
LAND DEGRADATION DUE TO 'KOTA STONE' INDUSTRY

Durga Prasad Tanwar

Lecturer, Department of Civil Engineering
Government Polytechnic College
Kota, Rajasthan

ABSTRACT

The aim of this paper is to address land degradation associated with 'Kota stone' industry. The kota stone is a flaggy dimensional lime stone. By virtue of its good geological structure, texture, physical properties it can be cut, dressed, carved in any shape and polished easily. Mirror polished Kota stone tiles give attractive and fine grained appearance. The kota stone usage as flooring material is very popular in India as well as across the world. The most of the processing units are located in Indra Prastha Industrial Area, Kota and RICCO Industrial area of Ramganj Mandi. The production of kota stones slabs and tiles is playing a significant role in economic growth of India and is enhancing revenue in term of foreign currency day by day. On other hand mining, cutting, dressing, and polishing processes of kota stone slabs and tiles are also generating huge volume of kota stone waste as by-product. As the need of kota stone slabs and tiles increases the volume of the slurry would increase. Each ton production of the slabs and tiles generates approximately 3000 liter volume of the slurry. Waste dumps have been covering 733 hectare prime land since 2001. Approximately 417 hectare land has been mined out and overall 1150 hectare land has been lost due to production of the stone in last 13 years The intensity of environmental damage is so high that decrease in depth of a natural nallah running in Indra Prastha Industrial Area, Kota is about one foot per year due to sedimentation and solidification of kota stone slurry at its bed.

INTRODUCTION:

Flaggy dimensional limestone is exposed between Deoli Kalan (N24° 48'-E75° 52') and Suket (N24°37'-E75° 03') of Kota district in Rajasthan of India. This lime stone take good polish and is commercially known as the 'Kota Stone'. Kota stone production work has been carrying out since 1942. A close view of a Kota stone mine is shown in fig. 1.

Processing the kota stone is a resource development activity. The demand of kota stone is increasing simultaneously day by day in India as well as from abroad which requires large volume of the quarried, cut, dressed and polished kota stone. The processing units are established in Indra Prasth Industrial Area of Kota and at Ramganj Mandi town of Kota district.

Deterioration of any one or more components of environment renders a harmful effect on the ecosystem which is a self sufficient natural unit.



Fig. 1: Close view of a Kota stone mine

Land degradation due to Kota stone mining has the potential to cause irreversible damage to the environment. The improper handling and disposal of waste substantially increase the risks to the environment. By knowing the extent of the degradation a plan could be thought of regarding control the same. Aim of this paper is to extent of the problem of land degradation due to kota stone industry in proper way so that agencies concern to control may be benefitted. Miners and processing units daily throw tons of slurry. Kota stone waste is occupying the prime land because due care is not being taken for proper disposal of the same. It is degrading land day by day. Although processing of kota stone is generating revenues, employment and income but on other hand it is crucial to curb land degradation and the ecosystem which includes to conserve the agricultural land, the forest cover, soil fertility, land scape, topography and aesthetics However Eco-friendly Mining Guidelines, Government of Rajasthan (2010) provide sufficient provisions to protect environment described in Minor Mineral Concession Rule, 1986. Enatfenta Melaku (2007)^[12]

Investigated impact assessment and restoration quarry site in urban environment: the case of Augusta quarry located in Addis Ababa (Ethiopia), producing crushed stone

Dr.Fergus Sinclair (2009) has studied Livelihood impacts of quarrying and the restoration of quarry sites in Kota and Bundi Districts of Rajasthan, India and had concluded about the effect on local hydrology, the negative impact of dust and other pollutants, on the composition and productivity of natural vegetation as well as of agriculture drastically. AshutoshVyas, Archana Pancholi (2009) “Environmental degradation due to mining in south Rajasthan: A Case study of Nimbahera, Chittorgarh” During the course of field studies and They made a survey by person to person who has been working and non-working but confronted with mining area and concluded in their study that environmental impact is very much and serious.

RESEARCH METHODOLOGY

SCOPE OF RESEARCH

To study the environmental degradation due to kota stone quarries and associated processing unit in Kota district, Rajasthan, India.

OBJECTIVE OF STUDY

The main objectives of this study are listed below:

- To study the types and volume of waste generated from kota stone processing units located at Kota.
- Objective of analysis is to determine the extent of land degradation due to ‘kota stone’ industry.
- To study the impact of slurry waste on environment

First of all the inventory of kota stone quarries and processing units in kota district was prepared through collecting data from various government and non-government sources. The waste disposal system and mathematical analysis of degradation of land due to waste disposed have been done in this thesis report.

OVERVIEW OF KOTA STONE INDUSTRY

Kota Stone Industry has two sectors that is Kota Stone Mining and another one is Kota Stone Cutting and Polishing Industry. Kota Stone is categorized as minor mineral. This mineral is regulated by Rajasthan State Minor Mineral Concession Rules (RSMPCR) under which mining lease rights are granted to applicators for 4.0 hectare area. In Indra Prastha Industrial Area (I.P.I.A.) at Kota the most of processing units are located near urban population and market. It was set up by RIICO in 1969-70. Ramganj Mandi Industrial Area is situated in Kota district and was set up by RIICO in 1972-73.

The soil of area of Kota stone industry is characterized by fertile shallow alluvium black cotton soils. Kota stone is available in Ramganj Mandi and some pockets in other blocks. As per information collected from office of The Mine Engineer, Ramganj Mandi, Government of Rajasthan, the list of granted mining leases upto 08th may, 2014 total land leased for kota stone mining is 1497.18 hectares. Lease land allotted to miners of Chechat area is 330.91 and others is 1166.27 hectare. Ratio of above allotment comes to be 1:3.5..

MINING PROCESS

Kota stone beds are lying under overburden of soil, subsoil and different rock combinations made of shale, high siliceous non-laminated lime stone or basalt. Average thickness of overburden is 20 meter. Overburden considered as waste material is removed by semi-mechanized means and stone is mined by manual system through open cast mining.

KOTA STONE MINING AND ENVIRONMENTAL ISSUES

The mining activities for acquiring kota stone are found to be closely linked with environmental degradation at every stages of mine operations like exploration, extraction, processing, and the post closure. Particularly, small lease holders (less than 5 hectares) are unable to comply with various environmental laws having adequate plantation due to lack of awareness. The overburden waste disposal is occupying large land area and is not being rehabilitated properly. The key problem is land degradation along with scarring of landscape, deforestation, spread of windblown particulate on agriculture land, and soil pollution. Waste presents immediate and long-term risks to humans, animals, plants and the environment.

QUANTUM OF KOTA STONE BLOCKS AND WASTE GENERATED

It is estimated that reserves are of the tune of 100 million tonnes. The splittable lime stone beds are located at a depth of ranging from 10 m to 30 m from the earth surface. It has been learnt from the mine engineers and miners that approximately one and half lacs metric tonne quantity of Kota Stone can be obtained from one hectare land area of a mine. Approximately the waste generated consists of 30% mine waste, and 25% of block weight is converted into powder form due to processing and polishing. It has been observed that sedimentary kota stone lamina are not available in regular shapes like rectangular or square and sizes. For production of kota stone block of regular shapes and sizes dressing operation is done and 15% wastage is generated due to the dressing operation.

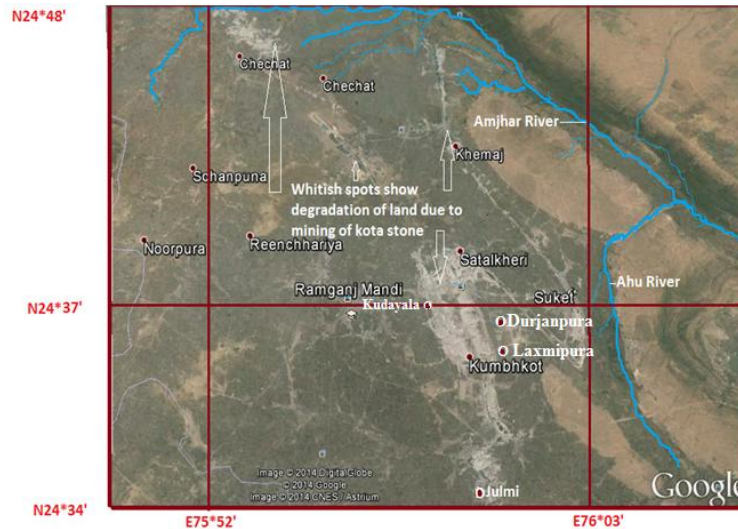
Total 62493 thousand tons of kota stone blocks have been mined out in last 13 years. As per mines land lease proportion equal 1 is to 3.5 for the Chechat and other areas, the miners of Chechat area had generated 13887.333 thousand tons kota stone blocks and others 48605.667 thousand tons. Total quantity of waste generated is 51779 thousand tons. Considering unit weight of waste equal to 2.0 metric tonne per cubic meter its volume stands 258.895 lacs cubic meter.

The overburden overlying kota stone beds at places like Chechat is comprising of soil, subsoil and mixed calcereon. The overburden in Pipakheri and Julmi area comprises of soil, subsoil and basalt rock. For each metric tonne of Kota Stone Blocks produced, 1.75 cum overburden waste is generated. The volume of overburden removed during last 13 year comes to 1108.67 lacs cubic meter. Hence total volume of mining process waste and overburden waste comes equal to 1367.565 (258.895 + 1108.67) lacs cubic meter. It was observed during survey of different mines of Pipakheri, Satalkheri, Kudayala and Kumbhkot that only one third waste generated was being back filled in mined out pits. On an average, two third of total waste volume generated that is 67.67% of 1367.565 lacs cubic meter which comes equal to 925.43124 lacs cubic meter is being dumped on land. It is assumed that volume of loose overburden thrown in dumps is almost double of the compacted overburden in the earth.

LAND DEGRADATION DUE TO MINING PROCESS AND WASTE DUMPS

Presently 1497 hectares of land had been leased for stone mining. This leased land for mining belonged to agriculture earlier. Quarrying Kota Stone is a major contributor to of land degradation. Mining activities is degrading useful land at faster rate and converting it into the waste land. Considering that one hectare land yields one and half lac metric tones kota stone blocks, total 62493 thousand tons of kota stone blocks have been mined out in last 13 years that is 417 hectare land has been mined. As per lease area ratio 1:3.5, 92.58 hectare land in Chechat area and 324.04 hectare land in other blocks have been degraded by mining process only. Loss of top soil due to kota stone industry is estimated equal to 35.8 lac cubic meter in last 13 year which is creating imbalance in ecosystem. Another activity of mining which is responsible for degradation of

agricultural land is formation of waste dumps over agricultural land. Most of miners are given small areas ranging from 4 - 25 hectare land area where side by side land reclamation is not possible after pits are made for mining Kota Stone. Blasted overburden of rocks produces huge quantity of waste material. Miners require and purchase additional land for dumping this waste material which occupy the prime agricultural land hence degradation of useful land takes place. The total volume of waste dumped has been determined equal to 925.43124 lacs cubic meter (2/3 volume of total waste generated).



LAND DEGRADATION AT SATALKHERI, KUMBHKOTA, KUDALAYA AND LAXMIPURA

Approximately 625 lacs tons kota stone block produced in last 13 year has resulted in about 925 lacs cubic meter overburden and mining process waste which had dumped on the land. The area of land degraded by this waste dumped over agriculture land can be estimated from the pyramid made out of this waste. Size, shape of pyramid and angle of



Figure: Huge mine waste dump at Satalkheri

repose of the waste are the important parameters for considerations. On an average about 1.26 lac cubic meter waste dump of a specific design occupies one hectare of useful land after taking into account the space for haul roads and benches as well. The estimation as follows:-

Considering a waste dump over one hectare land of size 80 meter x 125 meter and 30 meter high and the angle of repose of waste dumped 36° for dry season, hence the angle of repose of waste average material in rainy season may be considered 33° . The height of the dump in rainy season comes equal to $\tan\theta (b_b - b_t) / 2$ that is $\tan 33^\circ \times (80 - 3.5) / 2 = 24.83$ m so size of waste dump at top comes to be as shown in figure 3.8 below

Volume (V) of waste dump of specific dimensions spreaded in one hectare land

$$V = h/6 (A_{top} + A_{base} + 4 A_m) .$$

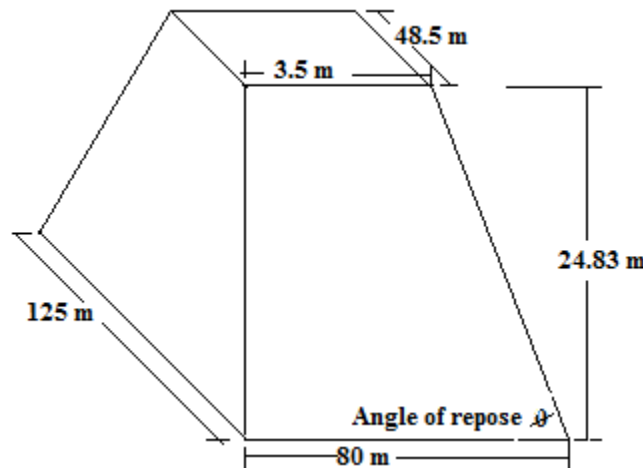


Figure : Waste dump

where, h = Height of the pyramid;

$$A_{top} = \text{Area of top of pyramid}; A_{base} = \text{Area of base of pyramid}$$

$$A_m = (A_{top} + A_{base}) / 2 = \{(48.5 \times 3.5) + (80 \times 125)\} / 2 = 5084.87 \text{ m}^2$$

$$V = 24.83/6 [(48.5 \times 3.5) + (80 \times 125) + 4 (5084.87)]$$

$$V = 126257.36 \text{ cubic meter.}$$

Total volume of waste of mining process and overburden is 92543124 cubic meter during last 13 years. Therefore land degraded by this waste under the dumps can be calculated as follows: - $92543124 / 126257.36 = 732.97211$ hectares say 733 hect. Severity of problem is can be understood in terms of area of degraded land for each metric ton of Kota Stone production. During last 13 years total mass of kota stone blocks produced is 624.93 lacs metric tons which degrade 733 hectare land so each lac metric tonne production of the stone render loss of 1.172 hectare of agricultural land. Average total thickness of kota stone beds are found 5.5 m (18 feet) and average density is 2.675 metric tons per cubic meter, hence one hectare land may yield about 1.5 lac tons kota stone slabs. Hence, one hectare land yields about 1.5 lac tons stone slabs

Therefore it can be said that 1150 hectare prime aggregation land has been lost due to kota stone production during last 13 years. As the stone is quarried degradation of land takes place in different forms. Hence, more than 100 hectare land is degraded completely every year. Permanent loss of prime agricultural land is additional. Such huge quantity of production has been requiring on an average more than 88 hectare land of different usage per year since 2001. On average more than 88 hectare prime land is being degraded every year for facilitating Kota Stone industry in Kota District.

LAND DEGRADATION DUE TO KOTA STONE SLURRY

Besides the degradation of land due to waste generated from mining activities, the Kota stone slurry generated from various processing units located in Inder Prastha Industrial Area of Kota city and industrial area of Ramgunj Mandi Tehsil is also degrading land and water of nearby streams and rivers. Cross sections and longitudinal grade is being affected due to deposition and solidification of Kota stone slurry. Slurry results from cutting and polishing process of the Kota stone. The slurry is being dumped in dumping yards located in the low lying areas, in the nearest convenient places like natural nallahs etc. During last 13 years, it has been estimated that about 1128 lacs tonnes slurry has been produced. Slurry having density 1.745 metric tonnes per cubic meter weighing 182 lacs tons and 104 lacs cubic meter in volume is thrown in form of dumps which has degraded the 82.69 hectare prime land since 2001.

CONCLUSIONS

After analyzing the results of the analysis it can be concluded that the kota stone industry is producing imbalance in the ecosystem. The environmental impact is significant.

Restoration of environmental damage is an utmost urgent requirement of the hour. Hence land degradation is increasing in surrounding of town Ramganj Mandi and other places like Kumbhkot, Julmi, Chechat, Udapura, Sandpur, Kudayala, Satalkheri, Pipakheri, Laxmipura, AranyaKhurd, Suket, Payali, Surera, Bansya Heri, Kukada and many small villages. All wastes of quarries are being disposed off in open places.

Kota city is facing the problem of disposal of kota stone slurry being generated by processing units established in industrial area. Slurry is being dumped in and along natural nallahs and manmade open storm drains. Depths of nallahs are decreasing day by day. The depth of nallah running along road number 5 of Indra Prastha Industrial Area is decreasing 1 foot per year. A day would come when depth of these nallahs will become zero. The area will become a flood prone zone.

Total mass of mine waste, dressing kota stone blocks waste generated in mines and splitting waste, dressing waste, edge cutting waste and polishing waste produced in processing industries of kota stone is about 51779 thousand tons and the volume of that stands 258.895 lacs cubic meter. Approximately 1108 lacs cubic meter overburden waste has generated. Hence total volume of mining process waste and overburden waste is 1367.565 lacs cubic meter. Only one third quantity of waste generated is being filled back in mined out pits. About two third balance quantity that is 925 lacs cubic meter waste has been throwing in form of dumps covering 733 hectare prime land since 2001. Approximately 417 hectare land has been mined out and overall 1150 hectare land has been lost due to production of the stone in last 13 years since most of miners are given small lease areas ranging from 4 hectare to 25 hectare land area where side by side land reclamation is not possible. Severity of problem can be understood in term of area of degraded land that is 1.172 hectare land for production of one ton kota stone. Such huge waste, on an average more than 90 hectare land of different usage is degrading every year and converting it into the waste land.

Solid stone slurry generated by stone cutting and polishing industries situated at Kota city and Ramganj Mandi tehsil is being disposed off through spreading over the valuable land. Native vegetation is being covered with the slurry disposed of by these industries and about 6.361 hectare land is also being degraded every year due to disposal of the slurry.

REFERENCES

1. Ashutosh Vyas, Archana Pancholi (October- December 2009), a paper "Environmental degradation due to mining in south Rajasthan: A Case study of Nimbahera, Chittorgarh" published in Journal of Environmental Research and Development vol.4, No.2.
2. Bhattacharya B.C.: September 18, 2002 "Possible utilization of waste stone waste powder/slurry- a case study" Seminar on gainful utilization of stone waste slurry in various construction activities; UCCI, Udaipur on line.
3. District Environment Atlas (from environmental considerations) DEA Report with maps on line "Kota & Baran District 2009.pdf".
4. Eco-friendly Mining Guide line, Government of Rajasthan (2010) on line.
5. Hussain, Akhtar (2014) w.w.w.slideshare.net "Kota stone mining – environmental issues."