

Black Diamond for Green Life

CELEBRATING



Years of Inception
1972 - 2022



Azadi Ka
Amrit Mahotsav

Bharat Coking Coal Ltd.

A Mini Ratna Company

(A Subsidiary of Coal India Limited)

Dhanbad

A virtual visit to environmental initiatives



RISE OF JHARIA COALFIELD

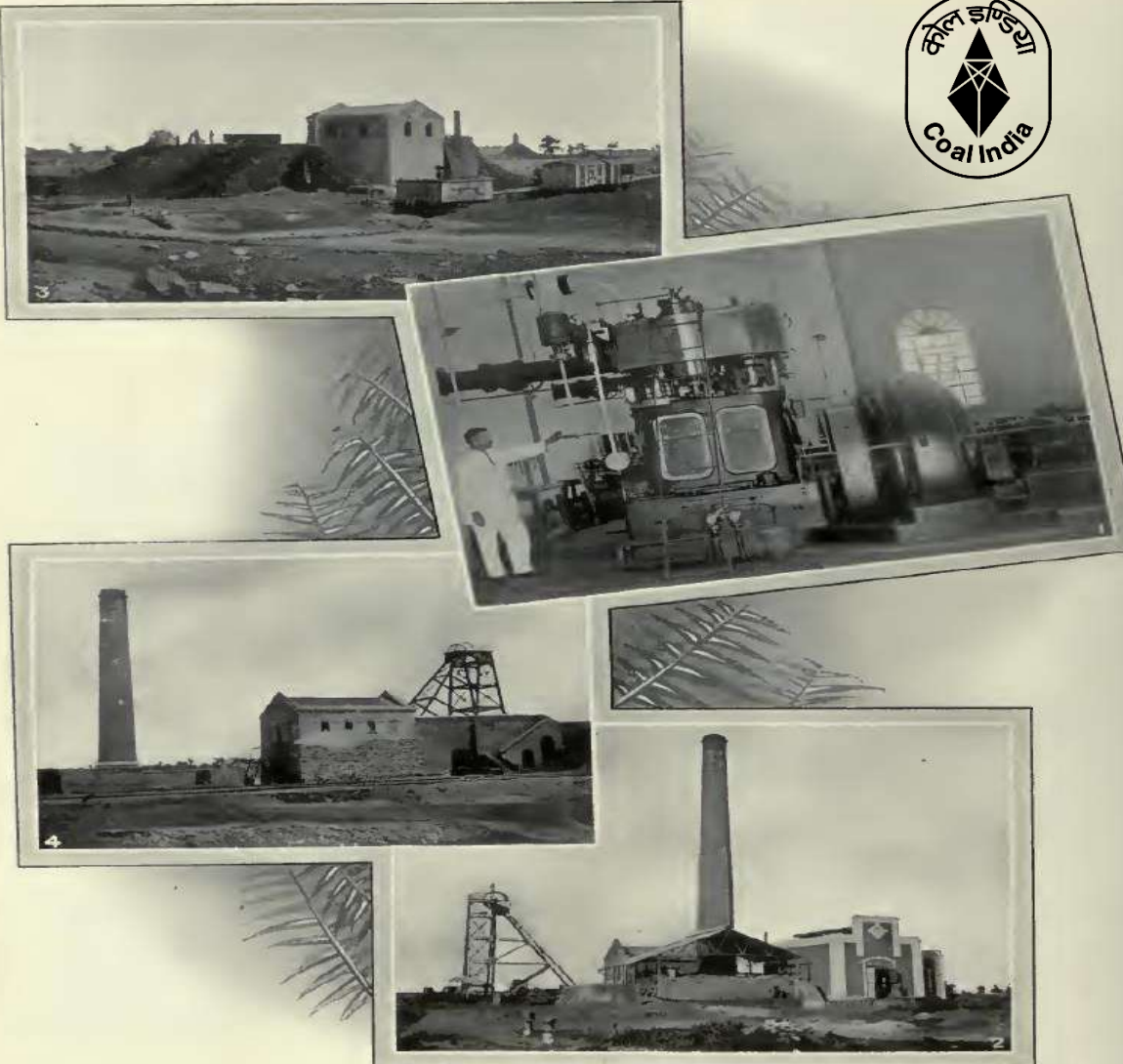
For the first century following the commencement of coal mining in India, the Raniganj field was the only, or at least the most important, producer. But towards the end of the 19th century, the large reserves of good quality coal of the Barakar measures in the Jharia field became increasingly realised. That area had been geologically examined by Mr. T. W. H. Hughes of the Geological Survey of India in 1865, but mining development was not seriously taken up for a number of years.

The 'rise' of the Jharia field has been dealt with by Dr. Fox in a paper submitted to the Mining and Geological Institute of India in 1929 [see *Trans. Min. Geol. Inst. Ind.*, Vol. XXIV, pp. 97-105, (1929)] and, as he points out, 'the whole future of the field in those days depended on railway communication'. Following an examination of the area in 1890, by Mr. T. H. Ward,

Mining Engineer, East Indian Railway Company, the Grand Chord line was extended *via* Dhanbad to Katrasgarh by 1894 and during the following year the branch line to Patherdih was opened. As a result, during the next decade, mining developed rapidly in Jharia and the output for 1906 exceeded the figure of 3,650,563 tons of the Raniganj field, and from that time to the present day Jharia has easily remained the principal producing field of India.

One cannot conclude a discussion of the history of coal mining in India without a reference to the associated bodies—the Department of Mines and the Mines Board of Health. The former was established in 1893 with its headquarters at Dhanbad. A Circle headquarters exists in the Raniganj field.

E. R. GEE : HISTORY OF COAL MINING IN INDIA



STANDARD AND BHULANBARAREE COLLIERIES.

1. GENERATING STATION STANDARD COLLIERY.

2. NO. 10 PIT HEADGEAR, STANDARD COLLIERY.

3. NO. 7 INCLINE AT BHULANBARAREE.

4. CENTRAL PIT, BHULANBARAREE.

Coal was discovered in Bengal in or about the year 1770, but very little mining was carried on until the East Indian Railway Company extended its system in 1854 to Raneegeunge, in the very heart of the most important coal-producing centres in India. Prior to the opening of the line coal had to be conveyed to boats on the Damuda River, but as this stream was not navigable for more than four months in the year it will be understood that there was little inducement to capitalists to invest money in commercial enterprises which would be so seriously handicapped in the disposal of their products.

Nationalization of Coal mines, 1972

With a legacy of land degradation, large population density and other socio-environmental constraints, BCCL had taken up some breakthrough initiatives to restore the environment of the coalfield.

- ✓ Strategic mining to liquidate fire and other dangers
- ✓ Rehabilitation of fire & subsidence affected families
- ✓ Ecological Restoration of mined out areas
- ✓ Surplus mine water utilization for community use
- ✓ Cluster wise Environmental clearance for better resource utilization
- ✓ CBM Utilization for power generation
- ✓ Employment oriented training to PAPs and unemployed
- ✓ Responsibility towards society (CSR)- water, health care, education, promoting self employment etc

Source Apportionment Study

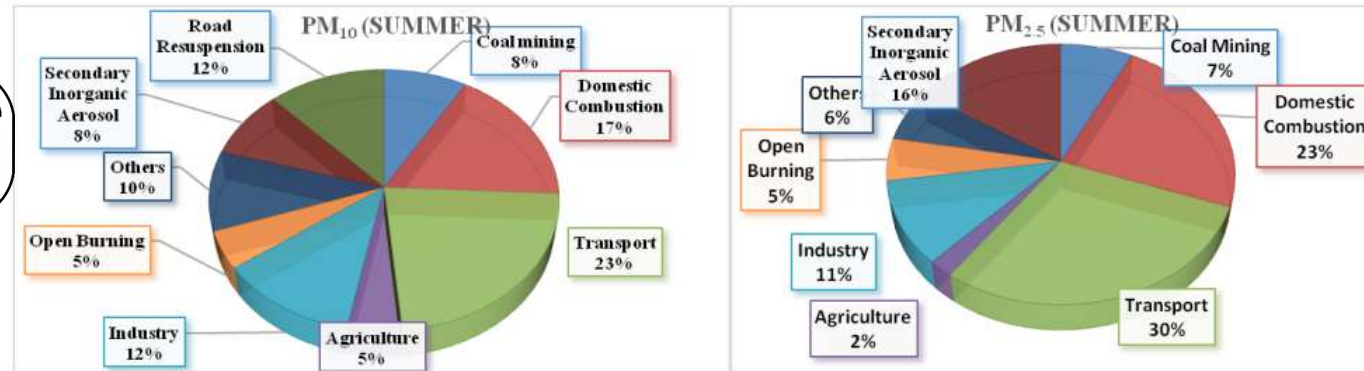
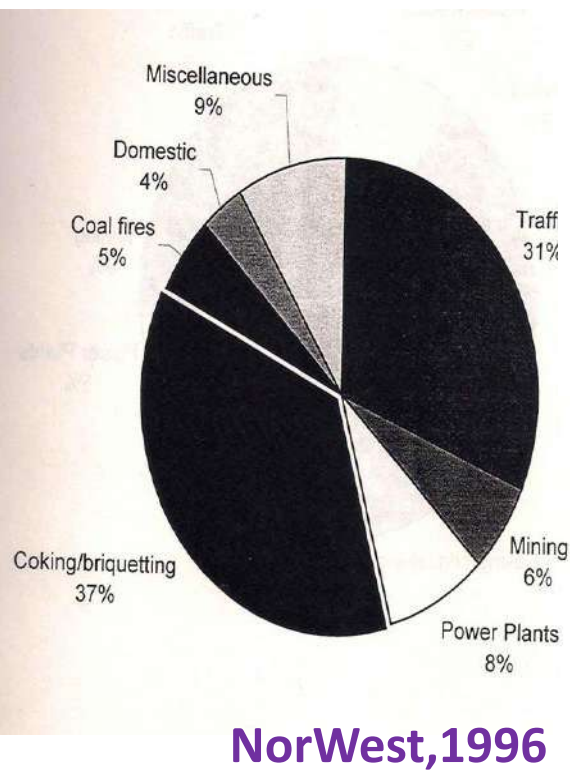


Figure 4.2: Source contribution at receptor locations of PM₁₀ and PM_{2.5} in summer

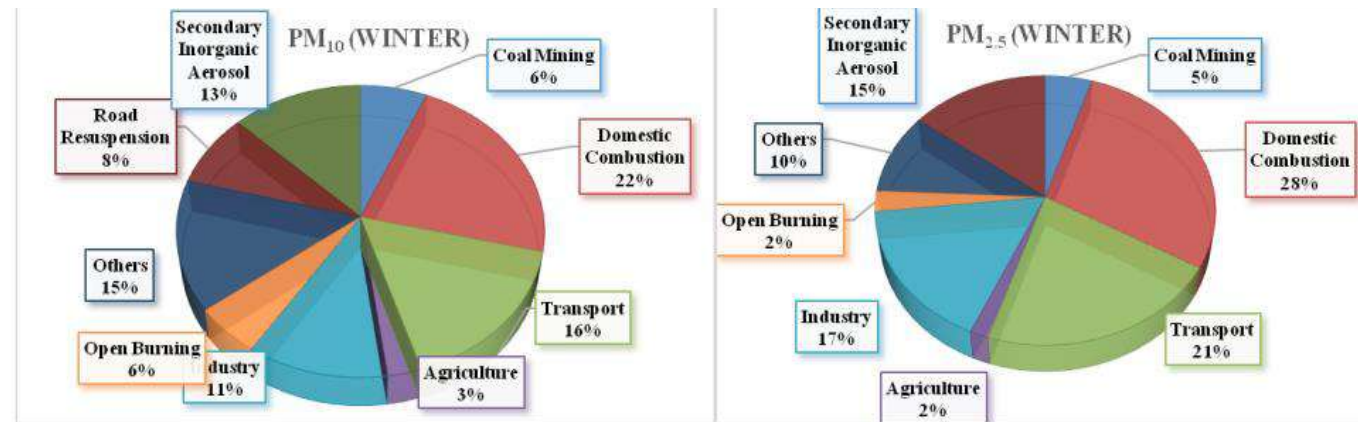


Figure 4.3: Source contribution at receptor locations of PM₁₀ and PM_{2.5} in winter

CSIR-NEERI, Nagpur 2019

The study's major objective is to assess the current ambient air quality, sources of air pollution, and propose the priorities for the actions for improvement of air quality. The study includes the entire Jharia Coalfield and an area up to 10 Km from the periphery/boundary of BCCL mines.

Cluster Concept

- BCCL has been granted EC, CTO and CGWA NoC on the basis of Clusters.
- All mines of BCCL have been divided into 17 Clusters and have been operative as per the EC granted.

The inheritance



- 1st mine fire detected in 1916, at Bhowrah
- In 1930 Khas Jharia and Golden Jharia collapsed in fires resulting in widespread destruction.
- The 1934 Nepal Bihar earthquake led to further spread of fire.
- BCCL inherited 70 mine fires from private owners at the time of nationalization in 1971-73.
- Survey after nationalization assessed Affected surface area to be 17.32 Km² With 1864 Mt Coal reserve locked with 37 Mt Prime coking coal destroyed. Subsequently 7 additional fires identified.
- M/s. GAI/ MET-CHEM study for Development of Fire Fighting Program in 1996
- BCCL made strategic excavation of fiery coal to liquidate fire. (now areal extent 1.8sq km). However Lack of availability of land for fire fighting is affecting progress.
- A Master Plan for dealing with Fire, Subsidence and Rehabilitation in the leasehold of BCCL was approved by Cabinet on 12th Aug 2009 for a total value of Rs. 7,112 Crore for a period of 12 years with cut off date 2004.
- The Master Plan is under implementation and under revision.



Rehabilitation & Resettlement of affected people in Master Plan:

- 595 sites identified with total affected area was 25.70 sq. km.
- Proposed R & R package includes 29444 LTH and 23847 non-LTH (cutoff date is 2004)

FIRE EXCAVATION: Proven method of fire dealing



TRENCH FOR SAVING RAILWAY



Initiatives for fire Control



ROCP fire Area compaction



Adra-Gomeh Rail line



ROCP fire Area N2 flushing RSP college

To control fire, blanketing, stowing, nitrogen flushing, compaction with water pool/plantation adopted success proved to be short-lived. Excavation/trench cutting has yielding results with reduction in fire area



Kustore fire Area



Kujama fire Area plantation



Muraidih fire excavation



Excavating out fiery coal



Concurrent reclamation and covering with soil cover

After excavation up to base seam and backfilling, land is being restored to greenery



Grassing: The first step towards restoration of ecology



Gokul Eco-Cultural Park, Lodna - Place to relax



3-TIER PLANTATION

Trees in the upper tier

Shrubs in the middle tier

PIONEERING ECOLOGICAL RESTORATION ON MINED OUT & DEGRADED LANDS

Grasses in the lower tier

WHY ECOLOGICAL RESTORATION? We need ecological goods and services-these are benefits from ecological functions of healthy ecosystems. Resources we use and the foods we eat are ecological goods of ecosystem processes. Ecosystem processes are the bio-physico-chemical interactions within an ecosystem, which produce ecological benefits to man in the form of clean water, regulating climate, pollinating crops, soils, nutrients, reduction in erosion, carbon sequestration, maintaining hydrological cycles, etc. Hence ecological restoration is the appropriate answer for the speedy recovery of degraded ecological systems.

WHAT IS ECOLOGICAL RESTORATION?

It is the process of short-circuiting natural recovery of degraded ecosystems through ecological interventions. It consists of 3-tier plantation by introducing native species. The lower most ground cover with grasses; shrub and bush species in the middle tier and trees as the upper tier.

Biodiversity is the essence of ecological restoration. Ecological restoration can be the most appropriate ecologically and socio-economically compatible measure, catering to needs of local community and bringing back the degraded landscape to its original forest cover in 5-10 years.



Physical reclamation



Fencing and Weeds removal



Mulching over slopes



Establishment of biodiversity

Process of transformation of degraded mined out areas /Over burden dumps of BCCL into Natural Forests



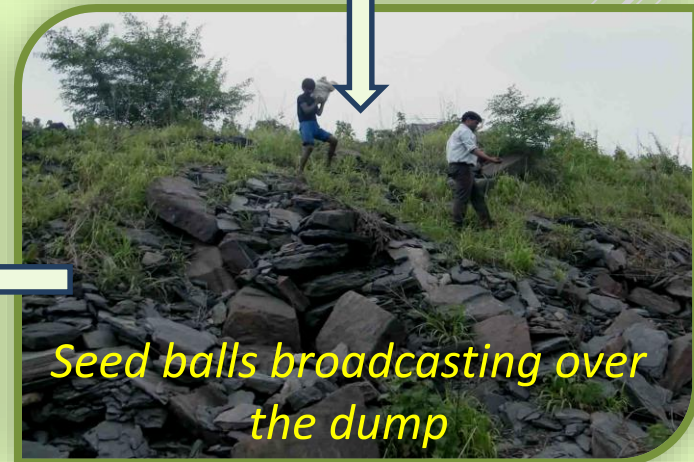
Seed balls preparation



Establishment of 3-tier ecological restoration system



Sapling plantation



Seed balls broadcasting over the dump

Strategy for Eco-restoration program



Pit digging



Seedling planting



Direct seed broadcasting



Seed ball broadcasting



Stem cutting



Soil addition



Bulbils propagation



Culm/ slip planting



Mulching of the OB dump

Mulching is the process of covering the dump surface by straw, compost, saw dust, wood chips, even stones and weeds all over and around the plants to prevent evaporation, control erosion and to create congenial conditions for their growth. It also enriches soil, inhibits weed growth, accelerates temperature moderation, salinity, etc. The mulch material helps in soil formation, retains moisture and adds nutrients, microbes/ soil organisms to the naked dump.

Seed balls preparation & broadcasting : Species selection for preparation of seed ball is mainly based on nativity, climatic condition, substratum quality & socio-economic needs. Seed balls are prepared by mixing soil, cow dung and grass/ native species seeds in the ratio 10:10:1 by volume. The balls are broadcast over the dumps just before the onset of Monsoon rains.



Shrubs established on the dump

Establishing shrubs on the OB dump is another most important eco-restoration activity. Shrubs acts as the middle tier ie., 2nd tier in the 3-tier ecological restoration. These shrubs help in establishing bio-diversity and food chains. They add biomass and organic matter to the stratum. They become home to insects and birds. Shrubs are introduced on the OB dump by broadcasting seed balls and direct planting.

<i>Botanical name of shrubs</i>	<i>Common name</i>
<i>Denrocalamus strictus</i>	Lathi bans
<i>Dendrocalamus asper</i>	Kaghi bans
<i>Bamboosa bamboos</i>	Thorny Bamboo
<i>Adhatoda zeylanica</i>	Vasaka
<i>Calotropis procera</i>	Aak
<i>Datura stramonium</i>	Datura
<i>Zyzyphus nummularia</i>	Beri
<i>Indigofera trita</i>	Indigo
<i>Dodonaea viscosa</i>	Vilayati mehandi
<i>Vitex negundo</i>	Nirgundi
<i>Agave sisilana</i>	Gwarpatha
<i>Crotalaria juncea</i>	Sanai

Trees established on the dump

Establishing trees on the OB dump is the ultimate eco-restoration activity. Trees acts as the upper tier i.e., 3rd tier in the 3-tier ecological restoration. Trees help in establishing bio-diversity and food chains. They add biomass and organic matter to the stratum. They become home to insects, birds and animals. Trees are introduced on the OB dump by broadcasting seed balls and direct planting.

<i>Botanical Name</i>	<i>Common name</i>
<i>Maduca indica</i>	Mahua
<i>Albizia procera</i>	Siris
<i>Dalbergia sissoo</i>	Seesam
<i>Psidium gaujava</i>	Amrut
<i>Phyllanthus embilica</i>	Amla
<i>Albizia lebbeck</i>	Kala siris
<i>Bahunia variegata</i>	Kachnar
<i>Mangifera indica</i>	Mango
<i>Artocarpushetrophyllus</i>	Kathal
<i>Bombax ceiba</i>	Seemal
<i>Cassia fistula</i>	Amaltas
<i>Butea monosperma</i>	Palas
<i>Ficus glomerata</i>	Gular
<i>Aegel marmelos</i>	Bel
<i>Ficus religiosa</i>	Pipal
<i>Azadirachta indica</i>	Neem
<i>Pongamia pinnata</i>	Karanj
<i>Ailanthus excelsa</i>	Mahanim
<i>Ehretia laevis</i>	Chamror
<i>Melia composita</i>	Bakain
<i>Spondias pinnata</i>	Amra

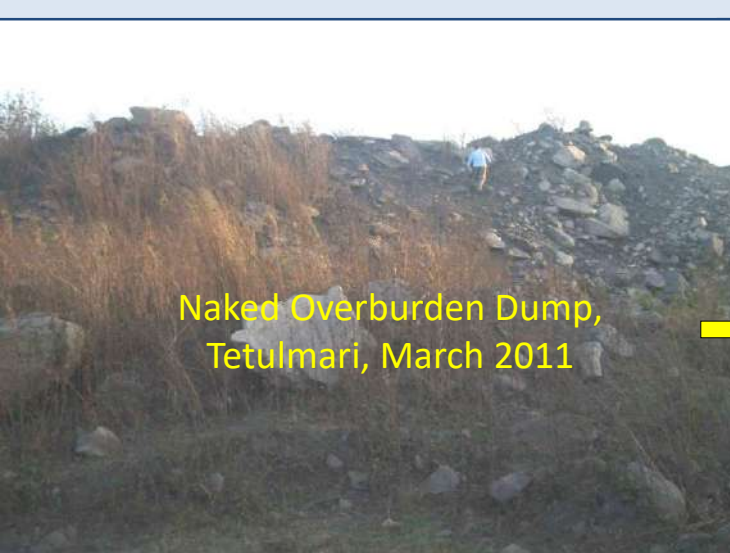
BHARAT COKING COAL LIMITED
(A Subsidiary of Coal India Limited)
TETULMARI COLLIERY, SILEIGHA AREA
ECOLOGICAL RESTORATION PROJECT
IN COLLABORATION WITH
FOREST RESEARCH INSTITUTE (FRI) DEHRADUN

BEFORE
ECOLOGICAL RESTORATION
AT TETULMARI, 2011

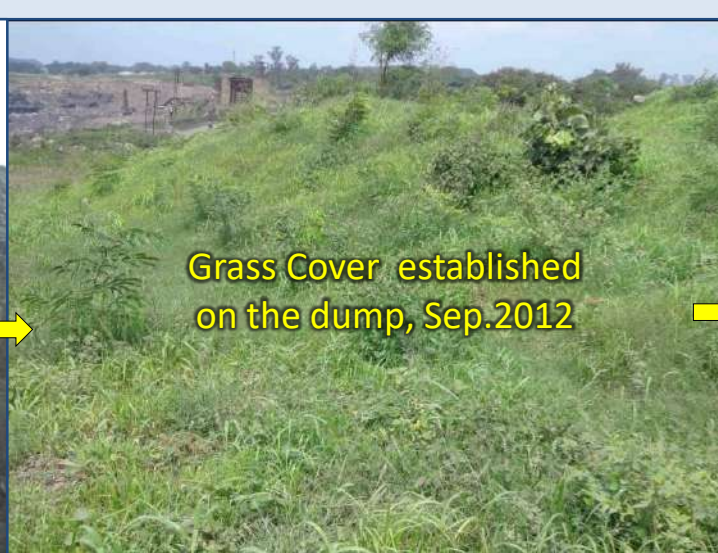


PRESENT STATUS TETULMARI, 2022





Naked Overburden Dump, Tetulmari, March 2011



Grass Cover established on the dump, Sep. 2012



Regeneration of Dodonea Viscose from seed ball, July 2013



3-tier plantation, July 2016



3-tier plantation, Sept. 2015



3-tier plantation, Sep. 2014

SUCCESSFUL TRANSFORMATION JOURNEY OF ECO-RESTORATION PROCESS



3-tier plantation, July 2022



Fauna at the site



Wasp hive at the site

Before Eco-restoration , July 2011



Grass Cover Establishing, Aug. 2012



Bamboo & Other Species Establishing, Sep. 2013



ECOLOGICAL TRANSFORMATION STORY OF DAMODA ECO-RESTORATION SITE

3- tier plantation, 2016



3- tier plantation established, August 2015



3- tier plantation established, Sept. 2014



3- tier plantation, 2022



Biodiversity Establishing at ER Site



CARBON SEQUESTRATION ASSESSMENT



Carbon Sequestration Study at
Eco-restoration Sites of BCCL
(Tetulmari - 8 ha & Damoda - 7 ha)

Submitted by



Department of Environmental Science & Engineering
Centre of Mining Environment
(A Centre of Excellence by MOEF & CC, GOI)
INDIAN SCHOOL OF MINES
Dhanbad – 826 004

Submitted to



Bharat Coking Coal Limited (BCCL)
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Koyla Bhawan, Dhanbad – 826 005

August 2015

Going a level ahead, BCCL had engaged Indian School of Mines, Dhanbad for assessment of Carbon Sequestration at BCCL's eco-restoration sites in March 2015. FRI's Ecological Restoration site at Tetulmari, Sijua Area was one of the site. BCCL is the pioneer coal mining company, rather any mining company, to take up a study like this. Terrestrial Carbon sequestration is the process of (i) transforming atmospheric CO_2 through photosynthesis into biomass components such as trees, shrubs, vegetation, and soil organic matter, and (ii) incorporation of biomass into the soil as humus. This leads to the effective storage of atmospheric CO_2 into the ground, forming a Carbon Sink, thereby reducing the amount of CO_2 , which is a Green House Gas, in the atmosphere. A comparison was done with the amount of CO_2 sequestered at the eco-restoration site and at a natural forest site and an unreclaimed OB dump.

CO ₂ sequestration by different components	Damoda Ghutway Eco-restoration Site	Damoda Incline Eco-restoration Site	Tetulmari Eco-restoration Site	Unreclaimed OB dump	Natural forest site
Above ground & Below ground biomass (t/ha)	53.02	63.51	142.15	17.63	242.58
Litter fall (t/ha)	3.592	4.007	5.533	1.145	5.650
Soil (t/ha)	59.93	46.00	65.65	28.85	130.285
Total CO ₂ sequestration (t/ha)	116.542	113.517	213.33	47.625	378.522

In 2018, BCCL has also conducted CO_2 sequestration estimation through Forest Research Institute, Dehradun at Tetulmari eco-restoration site and the CO_2 sequestered increased to 259.09 ton/ha from 213.33 ton/ha as estimated in 2015.


BCCL IN ASSOCIATION WITH FOREST RESEARCH INSTITUTE (FRI)

Developing ecological restoration model in the mine spoils at Tetulmari mine under Sijua Area (about 8-10 ha), 2015


To act as technical advisor/expert for the ecological restoration works being undertaken by BCCL on OB dumps/ mined out areas (44.0 ha in 9 sites) of Ecological Restoration sites, 2016-2021

Enhancement of Biodiversity and its Conservation in the Ecological Restoration Site at Tetulmari, Sijua Area of BCCL, 2018


PROJECT REPORT ON
DEVELOPING ECOLOGICAL RESTORATION MODEL IN THE MINE SPOILS AT
TETULMARI UNDER SIJUA AREA (ABOUT 8-10 Ha) OF BCCL MINE




Submitted To
Bharat Coking Coal Limited
(BCCL)



By
Forest Ecology & Environment Division
Forest Research Institute
Dehradun-Uttarakhand
2015



ENHANCEMENT OF
BIODIVERSITY AND ITS
CONSERVATION IN THE
ECOLOGICAL
RESTORATION SITE
AT TETULMARI,
SIJUA AREA (08 HA)
OF BCCL, DHANBAD



PROJECT REPORT

- ✓ Restored site has been replicated similar to natural forest, Eco-restoration is a better alternative than afforestation and helps minimising pollution
- ✓ Considerable improvement in soil nutrients post eco-restoration noticed
- ✓ Restoration site enriched with floral biodiversity of 103 plant species in comparison to 58 species in 2013-14.
- ✓ Site provides habitat to fauna for large number of birds, butterflies and insects
- ✓ Estimated 259.09 ton/ha equivalent Carbon sequestration
- ✓ Helped in developing environment-friendly image of the company among the stakeholders
- ✓ Established that mining sites can be successfully restored and converted into carbon sinks by adopting appropriate eco-restoration strategies



औषधीयगुणयुक्त
दुकाई
गोमट्टीहसारसुखा

MONITORING IS THE KEY TO SUCCESS OF ECOLOGICAL RESTORATION

The results of eco-restoration are very encouraging. Within a couple of years, nutrient levels, organic matter, micro-organisms, moisture content in the stratum have increased resulting to lush green vegetation with biodiversity on once a naked spoil dump.



Butterfly: an indicator of a healthy environment



Source: FRI, Dehradun report on Tetulmari dump biodiversity



Year	No. of floral Species
2013-14	58
2017-18	103

The enhanced biodiversity has promoted the species introduction as many species of birds (20), butterflies (14), insects (27), reptiles (1) and few of animals etc. have naturally recolonized or visiting at restored site.

Year	Carbon Sequestration (ton/ha)
2015	213.33
2017	259.09



Birds



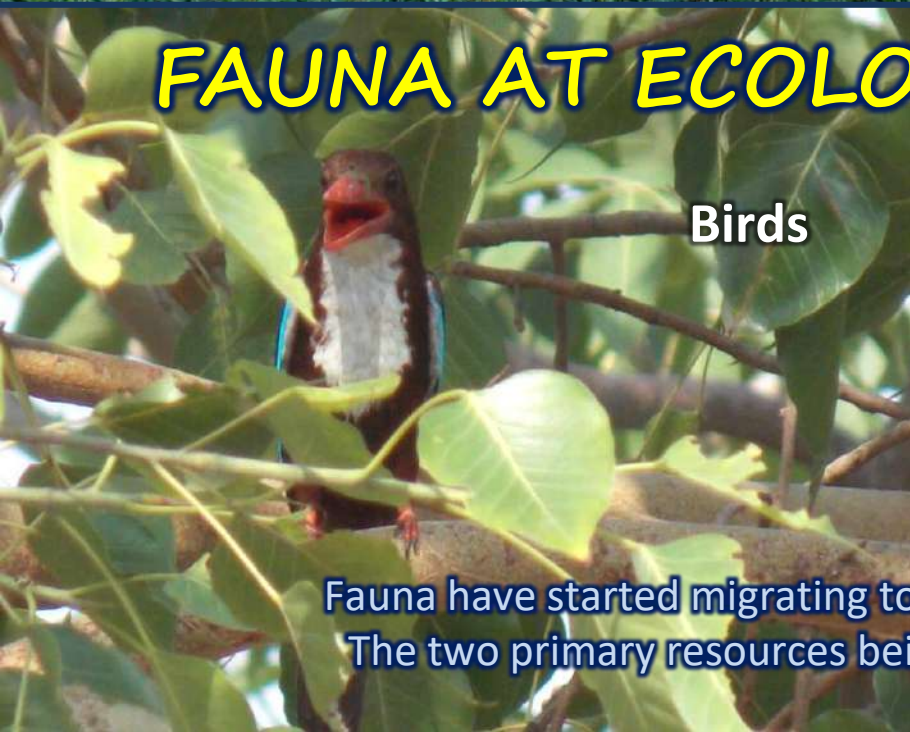
Millipedes



Birds



Owl



Birds



Butterfly



FAUNA AT ECOLOGICAL RESTORATION SITES

Fauna have started migrating to move from far areas to ecological restoration sites. The two primary resources being sought by fauna are food and nesting locations.



Porcupine



Birds



Wasp hive



Bee



Insects



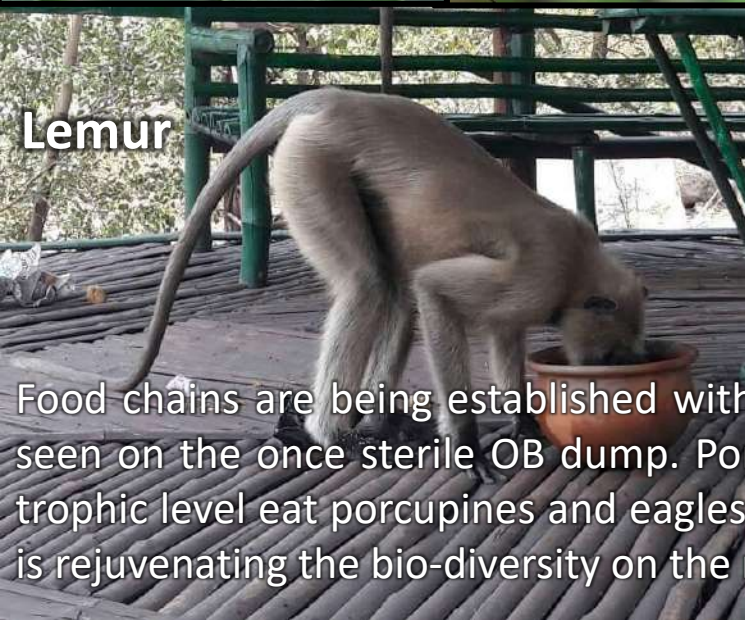
BCCL's ecological restoration sites have become home to a whole lot insects, birds, reptiles, mammals



Grass hopper



Spider



Lemur



Jackal



Birds

Food chains are being established with different trophic levels. Second to Fourth Trophic level organisms are now seen on the once sterile OB dump. Porcupine as the second trophic level eat bamboo shoots, Jackals as the third trophic level eat porcupines and eagles could be the fourth trophic level of one food chain. This eco-system process is rejuvenating the bio-diversity on the restored dump.

ECOLOGICAL RESTORATION



- In 2011, BCCL adopted it with a view to link it with future needs of surrounding community & recreate original ecosystem of the region and prepared a Road map for ecological restoration through Forest Research Institute (FRI), Dehradun, constituting a dedicated team for successful implementation.
- The ecological restoration is to establish a three-tier vegetation comprising of native species grasses as lower tier, shrubs and bushes as middle tier and trees as upper tier with an objective to establish biodiversity and food chain; to improve the local climate regime and socio-economic condition.

BENEFITS

- ✓ Helps in reduction of Air pollution
- ✓ Carbon sequestration of three year old Tetulmari Ecological restoration site is 213.33 ton/Ha as compared to 47.625 t/Ha of Un-reclaimed OB dump & 378.522 t/Ha of Natural Forest site. Also, carbon sequestration potential of Tetulmari site has increased from 213.33 ton/Ha to 259.09 t/Ha in next 2 years. (Source: Biodiversity Enhancement report)
- ✓ Helps in generation of future source for livelihood
- ✓ Creation of Eco-parks over reclaimed OB dumps provides site for recreation & rejuvenation to the locals
- ✓ Eco-Mining tourism program of BCCL allows the students/researchers to visit the mines & reclamation sites to understand the mining & reclamation techniques.
- ✓ Pilot projects for growing agricultural crops have also been taken up in the reclaimed sites.
- ✓ As per the biodiversity enhancement study there is an increase of floral species from 58 species in the Tetulmari site existing in FY 2013-14 to 103 floral species reported in FY 2017-18.
- ✓ The enhanced biodiversity has promoted the species introduction as many species of birds (20), butterflies (14), insects (27), reptiles (1) and few of animals etc. have naturally recolonized or visiting at restored site.

Experts and dignitaries has appreciated the initiatives and with establishment of native species growth potential, state forest department is also selecting native species for afforestation in our restoration work.



Barora



Block II



Govindpur



Katras



Sijua



Kusunda



Putki Balihari



Bastacolla



Lodna



Western Jharia



Eastern Jharia



Chanch Victoria

Till 2021-22, BCCL has done biological reclamation over 1534.73 Ha (including ecological restoration) consisting of 32,98,920 no. of plants including 32036 gabion plantation. The work of Eco-restoration is being acclaimed by regulatory authorities and they are directing the other companies along with BCCL for replicating the work of ecological restoration on large scale.



Secretary Coal & Chairman CIL at Gokul Park, Jan. 2021



Secretary Coal at GKKC Eco-restoration Site, Jan. 2018



Sri. R.K Dey, APCCF, MoEFCC visited GKKC Site, Kusunda, Jan. 2018



Director, FRI, Dehradun and MD, JSFDC GKKC, Kusunda Area, May, 2019

Visits by Dignitaries



Team from Finland visiting Kusunda, Dec 2016



Director, IIT- ISM Dhanbad Gokul Park, Lodna Area, Sept. 2018



Visit of Assistant Secretaries, MoC, at Gokul Park, Aug 2017



Team from South Florida University, USA, Gokul Park, Aug 2017

Visits by Dignitaries



SME Inc, USA Directors visiting Fire area in Lodna, Aug 2017



Delegates of IIT- ISM Dhanbad from Australia & Afghanistan Gokul Park, Lodna, 2019



Visit of Independent Director, BCCL in Gokul Park, Lodna, Jan 2022



Visit of Independent Director, BCCL in Gokul Park, Lodna, April 2022

Horticultural initiatives by BCCL as a part of Eco-Restoration



Paddy grown at
GKKC, Kusunda Area



Crop at Muraidih, Barora Area



Mustard and Wheat
cultivation at Lodna



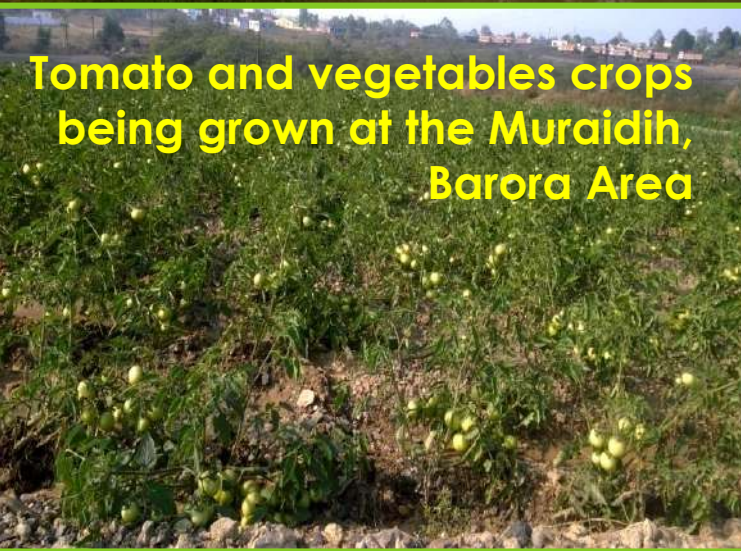
Sugarcane grown at
GKKC, Kusunda Area



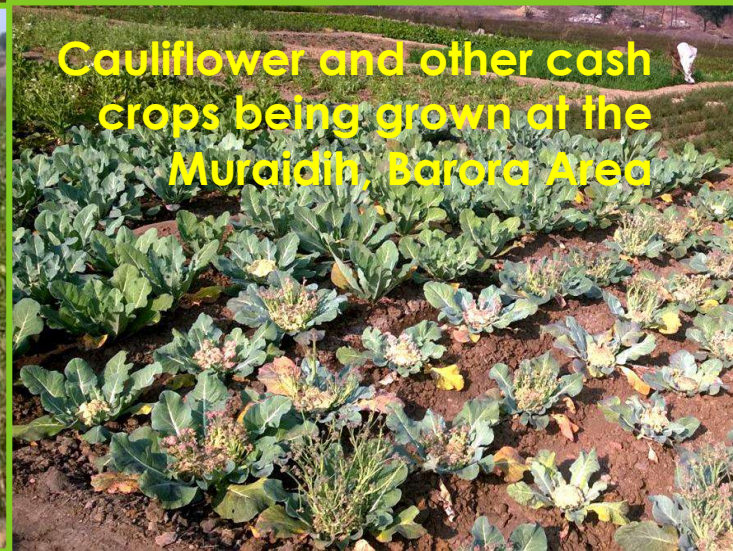
Flowers grown at Muraidih,
Barora Area



Wheat grown at GKKC,
Kusunda Area



Tomato and vegetables crops
being grown at the Muraidih,
Barora Area



Cauliflower and other cash
crops being grown at the
Muraidih, Barora Area



Maize cultivation at AKWMC,
Katras





PARASNATH UDHYAN
KATRAS





GOVARDHAN ECO-PARK ,
BERA



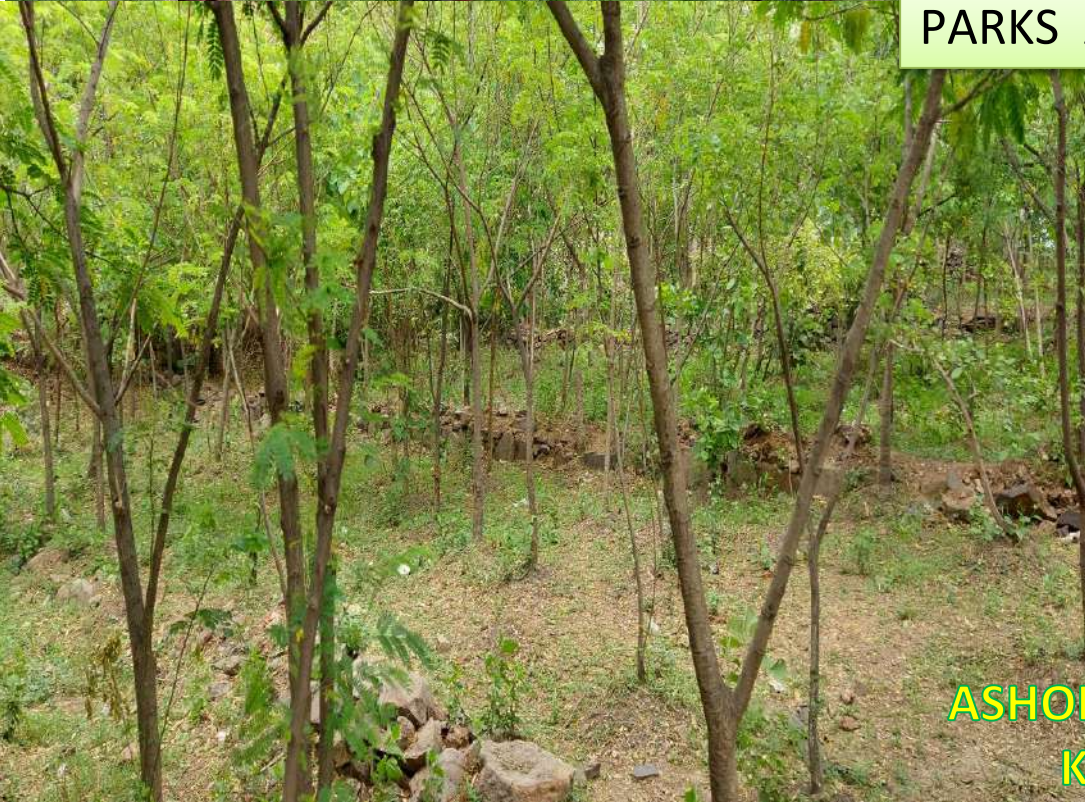


**VRINDAWAN PARK
GKKC**



**GOKUL PARK
LODNA**

PARKS AT BCCL



**ASHOK VATIKA
KUYA**





Journey beyond reclamation

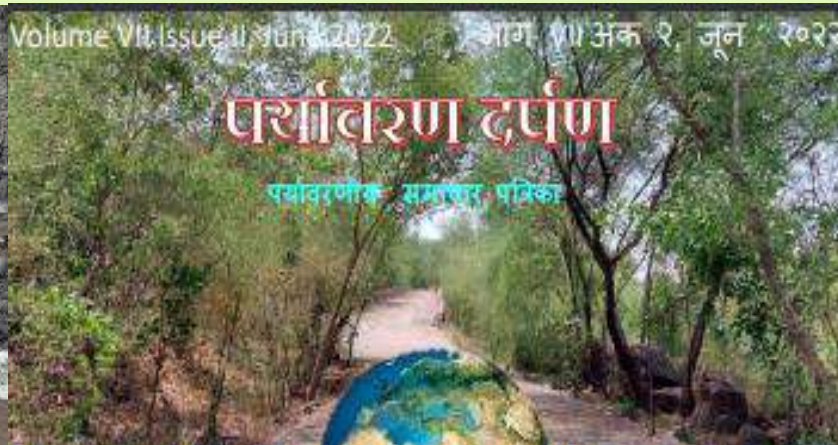


Vivo V11Pro
AI Dual Camera

2020.05.09 11:55

Awareness initiatives

- Eco tourism of school children
- Publication of Environmental Newsletter~ Paryavaran Darpan
- Digital Calendar showcasing bio-reclamation and bio-diversity establishment





Students from BIT, Sindri



Students from DAV, Koyla Nagar



Students from Dhanbad Public School

Glimpse of Eco-Mining Tourism in 2021-22



Students from P. K Roy College



Students from Delhi Public School



Students from P. K Roy College



Keeping pace with changing times



