

ECOLOGICAL RESTORATION AT KUDREMUKH

Ar. Lavanya Vikram

Associate Professor, Ramaiah Institute of Technology, MSR Nagar, Bangalore-560054

Abstract: Kudremukh National Park is located in the Dakshina Kannada and Chikmagalur districts of state Karnataka, India. It is the second largest protected area in the tropical wet evergreen-type of forest of the Western Ghats. Kudremukh is also known to be one of the largest repositories of iron ore mine in the world. Kudremukh Iron Ore Company Ltd (KIOCL) was given a mining lease of 25 years from 1976 and had extended its closure till 2005. The issues are well related to these 30 years of mining which has led to biodiversity threat, polluted rivers in case of Bhadra river, agricultural fields are affected with iron tailings, landslides due to extensive excavations. With extensive human intervention in the core area the wildlife corridor has been affected leading to the extinction of wildlife. The proposal aims at ecologically restoring the Kudremukh mined site. Various restoration methods dividing the mining area into phases for their restoration and suggesting appropriate policies and design guidelines.

Keywords: Biodiversity, Ecological restoration, Environment Impact Analysis.

Introduction to Kudremukh:

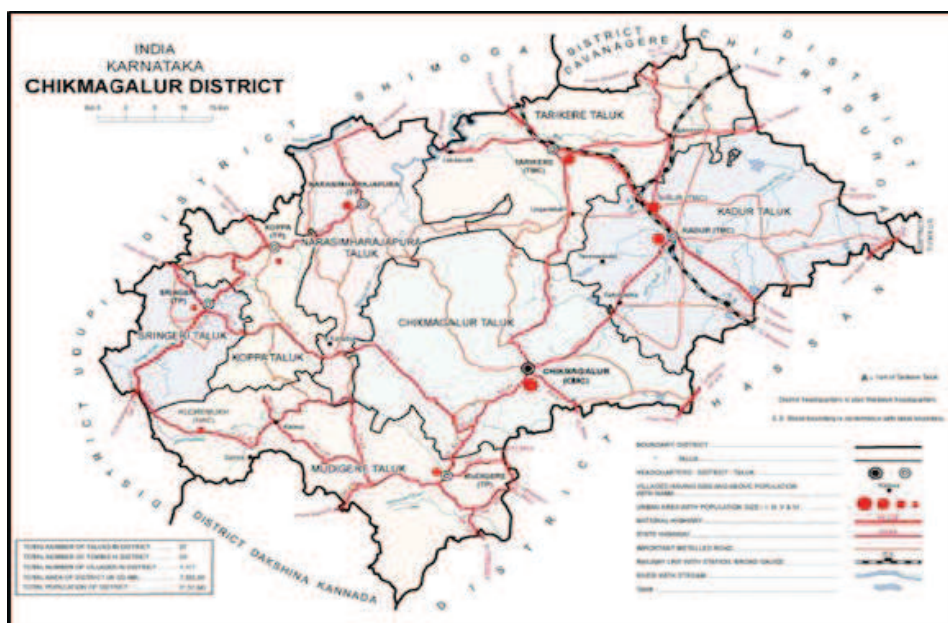


Figure 1: Chikmagalur District map

Source: <http://censusindia.gov.in/2011census/CHIKMAGALUR.pdf>

Chikmagalur district is one of the 19 districts of Karnataka in India. An area of approximately 7201 Sq.Km. with a population of 11,37,753 and density of population is 158 per sqkm. The main spoken language in the district is kannada and the literacy rate is 79.24%.(Census 2011). District is divided into seven Taluks - Chikmagalur, Mudigere, Sringeri, Koppa, Tarikere, Narasimharajapura and Kadur taluks. Natural divisions are the highest point in the district that is the Mulliangiri hills which is 1926.7 msl, secondly the Kudremukh signifying 'Horse face' mountain -1895.6 msl high and Baba Budangiri which is at an altitude of 1895.3 msl. The important rivers are the twin streams Tunga and Bhadra, the latter running most of its course in the district. Both rivers rises at Gangamoola on the Varaha Parvatha, at an

elevation of 1198msl in Sringeri taluk. The length of Bhadra river in this district is 32km. Whereafter the rivers combine in Shimoga district and is called the Tungabhadra. (Gazetteer of India, 1971).

Kudremukh National Park (KNP): Kudremukh region had been declared as a Reserve Forest in 1916 by the British Government in order to check the rampant destruction of forests by slash and burn cultivation practices interiors of the Western Ghats. Dr. Ullas Karanth an environmentalist and tiger expert prepared a conservation plan for survival of wild population of Lion- tailed Macaques in the region, delineating the present national park area as a proposed nature reserve. Government of Karnataka, in turn, issued the first notification of the Kudremukh National Park, in 1987, declaring the Reserved Forests as a National Park. KNP is the largest declared protected area of tropical wet evergreen forests in Karnataka. It is one among the world's 34 biodiversity hotspots identified for the conservation of biotic wealth. Kudremukh National Park also comes under the Global Tiger Conservation Priority-I, under the format developed jointly by Wildlife Conservation Society (WCS) and World-Wide Fund USA (WWF). The Park is also a recognized hill station,-rich in iron-ore deposits.

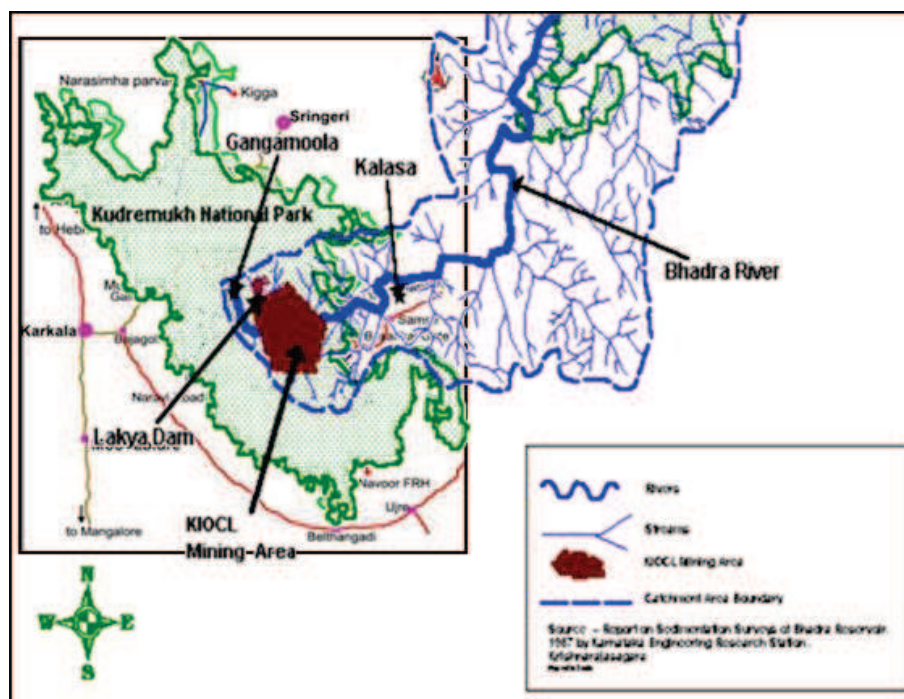


Figure 2: Karnataka Forest Department- Management Plan for Kudremukh National Park 2003- 2013



Figure 3: Laksha Dam and Reservoir During Mining

The Park stretching over an area of about 600.38 sq. km is located between 75° 01' 75° 25' E longitude and 13° 01' - 13° 29' N latitude, at the tri-junction of Udupi, Dakshina Kannada and Chikmagalur districts of Karnataka State. Its mountainous topography is, characteristically, with a central ridge running North-South through the Park. Altitude varies from range 100 to 1890 m with an average elevation of about 600 m, the highest point being the Kudremukh Peak of the Park.

Introduction to Mining Area: Kudremukh: Kudremukh Iron Ore Company Ltd (KIOCL) Incorporated on April 2, 1976 is a Government of India enterprise having its head office in Bangalore. Kudremukh is known to be one of the largest iron ore mine in the world. The initial period of 25 years and was supposed to be closed by Dec 2001 which eventually got completely stopped in Dec 2005. Now, the plant runs on ores supplied by National Mineral Development Corporation Ltd. (NMDC). **Lakhya Dam:** Major problems faced by KIOCL are the disposal of waste tailings. Lakya Hole was selected for the tailing pond. It had a catchment area of 20 SqKm. with a stream of 840 m that joins the Bhadra at 780 m. elevation. The length of the dam is 7 Km.



Figure 4: Lakhya Dam and Reservoir: 2013 (Authors Own)

with a width of 10-20m. Dam status as on 2013: silt deposits (20%iron). Water used for Mangalore pellet plant spillway connected to Kunya hole. Conclusion: Admitting that the mining has caused pollution, they say it has been able to keep the level of pollution to the minimum. They have to be either disposed off or permanently stored to prevent them from being carried off into the river by rainwater. The Lakya dam has submerged 604 ha of shola forests (7 Sqkm). The unfortunate havocs which took place accidentally in 1992 and 2000, will definitely take decades together to revive and is irreplaceable. Since only 30% of minerals are found in the soil and the rest is waste it is uneconomical to be mined at the cost of Biodiversity loss. Sand silt in the Lakya dam can have an adaptively reused for concrete roads eg: IISC has tested the sand to be used as building material.

Features	PCD-I	PCD-II
Catchment area	3.0 SqKm.	1.33 SqKm
Reservoir capacity	3 lakh m ³	1.4 lakh m ³
Type	Rock fill with concrete spill way	Rock fill with concrete spill way
Max. flood inflow	57 m ³ /sec	25 m ³ / sec
Max. length	100m	160m

Features	PCD-I	PCD-II
Max. height	11 m	18 m
Max. base width	50 m	69 m
Top width	6.5m	5m
Side slope	1.5 : 1	1.5 : 1
Time of construction	4 months	8 months

Pollution Control Dam(PCD)I & II:



Figure 5: Overflow to Bhadra at 781.0 lvl.
(Photo: Authors own)



Figure 6: Mines runoff reservoir
(Photo: Authors own)

In Mining Operation Area, the mines runoff water accumulates and during the rainy season from June to September a huge quantity of mine runoff flows down from the mined area to the valleys. PCD I & II are the permanent solution taken up. Development of diversion channel of 1200m of Kudremukh Hole to river Bhadra for maintaining independent flow. Conclusion: Pollution Control Dams are good solution to trap the silt before entering the stream. Care should be taken to assess the water quality during monsoon. Dam should be well maintained without any cracks to prevent further deterioration of the river. These dams would not be the permanent solution for the water pollution caused to Bhadra river.



Figure 7: Original Site, Survey of India, 1954

Impact on Bhadra River: Impact of open-cast mining are very severe; the magnitudes of post-disturbance sediment levels are higher compared to other land-use changes such as deforestation, agricultural intensification, road building and Urbanisation. Restoration of the mined out area such as slopes can be stabilized and vegetation re-established can minimize the sedimentation discharge.

Impact on Forest:

Perennial Streams				
1	North streams	Water course originates	Lakya Hole	Dam built, used as iron tailing pond
2		900-950m altitude	Kunya Hole	Flows towards south and joins Bhadra
			Sitabhumi Hole	Used for drinking in Township area
3	South streams	Ouriginates from Kudremukh	Kachige hole	The ore is bound between the two streams
4		Hill range 1050-1150m high	Kudremukh Hole	Diversion of Kudremukh Hole

Kudremukh - World's largest iron ore deposits which were identified in 1913 by Sampath Iyenger of the Department of Mines & Geology of erstwhile Mysore State. Ore Deposit -362 million tons of mineable weathered ore in Airoli range for an area of 4605 ha. of forest land. Private land acquired -108 ha was leased initially to NMDC in the year 1969 and Kudremukh Iron Ore Company Limited was established in the year 1970. Actual mined land was 500 ha of the area. Lease period- 30 yrs. till Dec 2005.

In the process of establishing the unit entire fabric got modified, huge township of about 1900 permanent houses, massive administrative offices, labour colonies, school, factory, Lakya reservoir etc. Mining operations were preceded by extensive forest clearance for roads, electric lines, town ship, reservoir and so on using a large fleet of vehicles and a herd of elephants. Meeting the dead line dates was considered more important than anything else. Mining operations were planned and carried without any regard to the ecology of the region.



Figure 8: Mining activities in Kudremukh in 2001



Figure 9: Shola forest in Kudremukh Biodiversity Hotspot Before Mining Took Place

Impact on Wildlife: Mining affects the environment and associated biota through the removal of vegetation and topsoil, the displacement of fauna, through release of pollutants, and the generation of noise.

Habitat loss: The impacts stem primarily from disturbing, removing, and redistributing the land surface. Some impacts are short-term and confined to the mine site; others may have far reaching, long-term effects. Predators are reduced by the disappearance of these land and water species. Disturbance in the corridors affects the wildlife for the movement and breeding habits thus resulting in extinction of the wildlife species.

Conclusion: Stitching the lost fabric of biodiversity due to mining activities. The nature of Shola forest has a very high degree of endemism. Due to high altitude the soil is infertile and greatly depend upon Biomass. External disturbance to Shola forest has compounding effect on its fauna. If these animals are lost forever, then such trees are biologically dead. Restoration of the mined-out area can be done through slope stabilization and vegetation re-establishment which in turn will reduce sediment discharge as well as provide habitat for wildlife. The re-establishment of the original Shola grassland system after so many years will be very challenging and also would be a long-term goal.

Socio – Economic Impact: Formation of KIOCL (Kudremukh Iron Ore Company Ltd.). During 1977 land acquisition from the neighbouring villages took place. A compensation of 7-member family was one job, 2 acres of agricultural land with a 1BHK house with AC sheet roofing was provided by the KIOCL. The land purchased was Rs 4000.00 per acre by the villagers. The source of drinking water for the villagers was the Jamble Hole (tributary of Bhadra River). 63 families housed in Jamble village with a population of 300, 6-7 Km from the mining land. KIOCL improved the infrastructure like Roads, schools, Hospitals, banks, bus services etc.

Conclusion: Socio Economic Survey: In 1976 all villagers residing in Kudremukh was given no choice but to surrender. People were happy that infrastructure would improve for their next generation. If Government co-operates in providing the basic amenities to villages encroachment can be controlled to a major extent.

Present Issues: till 2013, retired employees are residing in these houses. No man power available for agriculture works. No buyers for the land due to the remoteness and Kudremukh is considered to be a dead city. People are left with no choice but to stay in Jamble.



Figure 10: Socio-Economic Survey, 2013

Design Proposal: Mine Drainage: The area of mining is bound by two major streams Kachige Hole and Kudremukh Hole. The streams flow from south to north and meets river Bhadra. The mine's runoff water accumulates during June to September. Huge quantity of mine's runoff water flows down to the valleys. The extreme Eastern end is a ridge which is retained, acts as a natural barrier against Kudremukh Hole. Kudremukh Hole has been diverted 1200 mt. long excavated channel taking off at 790.0m to meet river Bhadra at 773.0m. Ore Deposits was not covered with any overburden in the form of soil or rock. So, there is no removal of overburden or stripping. The road networks of 10m wide along the contours for the pre- production vehicular movement. Conclusion: The restoration of the mined area can be done in zones. Phase wise restoration would result in better outcomes and would be easier to monitor.

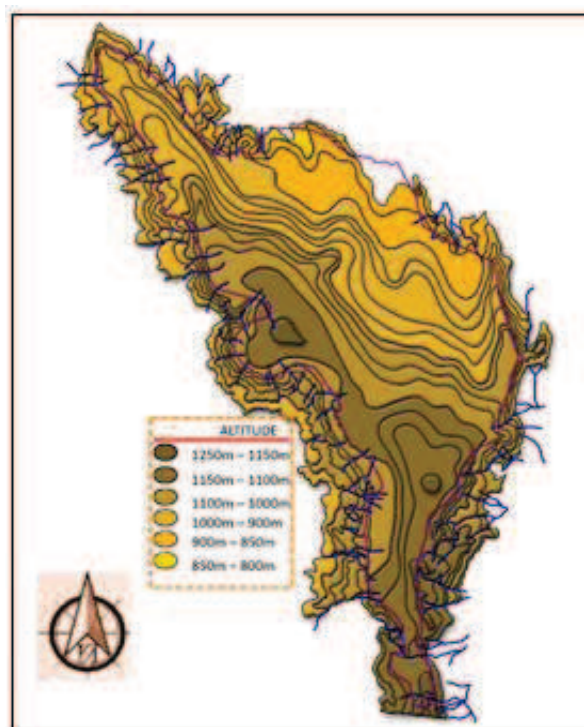
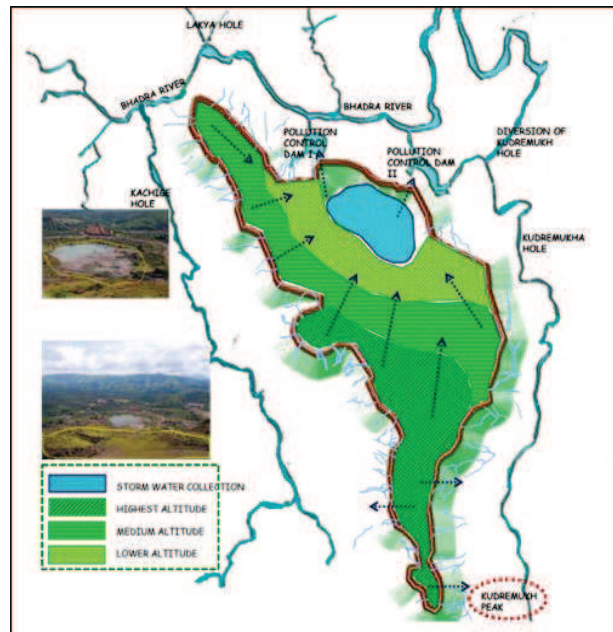


Figure 11: Slope and Drainage Analysis (Author's Own)

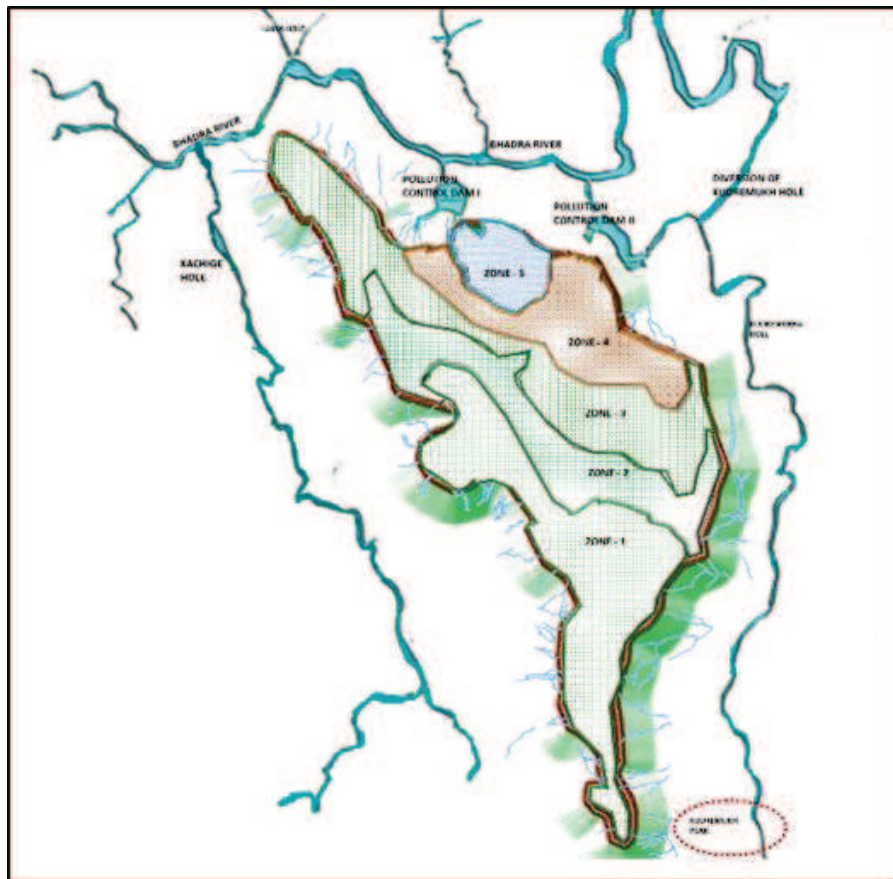


Figure 12: Restoration of Kudremukh, Design Proposal (Author's own)

Design Proposal and Guidelines: As Kudremukh National Park is a rich repository of biodiversity and has significant populations of many endangered and globally significant fauna the Keystone Species Lion Tailed Macaque, Great Hornbill and the Tiger and Elephants. A multi-disciplinary team should be empowered to oversee the restoration of the mined-out area. The slopes can be stabilized. Vegetation re-established which will reduce sediment discharge as well as provide habitat for wildlife.

Zone – 1 & Zone – 2: Altitude 1200 m – 1100 m MSL. Ecological Issues: Soil erosion which accentuates the impact of siltation. Stabilization of broken soil of the mined area. Lack of the vegetation of endangered native species of KNP Region. Due to the disturbance in the ecosystems and broken soil structure. There is direct impact on Flora and Fauna of the Region. Objectives of Zone 1 and Zone 2 is to introduce the forest eco- system. No Human Intervention Zone. Stabilization of Slope by appropriate measures like Green Cover, Check Bunds, Chutes for Storm Water Drains.

Zone – 3: Altitude 1100 m -900 m MSL. Ecological Issues: Soil Erosion which accentuates the impact of siltation. Excess of siltation in Zone - 5. Stabilization of broken soil in the mined area. Lack of the vegetation of endangered native species of KNP Region. **Mitigation:** Formation of terraces at every 20 m level. Avoiding storm water runoff along the slope by diverting the drainage. Conservation of soil. Afforestation with 3 forest layers- middle storey, under storey and forest cover. Partly on eastern side of zone 3 can be used as trekking path.

Zone – 4: Altitude 900 m – 850 m MSL. Ecological Issues: Soil Erosion which accentuates the impact of siltation. Excess of siltation in Pollution Control Dam I and II. Fact that the Dams are connected to Bhadra River. Stabilization of broken soil of the mined area. Lack of the vegetation of endangered native species of KNP Region. **Mitigation:** Proposal of ECO PARK in Zone – 4, Venturing into an Eco Park can act as a strong financial support. Government can maintain all the zones for another 20 years. Some of

the existing road networks used. Close proximity of State Highway to Zone -4. Avoiding storm water runoff along the slope by diverting the drainage pipe to the pollution control dam. Storm water fed to Pollution control dams. Conservation of soil measures. Native species are considered keeping aesthetic value in mind.

Zone 5: Altitude 875 m – 850 m MSL. According to the Slope Analysis Zone 5 is the lowest level in the Mined Site Area. Heavy amount of siltation takes place due to un-stabilized slope. The overflow will lead to PCD-1 and 2. **Mitigation:** To create an aquatic eco- system. Utilizing the natural slope of the contours. Proposal to create water body for Eco Park. Encourage eco-water sports. Proper surface drainage at all the Zones.

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