

Environment Planning Approach for Mining Wastelands: A Review of Case Studies

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Abstract

The case of mining land use typology post-independence planning has to be done with the consideration of ecological or landscape factors which could be the foundation for their approved post-mining closure plans. This paper reviews two such case studies on the mining activity carried out for more than 25 years. Kudremukh Iron Ore Corporation Limited (KIOCL) and Neyveli Lignite Corporation Ltd. (NLC) are the two companies in South India, led by the Central Government for the identified mineral extraction. KIOCL had to come to a complete halt in the year 2005 whereas NLC is an ongoing mining site. This review paper studies the environment planning approaches at global, national, and state levels in both cases. The paper tries to identify the gap in the planning approach considering landscape factors that can be imperative for achieving sustainable development goals from the critical review of case studies in India.



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Environment Planning;
Landscape Planning;
Mining Closure Plans;
Mining Wastelands;
Reclamation Methods.


Abbreviations

1. WCED - World Commission on environment and development, Brundtland Commission
2. UNCED - UN conference on environment and development Earth Summit
3. MDG - Millenium Development goals
4. SDG - Sustainable Development Goals
5. EPA - The Environment (Protection) Act
6. KIOCL - Kudremukh Iron Ore Corporation Limited
7. NLC - Neyveli Lignite Corporation Ltd.

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Introduction

For ages, mining is known for its development and economic growth for any country. As the requirement has increased the search, extraction, and sharing of mineral resources has been common. From the point when a company identifies the mineral on the site area, the planning of the extraction in a systematic way has been encouraged by the government and the other supporting authorities. The permission for the extraction, environment management plan, environmental impact assessment, mining closure plans, and financial management are all explained in

detail with maps, figures, and tables, by the mining owner taking the support of respected agencies to conduct the surveys and get data from the authorities. This review paper aims to understand the planning parameters (environmental/ Land use) from the below case studies.¹ The paper tries to find the gap in the system from the stage of planning till the implementation process. The cause for the success and failure of the mine closure can lead to the occurrence of mining wasteland which leads to a damaging footprint and impact on the ecology and environment.

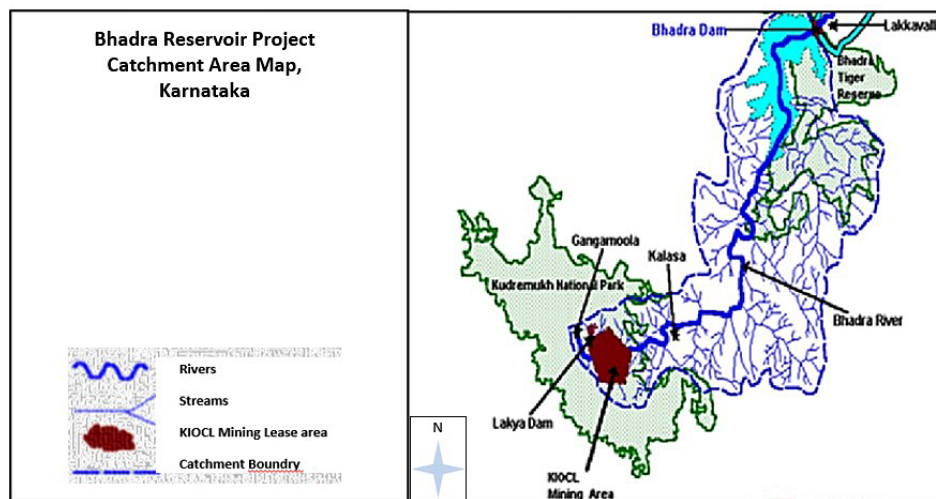


Fig. 1: Management Plan for Kudremukh National Park (2003-2013)
Source: Karnataka Forest Department

Case Study 1

Background

Kudremukh is a region well known for Kudremukh National Park and KIOCL in the state of Karnataka, India. The region with latitude 13°01'00" to 13°29'17" N and longitude 75°00'55" to 75°25'00" E is the second largest wildlife-protected area in the Western Ghats (Tropical Wet Evergreen Forest of India). Western ghats is one of the thirty biodiversity hotspots identified for conservation in the world. Kudremukh is spread between Chikmagalur, Udupi, Dakshina Kannada, Shimoga, districts. It is rich in its biodiversity and culture. The place is also the origin of 3 rivers Tunga, Bhadra and Nethravati, rich cultural heritage, and the highest combination of ecosystems. The presence of iron ore was identified in the early 20th century but the

serious attempt was in the year after 1960. In 1972 the KIOCL got permission for mining, by 1980 they managed to enter the global market by exporting 82% of the ore outside India and only 18% used by the country. KIOCL which was a profit making company until 1996, has been brought to an end for its several uncertainties like environment, ecology, sustainability, national park status, etc.

Following are the review on environment planning approaches carried out by the company:

The KIOCL lease period was to end by 1999 and laterally the interaction in the global market about ecology, environment, and capitalism became the highlight of this mining company. The company was accused for violating the environmental norms,

displacement of the culture and disturbing the social life. The Environment (Protection) Act 1986 (EPA) brought major changes to the companies violating the law. The EPA, a government body declared Kudremukh a 'National Park' and reserved forest. This meant that KIOCL was creating problems on environmental issues. This led to the rehabilitation of the tribals which was forcible eviction when the mining was functioning. The state was trying to shift the tribal at the periphery in the name of national parks.

The issue was the major ecological disaster that the mining industry had created with rivers and biodiversity as seen in Figure 1. Kudremukh which is known for its Shola Forest got affected with irrigation and also forcibly changed the cultural practices of people. Any place will have its own identity and cultural practices, civilization and lifestyle along the river system. There is around 8300 Ha of agricultural and farming land in Kudremukh. Large number of people opposed to the mining and its extension of KIOCL activity. Many anti-mining movement against Kudremukh was established like "Tunga Ulisi" (Save Tunga), Save Western Ghats, Uttar Kannada Ulisi Andolana and the district was known for its forest, agriculture and fisheries were the major institutions to oppose the mining activity.²

Literature Study

Jagdish Krishnaswamy and his team conducted an observation in Kudremukh during the monsoons in the year 2002. The assessment was made on the activities of mining and its impact on Bhadra river. The sediment loading in early 1984 was 1197 tons which increased drastically to 49,429 tons in 1986. In the year 2002, nearly 68000 tons of sediment discharge was calculated during the monsoons into the Bhadra river. The recommendation after monitoring the event during the monsoons was to stop mining activity at Kudremukh. Watershed characterization was based on the topography, land use, and rainfall data were marked as an important factors for the collection of sediments in Bhadra river. Onsite surveys along with Geographical Information System (GIS) and Remote Sensing (RS) techniques were integrated for this purpose. Recommendations were to take up a restoration project to stabilize the soil, reduce erosion and sedimentation to the river stream and establish the vegetative cover in the mining areas.³

Prof. K Ullas Karanth a conservation scientist and director of the Center for wildlife studies, Bangalore observes that the Supreme Court (2002) orders the KIOCL company to shut down the mines by 2005. This project was the debate between development Vs conservation where it argues on economic growth and social equity with a major undermine of environmental sustainability. Professor in this article notes 3 major case analysis for the mining activity to come to a halt immediately:

- i) The ignored fact that Kudremukh was the largest biodiversity-rich area of the tropical rainforest with a rainfall of 7000mm per year. The ecological factors like rainfall, biodiversity, steep slope, and high altitude to select such a site for mining activity were not considered.
- ii) Second issue ignored was the impact on the ancillary activities like highways to Mangalore, there were several other roads which was carved out into the wilderness opening avenues for illegal hunting and undesirable human impacts.
- iii) The company KIOCL and Forest Department's greening had not met the Shola forest ecosystem's requirement and had further led to the expansion of the road network.

There are many stakeholders social and political parties were affected due to mining, like KIOCL employees, local dependencies in Kudremukh, business associates in Mangalore port workers, foreign collaborators, local collaborators, government departments like Mangalore, Chikmagalur, and Bangalore where the company existed, farmers near the Bhadra river were affected, State Forest Department to force the conservation laws and policies for promoting people living within the National Park, priority for wildlife conservation of plants and animals who is bearing the impact of mining activity.

In addition, the KIOCL had established a 100% export-oriented sector and had made a record on sales and profit. The mining would open avenues on devastating drilling, excavating, blasting, and subsequent palletization, the tailings are composed of silica and water. The mine waste product and heavy metals settled at the bottom in Lakhya dam. KIOCL implements several measures to lower the

inflicting damage caused to the environment and community. A quarter of the capital profit was spent on the mitigation to minimize the noise and dust level, afforestation was carried out to replace lost green cover and CSR activity for the development of the nearby villages.

KIOCL from 70's to 2002 there were many regulatory charges imposed on the company in the order of: The Wildlife (Protection) Act, 1972 declared Kudremukh as Kudremukh National Park in 2001 and that the mining activity was a direct stress on the ecosystem. The Forest (Conservation) Act, 1980, the land under the custody of the central government were ordered to stop the mining activity. The Environmental (Protection) Act, 1986 came down heavily on the companies that violate the letter of law across the country. The supreme court has ordered to apply green business strategy and take up certain initiatives by KIOCL:

1. Increase palletisation activity so that it would initiate green practices.
2. The Lakya Dam have the potential of producing clay tiles and charge a premium on the same.
3. According to the stakeholders and green activists along with the local population, the Kudremukh area should be developed into a pilgrimage and eco-tourism centre that could boost the local economy.
4. KIOCL should have a master plan of free greening the entire area to ensure that the plant hierarchy chosen for the region's ecosystem should match the Shola ecosystem, seek the government's initiative and set a timeline for this process.
5. Convert the entire mining area into a business opportunity and have a strategic plan for mining companies with similar situations worldwide.

When KIOCL started in 1967 none of the above three agencies at that time was established it was only later that Green bench of the Supreme Court had to take up a decision combining all the three above government bodies.

In this case, as mentioned by Rajiv Motwani, Kudremukh National Park had significant

environmental changes since 1960. The main reason for KIOCL to be established was to bring foreign financial support into the country during the 1980's. But due to liberalization, this was not a major consideration in the 1990s. There was an end to the license era due to liberalization and privatization, hence KIOCL impact was lobbying with the government. Loss incurred was 75 million annually which did not consider environmental and intangible losses like license water productivity efficiency irrigation power by the year 2000. The irrigation, power, and drinking water supply in this region were all affected with the activities of KIOCL. In the past 20 years forest cover has been reduced as the open cast mining is irreplaceable damage causing loss of biodiversity, natural grasslands, and water bodies. Kudremukh had adapted to only little changes regarding the environmental board and the Green Bench that was constituted by the Supreme Court. Lakhya dam height was increased illegally in 1994 which caused to the submersion of 340Ha of dense forest area.⁴

Prof. V K Sridhar speaks on a case referred by Central Empowered Committee CEC for hearing to both parties. Mining in national parks and sanctuaries is a fight between ecology and development where a balance need to be maintained for future generations. Final judgment from the Supreme Court and recommendation made by CEC that Kudremukh mining be closed by 2005.⁵

Mines and Minerals Regulation and Development Act 1957 (MMDR Act) The National Mineral Exploration Trust (NMET), objective to support mine exploration in our country is the leaseholders to contribute 2% of the royalty to NMET. MMDR 2015 notified five Central Public Sector Undertakings (PSU's) to conduct the prospecting operations. The notified central government PSU's are Rashtriya Ispat Nigam Limited - RINL, Steel Authority of India Limited -SAIL, National Mineral Development Corporation Limited -NMDC, Kudremukh Iron Ore Company Limited -KIOCL, Manganese Ore India Limited-MOIL. Central Government ordered these PSU to carry out the prospecting mining exploration without receiving the prospecting license. The state government receives 100% royalty from the mineral companies for which they have to return more than 45% to the central government.⁶

CASE STUDY 2

Background: Neyveli Lignite Corporation (NLC) is situated at latitude 11°32'25.93" N and longitude 79°28'43.77" E having the nearest Highway and railway station within 10 km in the area, there are few river and water bodies which has been diverted in the remote region. The region is not near to any ecologically sensitive zone, national parks and wildlife sanctuaries, coastal regulation zone, historical temples and heritage sites or any other industrial establishment. NLC is a Navratna company, (Government of India under Indian Companies Act 1956). The company exploits lignite deposits from the Neyveli region. This is an open cast mining where the overburden thickness is 45 m to 210 m, has to be removed as pay waste. The total mine project area is 7193.9 hectares. The mining project operates a unit that supplies lignite to thermal power station. The overburden consisting silica and ball clay has its demand and in the production of glass-making and ceramic materials. This would add to the royalty and taxes of the state as well as the central government.⁷ The proposal has been essentially sustainable in value of the raw materials being reused and would not go waste.

Environmental Setting

The Paravanar river channel has been diverted stage-wise away from the mine area along with the existing infrastructures like physical buildings having regulatory standards, connectivity and roads from the residential and commercial areas, water supply infrastructure and drainage systems, Generation, transmission and supply of power, etc. Soil classification has been managed well,

considering the top layer of soil the laterite loam and blackish grey alluvial soil which are segregated for the rejuvenation of soil post-mining. The land requirement for the lignite mining site is 7193.9 hectare which includes the mining area, the dumping area, over burden and infrastructure area. The overburden dumps would be converted into forests as part of the mine reclamation process, following approved closure plans.

Details on Sustainable Mining Method

For the mine II and mine II expansion - bucket wheel excavators, conveyors, spreaders are deployed for the clearance of overburden in mine excavated land as shown in Figure 2. The extracted lignite is then transported by the conveyor system to the stock yard, while the overburden is filled back in the mined area. The topsoil is spread on the land for reclamation to restore it to the pre-mining condition by typically growing a forest. As shown in figure 3 and figure 4 in the restoration process, terracing or benches created in the mining excavated areas and stabilizing the soil has to take place, top soil is spread over for afforestation on the overburden. The integrated farming methods and aquaculture are being carried out in the afforestation land artificial rainwater harvesting ponds, parks, boat houses and other recreational facilities are established as shown in Figure 5. Drainage systems are systematically laid out in Neyveli mining area check walls, gully chute, edge bund, retaining walls, silt trap, etc. Along the road, drainage is provided with a feasible slope to avoid stagnation of the water. Wastewater is treated and is used for irrigation and gardening.



Fig. 2: Panoramic view of the NLCL Site during the extraction of lignite



Fig. 3: Slope Stabilization with 5 benches

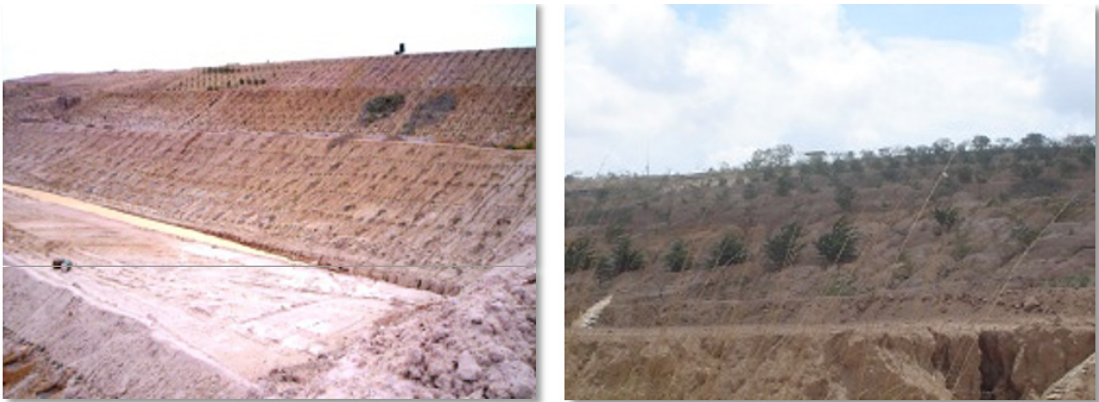


Fig. 4: Preparing the benches for Plantation
Source: Author (Site Photos- Neyveli, Tamilnadu)

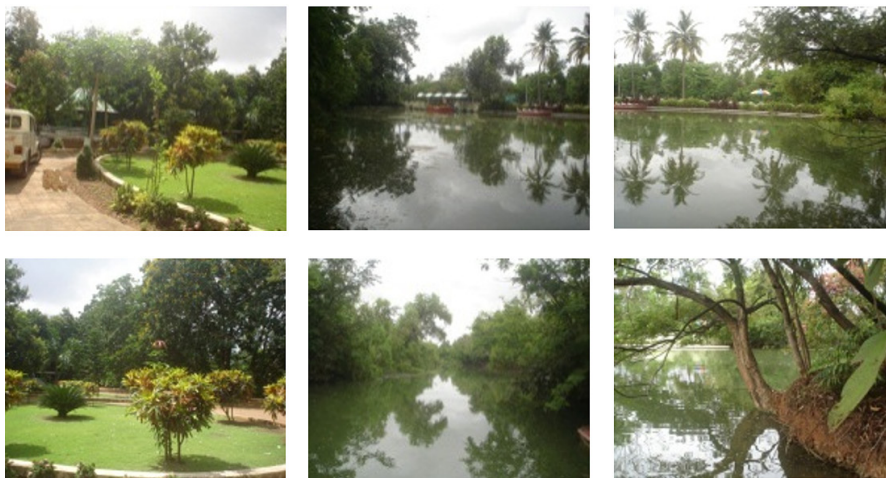


Fig. 5: Post-mining reclaimed land, Neyveli, Tamilnadu
Source: Author (Site Photos- Neyveli, Tamilnadu)

The liquid waste categorised as hazardous waste generated from the oils, lubricants, and engine oils, are all stored separately in drums and given to authorized recyclers. To control air pollution, sprinklers are used to control the dust from the mining operation. Noise pollution control is mitigated with specialized machinery, which is used for overburden and lignite excavation. The noise levels are well within the permitted limit of 60 to 90 decibels. The operators of these machinery are given air-conditioned cabins making it noise proof, there is no risk of vibration being transmitted to the built structure.⁸ The sewage generated from the offices is directed to septic tank or soak pit, there are effluent treatment plant (ETP's) for the sewage generated from the colony. The best practices adopted by NLCL there were no adverse effect on the environment. Many employment opportunities for the mining affected families and villagers these are through direct or indirect employment facilities, there are many service providers contract hiring vehicles etc. Transporters, traders were provided with employment opportunities and business opportunities for the glass and manufacturing ceramic industries.⁹

Mine Closure Plans

Progressive mine closure implementing plan would be laid out continuously and phase-wise reclamation takes place along with the mining activity. Ongoing mining shall begin and is prepared once in 5 years from the date of the mining operations. The active mining site is examined once in 5 years from a third-party agency as appointed by the central government. Mine closure activities would begin at the final stage of the mine life and continue to reclaim even after the reserves are exhausted till the mining area has been aligned and reclaimed to an acceptable level.¹⁰ The land should be restored to its original condition as much as possible after mining. Mining should be carried out in a phase manner along with reclamation or afforestation work in the mined-out areas. The project specific activities like the mined out land there are technical and biological restoration plan, water quality management, infrastructure that has to be retained and demolished, and mining machinery has to be disposed of to specific agency. If backfilling of the mine void has to be part of the mining operations this cannot be included in the mine closure plans. But

if the filling of the void is part of the mining closure, then it has to be included in the post mining plans for the closure. There might be certain requirement that has to be included for the mine closure and it could be suggested by the government for conservation and safety of the environment and the surrounding place.¹¹

Finances for closure plans: The mining plan and closure plans are updated regularly and a detailed cost estimates for various activities along with the budget cost is submitted to the authority for approval, 5 years before the final closure of the mine. An Escrow account has to be maintained where the mine owners are depositing their annual amount. Failing which the government can take strict action with penalties and enforce actions of withdrawing the permission. The funds are allocated for in case the owner fails to complete relevant closure activities. The account is intended to ensure the reclamation and rehabilitation work which can gain a closure certificate to the owner following the approved mining plan covering the recontouring, revegetation, and water management like closure activities, the mine owner surrenders the reclaimed land to the state government.¹²

Professor Atun Roy explains that the oldest mine closure technique was called bibliometric mapping. This paper explains the safety and environmental issues and discusses on the legal framework for the closure of the mining activity. The objective is to know the technological advancements intended for development of the closure of mine planning system in Quantum GIS (QGIS). Other technical aspects of mine closure plan are dealing with pit slopes, hydrology, and closer to the mining entries, and decommissioning of the infrastructure. Redeployment of workforce, minimize community and socio-economic risks are few social impacts on mine closure. There is certain cost involved in the closure of the mining activities: activities related to closure, organisational cost for execution of activities, post project monitoring cost, maintenance and insurance cost. Usage of DEMs, QGIS, and analysis tools for generating the contour and 3D Terrain map. The drainage pattern adopted by the NLC is a temporary solution of pressure removal, the system which the other has tried to adopt is the GIS based technique which identifies the relief,

pressure and drainage flow in the region. It gives the solution for the bursting of the mine floor and submerging the mineral floor could be one reason for the closure of mine.¹³

Environmental Planning Approach

Background: Urban planners around the world are crucial players to ensure the functioning of the urban areas sustainably. Since the resources are overexploited and can lead to social instability addressing the issues like environment, severe health hazards, loss that affects the ecosystem and biodiversity with poor quality of life. To overcome this United Nations (UN) recognises to conduct a conference of planning commission on Urban Planning and development.

International: The following events took place in the 1972 Stockholm, conference on human environment, in 1987 WCED, Brundtland Commission, in 1992 Conference on Earth Summit, in 1992 declaration on 25 Principles of Rio, in 2000 implementing 8 MDG- the Millenium goals, in 2015 the SDG goals

The UN conference highlights are to safeguard and maintain the natural and renewable resources. Non-renewable resources cannot be replenished and cannot be exhausted. Pollution should be kept within the optimum limit, development to take place with necessary precautions to safeguard the environment and other natural resources. The WCED, Brundtland Commission 1987, defines "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". UNCED Earth Summit- 1992, AGENDA 21, the inclusion of financial support of resources to the developing countries to cover their incremental cost for mitigation and adaptation to reduce the greenhouse gas emissions and the impact of climate change. Agenda 21 discusses on the implementation of the present problems. The Rio Declaration Summit-1992, they have put forth 25 principles of international guidelines and importance in preserving the environment. The Millenium Summit 2000- the summit has discussed 8 sustainable goals and

each country would take up the responsibility to abide by them. Later UN Sustainable Development Goals- 2015 New York was held, and 17 SDGs were discussed.¹

National

Soon after the Bhopal, Madhya Pradesh incident in India, the Government of India enacted an EPA in 1986, the state and central government in coordination with various activities have established the Water Act and Air Act. The objective is to protect the environment and regulate the discharge of pollutants into the air, water, land their inter-relationship with human beings and other creatures living and non-living. The National Conservation Strategy and Policy Statement on Environmental Development, 1992, it helps in laying out the guidelines for environmental consideration into the fabric of development process. Objective highlights the issues, actions, and lists the strategies for implimentation. Next was the Policies Statement for Abatement of Pollution, 1992, this helps in taking decisions at all levels integrating environmental objectives. To achieve this, a detailed list of various levels of management of pollution at the source encourages the implementation of best practices and practical solutions.¹³ The fourth was the National Environment Policy-2006, there are numerous challenges like social, economic, political, cultural and environmental areas in India for the developing society. The multi-dimensional aspects like livelihood security, education, healthcare, empowerment elimination of gender disparities and poverty, all of these are imperative.^{6,14} The Vision Statement on Environment and Health 2002, the focus of the vision document was to come up with a strategy of health risk reduction for the rising environmental pollution that would help the agencies take affective actions. The symposium on environmental health organized by the Ministry of Environment and Forest (MoEF) in 2002 highlights the need to be adhered for public health safety measures. Key purpose of this body was to evolve a strategy and reduce the risk of health.^{15,16}

Table1: Environmental Planning Parameters and its Comparative Study

S. No	Environmental Parameters	Case -1- Kudremukh Iron Ore Mining	Case-2- Neyveli Lignite mining
1	Location	Tropical Wet Evergreen Forest, Chikkamagaluru Dist, Karnataka, India	Dryland with the land almost flat, 18. 0m msl, Cuddlore, Dist Tamilnadu, India
2	Type of Mining	Open Cast Mining- Category A type of projects	Open Cast Mining - Category A type of projects
3	Year of Mining	1969	1956
4	Lease period	30 Years (1999)	20 years, Mine-IIA expansion
5	Area	5218 Ha (48Sqkm)- Category A	7193.9 Ha- Category A
6	Geology Landform/ Topography Soil	Hilly Terrain, Kudremukh-Aarili- Gangamoola Range Mineral-rich soil- High in quality	Dry deciduous almost flat land Alluvial deposits, loam in the upper most layer- High in quality
7	Hydrology Surface Water	Bhadra river, origin of Tunga, Bhadra and Netravathi Rivers- Biodiversity reserve	Nearby River: Parvanar river (2km,N), Manimukta river (4.5 km, SW), Vellar river (8.0 km, S) Nearby Pond/lake: Walaja tank (9.0 km, E), Vriddhachalam anicut, Wellington reservoir, Jambu eri, Perumal eri.
8	Groundwater	-	Low depth near the streams
	CRZ	NIL	NIL
	Precipitation/ Rainfall	7000mm per annum	1200mm per annum
	Wind Km/ Hr Air Quality	- 24-hour operated mining had extraction and transportation of ore	6-13KM/hr SO ₂ - less than 16.6, NO ₂ - Lower than 19.5 all within the CPCB standards.
	Noise	KIOCL took Gyrotory crushers to reduce the noise. Plantation to reduce the noise and dust.	Specialized mining machinery (SME)are used for the over-burden and lignite. The noise levels are maintained 60 to 90 db.
9	Biodiversity Flora/ Fauna	1972 - Declared as Kudremukh National Park- 563 sqkm Savanna forest. National Park- Lion tailed macaque. Critical habitat for wildlife	Dry deciduous- Low
	Agricultural Ecologically	Rice fields and coffee High	- Low

		sensitive Zone		
		National Parks	high	Low
10	Waste management	Solid waste management	Nothing was disposed of in open. Waste oil, grease etc were all treated and reused.	excavator, conveyors, and spreaders for removal of overburden. Sewage generated offices are collected in septic tank and soap pits.
		Over burden	Lakhya dam was built to store the tailing of the mined ore.	45-112m overburden,
		Hazardous waste	Machinery oils are all stocked in drums and is reused for industry purposes.	Used oil, engine oil, brake oil are all separated into cans and drums and is disposed of to authorized recyclers.
11	Reclamation Planning based on Environment Protection Act	Strategic Plan dept. was not able to achieve the lost	Afforestation with forest Agricultural Land, deer park, boat house are established. biodiversity	Restoration to afforested land,
		Landuse	Displaced 32 families from the lease area. Giving financial support	Integrated farming land and aquaculture is being carried out.
		Financial/ Fund	75 million loss and was not able to take up the reclamation. Lack of time.	Escrow Account calculation: as per the GOI for an open cast mining as on 1.4.2019 is estimated. Annually the deposit would be compounded by 5%. Escrow account is released after every 5 years of the closure plan.

Source: Author

Results and Discussions

The issue was the major ecological disaster that the mining industry had created with rivers and biodiversity.¹⁰ the end of lease period in the year 1999 and the company's appeal for extension in this ecologically sensitive zone was a violation of the environmental norms. The identity, the culture, civilization and lifestyle of the place and the nearby villages were lost due to the mining activity. The case papers by Jadish Krishnaswamy and team, Prof. K Ullas Karanth, conservationist, Rajiv Motwani, and V K Sridhar are all highlighting the impact of mining on the environment. The start of mining during the 1960s and later the formation of all the environmental bodies has brought awareness among the stakeholders on biodiversity and environment conservation. The court had to abide with the Regulations and put a stop for the activity

to proceed any further. In the case of Neyveli Lignite corporation, the sustainable method of reclamation is adopted, the pollution levels of air, noise, water are all under the CPCB limit. The solid waste management are as per the Environment Impact Assessment proposed plan. The mine closure plan is carried out during the period of entire mining activity and the third-party agency as appointed from the govt for inspection. The finances for the reclamation process is managed very well in the NLC. The various planning approaches with respect to the UN conference held in Stockholm-1972 has highlighted the method to safeguard and maintain natural and renewable resources. The details of various other summit and conferences which came after the UN Conference like WCED, UNCED, AGENDA21, MDG8, and SDG17, the highlights on environment and mining are noted. At the National

level the year Environment Protection Act 1986 followed by the other Acts have discussed on the issues and mitigation measures for the same. A comparative study on both the case studies have been taken considering the environmental parameters and the company's effort to protect them. The landuse reclamation aspect has highlighted on the forest green covers, green belt areas as buffers, agricultural land and water bodies in the pit, and so forth. The option for the post mining land use could have options like residential, commercial, mixed-use development depending on the context and location of the site and its feasibility report on future use.

Conclusion

The paper identifies the environmental problems and different planning approaches in open-cast mining lands in India. In India the event of the Bhopal gas tragedy in 1984, became a turning point for The Water Act in 1974, The Air Act in 1981, and the EPA in 1986 to form the Indian environmental regulatory framework. This paper uses a critical review of existing literature and policies on open-cast mining in India primarily the case of KIOCL and NLC is undertaken. It is revealed from the study that the following environmental parameters are significant to take up planning decisions in the context of mining lands. These planning parameters include the status of the mining area, geology, hydrology, climate, biodiversity, waste management, reclamation planning and procedure, and financial planning submitted by the mining owners. By

considering the study a systematic planning method that is environment centric can form a regulatory framework for the reclamation work of the post-mining wasteland areas.

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Conflict of Interest

The authors do not have any conflict of interest.

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Ethics Statement

This research did not involve human participants, animal subjects, or any material that requires ethical approval.

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