118 dB (**Table 2**), that is also in higher side, when compare with limits as decided by WHO [11] and Noise Pollution Rules [12] of India. The results of noise levels from the granite mine Jhansi are also shown the same as compare.

Table 2: Noise Level

Pollution	**Granite Mine** [4]		**Dolerite Mine**		Limit [11]
	Range in dB		Range in dB		in dB
Noise	Min.	Max.	Min.	Max.	
	96	**125**	**90**	**118**	**75**

6.3 Water Pollution

During open cast mining at the sites, due to the overburden of deposit and topographic erosion, the water runoff contains large amount of suspended particles, which decrease the light penetration in the water bodies, affecting the survival of living organisms within, the situation invites bacterial infections subjected to surface and sub-surface water

pollution well. During the field survey at the mine site of dolerite same condition is well observed (**Fig.13**) at many places, same results are also found by the previous workers at granite mine Jhansi from the Bundekkhand region.

6.4 Effect on Flora and Fauna

Agricultural yield is affected due to the obstructions by the dust particles as settled on the leaves of the local crops, the condition reduce photosynthesis process of plants. During the field survey dust cover is seen in very large surrounding area of mine (**Fig. 14**). No wild life is found due to noise pollution by the present mining activities in the field, they might be migrated to other safe place for living.

Figure 14: Dust cover on vegetal carpet and surface water

6.5 Loss of Biodiversity

Large scale open cast mining activities have been contributed directly and indirectly to loss of biodiversity in the regions, here the overburden is separated and deposited in the form of huge dumps on the ground surface around or at some distance from quarry face [13], in hilly area the unused materials are often dumped into valleys and burying the precious vegetation of the surface, the existing slopes are leveled for development of terraces without taking note of the terrain and natural slopes (**Fig. 15**). The natural topography and forest are disturbed subjected to loss of biodiversity in the said areas.

Figure 15: Field photo shows unstable slope at the mine.

7. Environmental Management Plan (EMP):

Remedial measures should be taken to protect the environmental degradation due to open cast mining activities in the lease areas. In this regard a strong EMP must be adopted before the start of quarrying & mining in the field. EMP can be prepared to incorporate the following four steps [14] within –

7.1 First

A running mining programme of overall assessment of reserves, not only the benefits to be derived from extraction of deposits, but also the magnitude of adverse impacts on other natural resources, such as water, air, soil, agriculture, forest and grazing land etc.

7.2 Second

Strong legislative provisions should be there, for placing full responsibility of treatment and environmental rehabilitation of excavated areas by the mining agencies.

7.3 Third

Serious attempts should be made to stabilize the slopes during and after the mining also, proper drainage network must be developed for the stability of the mining area, blasting operations should be avoided during the mining and quarrying.

7.4 Forth

The provision of safe water to the workers and the inhabitants around the mines and the treatment of water pollution from mining and ancillary activities should be made the essential responsibility of mine owners.

8. Conclusion

Rocks and Minerals are the valuable natural resources of the nation, which plays very crucial role in the development and prosperity of any nation, once they are exhausted cannot grow like fauna and flora. The demand of present time for a well planned programme of survey, exploration, exploitation and management of the natural resources, those have already been discovered and to be discovered in the future also.

In the regions open cast mining activities are carried out to exploit the granite and dolerites for their commercial used, during the said mining method, overburden has to be removed first to get the deposit, causing losing of top soil and vegetative carpet of the area. Moreover, these activities are badly degrading the local environment. Judicious use of the natural resources is the matter of national interest. The exploitation should be the same without harming the environment. Moreover, serious attempt must be taken by the mining and quarrying agencies, for least degradation of the environment during the said activities in the field. Well harmony must be maintained in between the exploiter and environment to protect the ecosystem on the earth in general.

9. Acknowledgement

Author expresses his sincere gratitude to Professor Umesh Chandra Singh, former head, School of Studies in Earth science, Jiwaji University, Gwalior (M.P.) for their suggestions and providing all necessary facilities to compile

the work. Author is also thankful to Dr S. N. Mohapatra, present HOD of Earth Science department, Jiwaji University, Gwalior for their valuable help during the entire work. Thankful to Director, Indira Gandhi Academy of Environmental Education Research and Eco-Planning, Jiwaji University, Gwalior (M.P.) to permission for field air samples analyses at his laboratory.

References

[1] D. V. Reddy, "Decorative and Dimensional stones of India", CBS Publishers & Distributors, New Delhi-02, pp 1, 2008.
[2] Census, "Registrar General & Commissioner", Ministry of Home Affair, Government of India, New Delhi, 2001.
[3] Census, "Registrar General & Commissioner", Ministry of Home Affair, Government of India, New Delhi, 2011.
[4] G. Singh, Amit Pal, R. K. Niranjan, M. Kumar, "Assessment of environmental impacts by mining activities: A case study from Jhansi open cast mining site – Uttar Pradesh, India", Journal of Experimental sciences, Vol. 1, pp 9-13, 2011.
[5] P. K. Jain, Y. Waze, U. C. Singh, "Our National Mineral Policy and Environmental Degradetion due to Varied Mining Activities – With special Reference to Granite Mining in Bundelkhand Region", International Journal of Mathematics and Physical Sciences Research, Vol. 2, Issue 2, pp 168-173, 2015.
[6] B. S. Murthy, "Export of raw granite blocks; In Proc.: National Seminar on Dimensional stones and Quarrying, Processing and marketing", Mining Engineering Association, Hyderabad, Chapter, pp 256-257, 1991.
[7] P.K. Jain, A. C. Saxena, M. C. Khare, U. C. Singh, "Petrography of Bundelkhand Granite and Intrusive Rocks of an area around Datia (M.P) India", Asian J. Exp Sci., Vol. 8, No.1 & 2, pp. 51-57, 1994.
[8] K. S. Valdiya, "Environmental Geology, Indian Context", Tata McGraw-Hill Publishing Company Ltd., New Delhi, pp 149, 1987.
[9] Anwarul Hoda, "High Level Committee for NMP", National Mineral policy-2008, for non fuel and non-coal minerals, Ministry of Mines, Govt. of India, 2008.
[10] The Gazette of India, "National Ambient Air Quality Standards", Central Pollution Control Board, Notification No. B-29016/20/90/PCI.-1, New Delhi, Govt. of India, November 18, Part III, Sec. 4, 2009.
[11] WHO, "The World Health Situation", 6th. Report, World Health Organization, Geneva, 1980.
[12] The Gazette of India, "The Noise Pollution (Regulation and Control) Rules", Ministry of Environment and Forests, vide S. O. No1046 (E), New Delhi, Govt. of India, November 22, 2010.
[13] P. G. Adyalkar, "Environmental management in opencast mining – a viewpoint", Environmental issues in Mineral Resources Development, edited by K. L. Rai, Gyan Publishing House, New Delhi-02, pp34-42, 1993.
[14] K. S. Valdiya, "Environmental Geology, Indian Context", Tata McGraw-Hill Publishing Company Ltd., New Delhi, pp 158-165, 1987.

Author Profile

Dr. P.K. Jain did M.Sc., Ph.D. in Geology from Barkatullah University, Bhopal in 1988 and 1992 respectively. He has published more than 18 research papers in the various field of Geology, Remote Sensing & GIS on both National and International level. Moreover, he is RQP (Recognized Qualified Person) for the preparation of mining plan and mining scheme by Indian Bureau of Mines (IBM), Govt. of India. At present, he is working as Assistant Professor, at Centre of Remote Sensing and GIS, School of Studies in Earth Science, Jiwaji University, Gwalior (M.P.), India.