

SUSTAINABLE MINING AND GEOINFORMATION

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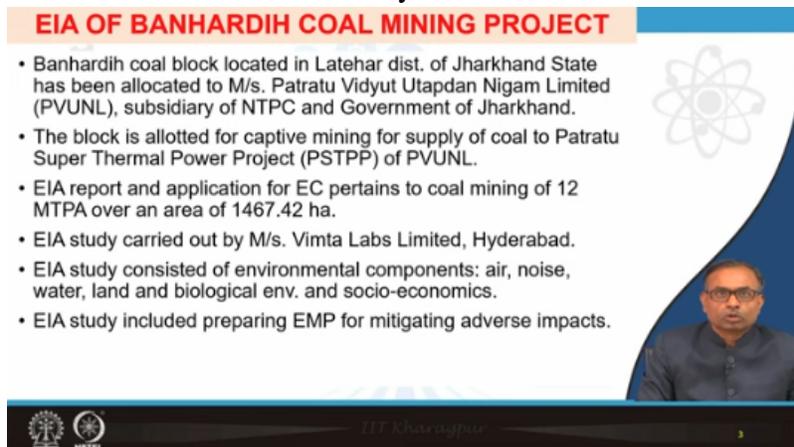
Week – 06

Lecture 26: Environmental Impact Assessment for Mining Projects-II

Thank you. Welcome, students, to Lecture 26 of the NPTEL online certification course on sustainable mining and geo-information. Last class, we were discussing the environmental impact assessment for mining projects. We discussed the general aspects of environmental impact assessment studies.



Today, we will discuss a case study of environmental impact assessment for a mining project. When we discuss a case study, it will be clearer. The general scientific aspects of the EIA study will be clearer. We will discuss, in particular, an EIA study of a coal mine from the state of Jharkhand. This case study is taken from an executive summary of an



EIA report available on the Internet. It is open literature. I have provided the reference, and you can go through it. We are discussing the Environmental Impact Assessment Study of the Banhardih Coal Mining Project. This coal mine or coal block is located in the Latehar district of Jharkhand state, and the coal block is allocated to M/s. Patratu Vidyut Utpadan Nigam Limited, which is a subsidiary of the National Thermal Power Corporation (NTPC) and the State Government of Jharkhand. This block is allocated as a captive mining project for the supply of coal to the Patratu Super Thermal Power Project. This project involves open-cast coal mining, which is planned to produce 12 million tons of coal per annum, and the project area is 1467.42 hectares. This EIA study was conducted by Vimta Labs Limited, Hyderabad. The EIA study covers different aspects of the environment such as air, water, noise, land, soil, and biological environments, as well as the socio-economic environment. The EIA study also provided an environmental management plan suggesting mitigation measures for different adverse environmental impacts. Now we talk about the general environmental settings of the project. This project is located in a topography known as rolling terrain with low ridges and depressions.

ENVIRONMENTAL SETTING

- General topography of the block: rolling terrain with low ridges and depressions.
- ~ 25 % of the block is covered by forest.
- Rest area - cultivated land and residential hutments.
- There is an operating coalmine, Sikni Colliery within 0.3 km from proposed mine; a brick industry is in nearby Serak village.
- The Bagdagga nala and Rajdaha nala and their tributaries forms the main drainage system of the area.

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This is an undulating topography, and 25% of the project area is under forest cover, while the rest is cultivated land, agricultural land, or residential hutments. Near the project, there is an operating coal mine within 300 meters of the proposed mine, and there is a brick industry in the nearby village. Regarding the drainage pattern, there are two NALAs: Bagdagga NALA and Rajdaha NALA, along with their tributaries. They form the main drainage of that area. Now, coming to the mine details: the net geological reserve is 401.56 million tons up to a depth of 300 meters. The extractable reserve by the open-cast method of mining is 250.5 million tons. The total overburden to be produced is

MINE DETAILS

- Net Geological reserves: 401.56 Mt up to depth of 300 m
- Extractable reserves by Open cast: 250.50 Mt
- Total OB Generation: 1173 MCM
- Average stripping ratio: 4.68 m³/t
- Expected life of mine: 30 years
- Method of mining:
 - Coal extraction - Surface Miner and conventional Drilling and Blasting.
 - OB Removal - Shovel Dumper combination
 - Temporary external dump (within block) area: 467.14 ha
 - Internal dump area: 727.24 ha
 - Topsoil generation: 17.94 M.cum
 - No. of PAPs: 963 no.s



1173 million cubic meters. The average stripping ratio, as per the mine plan, is 4.68 cubic meters per ton. We have discussed what a stripping ratio is in our earlier classes. The expected life of the mine is 30 years. The suggested method of mining is as follows: coal extraction will be done using surface miners and conventional drilling and blasting. Overburden removal will be done by conventional drilling and blasting, coupled with shovel and dumper combinations to handle the overburden. The mine will have a temporary external dump covering 467.14 hectares. The internal dump area will be 727.24 hectares.

Before the mining, we have to remove the topsoil. The topsoil that will be handled is 17.94 million cubic meters. In the project area, there are some residential hutments present, so some resettlement is also involved, and the number of project-affected persons is 963.

Coming to the land use before the mining—the EIA study will cover the baseline environmental status—you have to know the status before mining. The land use before mining is given in the table. As per the table, 40.1 percent of the area is agricultural land, water bodies account for 31.5 percent of the area, built-up area is 5.6 percent, forest area is 31.5 percent, and wasteland is 12.9 percent of the study area.

LANDUSE BEFORE MINING

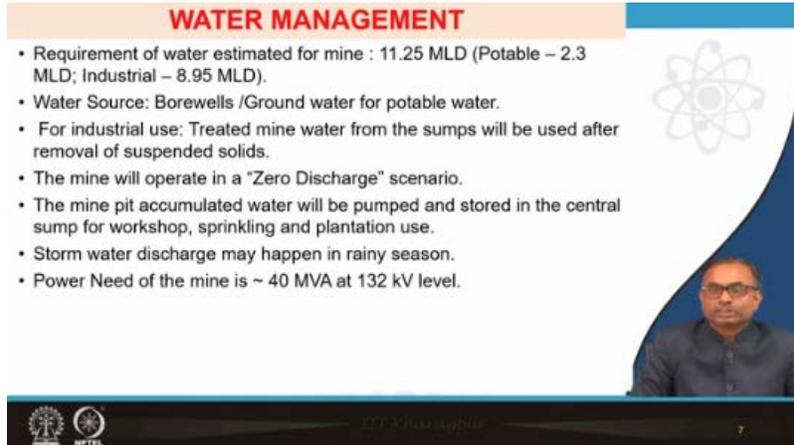
Pre-Mining Land Use in "ha"		
Tenancy	Agricultural	324.45
	Barren	208.33
	Water Bodies	8.00
	Road	0.81
	Others	35.78
Govt. Non forest	Agricultural	132.70
	Barren	151.40
	Water Bodies	33.44
	Road	27.61
Forest	Others	26.95
	Protected	474.25
	Shrubs type	43.70
Total		1467.42

40.1% of area agricultural lands, water bodies - 31.5 %. Built-up area – 5.6%
Forest area - 31.5 %. Wastelands - 12.9 % of study area.



Resource requirement for running the project: Estimated water requirement for the mine is 11.25 million liters per day, out of which potable water will be 2.3 million liters per day, and water required for the industry is 8.95 million liters per day.

Water sources: It will mostly be groundwater from bore wells for potable water and industrial use. As you know, when we go for mining, we have to pump out a lot of groundwater from the mine. This mine water is called mine drainage water. The mine drainage water will be treated. The sediment and suspended solids will be removed, and the treated water will be used for industrial purposes in the mine. The mine will operate in a zero-discharge scenario, and the mine pit accumulated water will be pumped and stored in the central sump for use in the workshop.



WATER MANAGEMENT

- Requirement of water estimated for mine : 11.25 MLD (Potable – 2.3 MLD; Industrial – 8.95 MLD).
- Water Source: Borewells /Ground water for potable water.
- For industrial use: Treated mine water from the sumps will be used after removal of suspended solids.
- The mine will operate in a "Zero Discharge" scenario.
- The mine pit accumulated water will be pumped and stored in the central sump for workshop, sprinkling and plantation use.
- Storm water discharge may happen in rainy season.
- Power Need of the mine is ~ 40 MVA at 132 kV level.

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It will also be used for sprinkling for dust control, irrigation of the plantation area, or reclamation purposes. We may have stormwater, particularly in the rainy season, and you have to have a sump. You have to design your sump for occasional handling of the stormwater. However, when there is excessive stormwater, we cannot design a sump for extreme events. Then the water will be allowed to collect in the sump and discharged onto the land or into the water stream, whichever is applicable. The power need of the mine is approximately 40 million volt-amperes at a 132 kV level. Now we come to the baseline environmental status. We come to the air quality. The baseline study was carried out from December 2020 to February 2021, which is the winter season. For three months, i.e., the winter season, the ambient air quality in the area before mining was monitored at 10 locations in and around the project site. The PM concentration, PM10, PM2.5, SO₂, NO₂, carbon monoxide, O₃—all these parameters were measured. As you know, these

parameters are the prescribed parameters in the National Ambient Air Quality Standard.

BASELINE ENVIRONMENT

- Baseline study carried in Dec 2020 - Feb 2021 covering winter season.
- Ambient air quality: Monitoring at 10 locations in and around project site.
- PM10 concn: 27.1 mg/m³ - 61.6 mg/m³.
- PM2.5 concn: 11.3 mg/m³ - 32.0 mg/m³.
- SO₂ concn: 9.1 mg/m³ - 16.6 mg/m³.
- NO₂ concn: 10.0 mg/m³ - 21.0 mg/m³.
- CO concn: 151 mg/m³ - 334 mg/m³.
- O₃ concn - 3.2 mg/m³ - 9.9 mg/m³.
- Pre-mining concentrations of PM2.5, PM10, SO₂, NO₂, O₃, CO, NH₃, Pb, Hg, BaP, As, Ni and C₆H₆ were well within the NAAQ standards, 2009 for industrial and rural /residential zone.

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The PM₁₀ concentration varied between 27.1 to 61.6 milligrams per cubic meter, PM_{2.5} varied between 11.3 to 32.0 milligrams per cubic meter. SO₂ varied between 9.1 to 16.6 milligrams per cubic meter, nitrogen oxides between 10.0 to 21.0 milligrams per cubic meter. Similarly, you can see the pre-mining concentrations of PM_{2.5}, PM₁₀, SO₂, NO₂, ozone, carbon monoxide, ammonia, lead, and other parameters mentioned in the National Ambient Air Quality Standard 2009. For the industrial, rural, and residential areas, mostly before the mining, the air quality conformed to the National Ambient Air Quality Standard 2009. Now, the baseline environment for the soil: The average topsoil in the proposed area was approximately 3.1 meters. The pH of the soil was between 5.84 to 7.41, which is slightly acidic to near-neutral or slightly alkaline. Electrical conductivity varied between 38.6 micromhos per centimeter to 124.1 micromhos per centimeter. Nitrogen content varied between 37.6 to 73.8 kg/ha, which was less nitrogen. Phosphorus content and potassium content were higher than the average in that soil. Chlorides varied between 48.9 to 108.5 milligrams per kilogram of soil. This is the baseline environmental status of the soil sample in the project area.

BASELINE ENVIRONMENT- SOIL

- Average topsoil in the proposed area of excavation: ~3.1 m.
- pH of the soil in study area: 5.84 to 7.41 (acidic to alkaline).
- Electrical conductivity: 38.6 $\mu\text{mhos/cm}$ - 124.5 $\mu\text{mhos/cm}$.
- N2 content: 37.6 - 73.8 kg/ha.
- Phosphorus content : 52.6 to 132.6 kg/ha.
- Potassium content: 253.6 –362.5 kg/ha.
- Chlorides : 48.9–108.5 mg/kg of soil.



Dr. Manoj Kumar

Now, water samples were collected from the project area. The slide shows the results of different water quality parameters. The pH was between 6.7 to 7.68. Electrical conductivity varied between 256 to 730 micro Siemens per centimeter. The electrical conductivity was relatively high compared to average water quality. DO, dissolved oxygen, varied between 5.6 to 6.2 milligrams per liter, which is okay for aquatic populations. Total hardness varied between 71.6 to 229.3 mg/L. 229.3 is a high hardness for a water sample. Fluoride and sulphate concentrations were measured. You can see how the water quality was there before the mining.

BASELINE ENVIRONMENT- WATER

Surface Water Quality:

- pH: 6.7 to 7.68 (within standards of 6.5 to 8.5)
- Electrical conductivity: 256 $\mu\text{S/cm}$ – 730 $\mu\text{S/cm}$;
- DO: 5.6 mg/l - 6.2 mg/l;
- Total hardness: 71.6 mg/l - 229.3 mg/l;
- Chloride concentration: 29.6 mg/l - 84.2mg/l;
- Sulphate concn: 16.5 mg/l - 58.6 mg/l;
- Fluoride content: 0.5 mg/l - 0.7 mg/l;



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10

BASELINE ENVIRONMENT- FLORA AND FAUNA

- Dominant Flora species: Sal, Sisal Hemp, Mahua, Mango, Ber
- Sloth Bear (*Melursus ursinus*), Peacock (*Pavo cristatus*), Python (*Python molurus*) and Bengal monitor (lizard; *Varanus bengalensis*) are the four Schedule I fauna reported from the forests of the buffer zone.
- *(As per Wildlife (Protection) Act 1972 Act "no person shall hunt any wild animals specified in Schedule I, II, III and IV)*
- Honeycombs were very abundant in the forest and non-forest including residential areas.
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11

Now, coming to the biological environment. Dominant flora species were surveyed, and it was seen that sal, sisal, mahua, mango, and ber were the dominant species in the project area. Coming to fauna species, sloth bear, peacock, python, and Bengal monitor are the four scheduled fauna species reported from the forest in the buffer zone of the project area. When I say Schedule I fauna, that is as per the Wildlife Protection Act 1972, there are restrictions in hunting the Schedule I fauna species. No person shall hunt any wild animal which are listed in Schedule I, II, III, or IV of the Wildlife Protection Act. So, these species are listed in Schedule I of the Wildlife Protection Act 1972. Honeycombs were very abundant in the forest as well as non-forest areas and residential areas of the project area. So, this is about the baseline study. Now, as part of the EIA, we determine the baseline environmental quality, and then in the second stage, we will predict the environmental impact. Prediction of the environmental impact on all the different environmental attributes like air, water, soil, noise, flora, fauna, and even socio-economics. First, we discuss what will be the impact on the land and the soil quality. We know that the mining activity will result in the loss of topsoil. We remove the topsoil and store it as per the current statutory provisions. We have to preserve the topsoil, but you

know there are many technical challenges to preserve the topsoil. In a mining area, there is no tree cover or vegetation cover. Frequently, there will be loss of soil as sediments whenever there is surface runoff or storm events. So, definitely, there will be loss of topsoil. Also, there will be changes in topography and drainage patterns. During mining operations, changes to the pre-mining land use will occur due to the following activities. What are the activities? First is the removal of topsoil. This is an essential part of open-cast mining. Removal of overburden and creating overburden dumps will change the topography of that area and the drainage pattern of that area. Stockpiling of coal and construction of mine infrastructures like incline, pit office, haul road, etc., will change the topography of the area and result in soil erosion. Land degradation is one major outcome of mining, and soil quality of the surrounding area are likely to be affected due to siltation and runoff from the waste dumps. Mine drainage, particularly coal mine drainage, will be acidic, and acidic mine drainage will contain toxic constituents, particularly the heavy metals. Coal contains many elements, and the acidic drainage will dissolve many metals present in the coal. This acidic mine drainage containing toxic constituents such as heavy metals, if not treated by a treatment process and when discharged to the nearby land, would affect the soil quality adversely. Particularly, the electrical conductivity and the heavy metal content of the soil will increase. When the acidic drainage is discharged into the nearby streams, it will affect the water quality adversely and make the water unfit for agricultural use.

ENVIRONMENTAL IMPACT

- Soil Quality: Mining will result in loss of topsoil.
- Change in Topography and Drainage Pattern.
- During mining operations, changes to the pre-mining land use will happen due to the following activities:
 - ✓ Removal of topsoil;
 - ✓ Removal of overburden (OB);
 - ✓ Dumping of overburden (OB);
 - ✓ Stockpile of coal;
 - ✓ Construction of mine infrastructure viz. inclines, pit office, haul road etc.;
 - ✓ Subsidence of surface topography of the area.



12

ENVIRONMENTAL IMPACT

- Land degradation is one major adverse outcome of mining.
- Soil quality of surrounding area likely to get affected due to siltation and run off from waste dumps.
- Mine drainage, acidic and containing toxic constituents, if not treated when discharged to nearby land would affect the soil quality adversely;
- When acidic drainage discharged untreated into streams effects the quality of water and make it unfit for agricultural use.
- Positive impact of mining on agriculture, as sufficient water is discharged from mine, which can be utilized for irrigation, increasing the productivity.
- Mine drainage water, in many mines, are not contaminated except high-suspended solids, which can be removed by simple settling.



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13

There are some positive impacts of mining. We are producing a lot of drainage water. If that drainage water is treated, suspended solids are removed, we manage the pH, then it can be utilized for irrigation purposes. Increasing the productivity of agriculture in the nearby areas. Mine drainage water, in most cases, contains high suspended solids (TSS), which can be removed by using a simple settling pond. In a settling pond, you can store the water for some time and then remove the total suspended solids. Once TSS is removed, that water can be used for many useful purposes. Now, we come to the impact on air quality. So, we know in mining, there are many heavy earth-moving vehicles used for transportation. We have different plants where crushing operations are taking place. Then we have blasting. All these mining operations are generating particulate matter and dust. So, dust or particulate matter includes PM 10 and PM 2.5. These two are present in the National Ambient Air Quality Standard. Apart from the particulate matter, which are solid pollutants, we also have gaseous emissions like NO₂, SO₂, and CO₂.

IMPACT - AIR QUALITY

- Mining will lead to increment of PM10 concn due to crushing, movement of vehicles, handling of solids and fugitive emissions from storage areas.
- Impact on air quality due to blast fumes.
- Gaseous pollutant levels will increase: NO₂, SO₂ and CO generated from burning of fossil fuel in mobile and stationary sources.

Sl. No	Parameters	Predicted GLC (µg/m ³)
1	PM10	55.2
2	PM2.5	16.6



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14

Presently, we are also concerned with greenhouse gases like CO₂ and methane. In a coal mine, we also have greenhouse gases like methane and CO₂. These greenhouse gases are, till now, not listed in the National Ambient Air Quality Standard. But we are measuring greenhouse gas emissions for other statutory requirements, for other government requirements. Now, you can see the impact prediction by the EIA study through air quality modeling. They have predicted that PM 10 will be after mining, will become 52.2 micrograms per meter cube, and PM 2.5 will be 16.6 micrograms per meter cube. These predicted values are all within the National Ambient Air Quality Standard for the industrial zone. Now we come to the impact prediction for water quality. So, pollution of surface or groundwater due to total suspended solids, soil sediments coming from soil erosion, oil and grease produced in the workshop and other industrial units. The oil and grease come from the wastewater of the mine, the suspended solids come from surface runoff passing through coal stockpiles and stormwater passing through the mines through the coal areas and coal stockpile areas. Then disruption of natural drainage patterns in the core zone. We have discussed how the drainage pattern is disrupted by mining and the

IMPACT PREDICTION- WATER

Pollution of surface/ ground water due to TSS, Oil & Grease from:

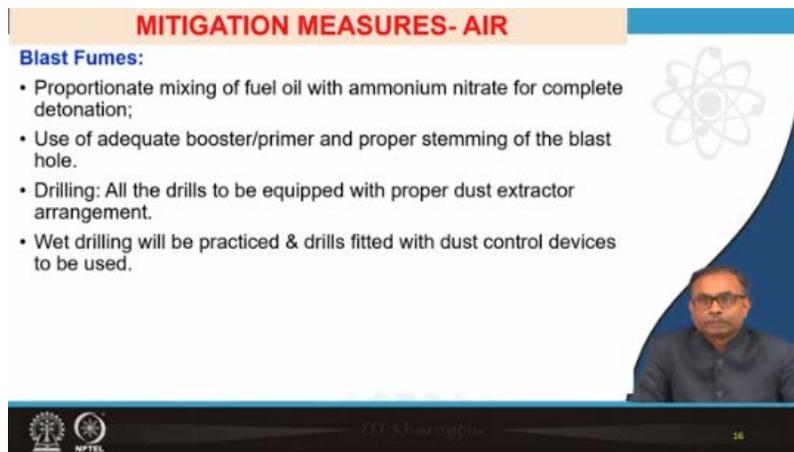
- Wastewater from workshop, mine
- Surface run off passing through coal stockpiles, storm water.
- Disruption of natural drainage pattern in the core zone.
- Deterioration of water quality & pollution of water bodies;
- Siltation in water streams causing scarcity of surface water.
- Depletion of aquifers in core zone, peripheral villages.

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15

overburden dump and pit. Deterioration of water quality and pollution of water bodies because of suspended solids, oil, grease, etc. Then siltation in the water stream: When there is a lot of soil erosion, the sediment is carried by surface runoff to nearby surface water bodies and surface water streams, and siltation will occur. Because of siltation, the carrying capacity of the water in the streams will decrease, and you will see a scarcity of surface water, particularly in the dry season. Because of mining, there will be a depletion of aquifers in the core zone in the mining area. Also, in the peripheral area and in the surrounding villages, there will be depletion or lowering of the water table. Mitigation measures will be suggested as part of the Environment Management Plan. EIA suggests mitigation measures for air quality, water quality, soil, flora, and fauna. Mitigation measures for air quality: first, we talk about blast fumes. We have discussed that mining

will have blasting. When you do blasting, there will be generation of particulate matter and blast fumes.



MITIGATION MEASURES- AIR

Blast Fumes:

- Proportionate mixing of fuel oil with ammonium nitrate for complete detonation;
- Use of adequate booster/primer and proper stemming of the blast hole.
- Drilling: All the drills to be equipped with proper dust extractor arrangement.
- Wet drilling will be practiced & drills fitted with dust control devices to be used.

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Blast fumes mostly consist of oxides of nitrogen, sulfur, etc. To reduce the emissions of the blast fumes from the blasting operation, a proportionate mixing of fuel oil with ammonium nitrate is necessary for complete and proper detonation. We need efficient blast design efficient explosive formulations, the use of adequate booster and primer, and proper stemming of the blast hole. Drilling operation also generates emissions, particularly the particulate matter or dust generated by the drilling. All the drill machines are to be equipped with proper dust extractor arrangement. Now the drilling machines come with the dust extractor arrangement. We have to practice wet drilling. As you know, there are two types of drilling: dry drilling and wet drilling. Dry drilling produces a lot of dust, but if you want to reduce your dust generation, you have to practice wet drilling. Drills fitted with dust control devices to be used to reduce dust generation. Dust is also produced at the loading and unloading points and during transportation. What are the measures that we can take for the dust at the loading and transportation? So, covering all service roads or permanent roads with asphalt, regular maintenance of HEMM heavy earth moving machinery engines to limit the emissions of the exhaust fumes, provision of gas filters for exhaust fumes of the HEMM frequent water spraying on the haul road, and service road. Normally, in opencast mining, water spraying is a common practice to control particulate matter generation. Provision of automatic sprinklers at the siding and haul roads.

MITIGATION MEASURES- AIR

Loading and Transport:

- Covering of all service roads/permanent roads by asphalt;
- Regular maintenance of HEMM engines to limit emission of exhaust fumes;
- Provision of gas filter for exhaust fumes from HEMM.
- Frequent water spraying on haul roads, and service roads.
- Provision of automatic sprinklers at siding and haul roads.
- Use of fine nozzle mounted fixed sprinklers and covering of belt conveyors.
- Physical removal of dust from the roads;
- Greenbelts around quarry, service building area, plantation along roads;



Nowadays automatic sprinklers are there that measures the ambient air particulate matter concentration and as and when the particulate matter concentration exceeds the set values, it will start spraying the water. Use of fine nozzle mounted fixed sprinklers and covering of the belt conveyors: you are transporting coal by a belt conveyor. So, you cover the belt conveyor and also along the belt conveyor also this automatic fixed sprinkler can be fitted. Physical removal of dust from roads. So, if we do the physical removal of dust then when the vehicle splash there will be less dust generation. Green belt around the quarry, service building areas and plantation along both sides of the roads. Now, waste handling and disposal, what are the measures that we can take? Topsoil is scrapped and stored in the designated place. Now, topsoil will be utilized in the embankment in the initial years and then when we go for the reclamation, the topsoil will be spread over the reclaimed area in the later phase during the progressive and the final closure of the mine. OB generated in the initial 5 year will be dumped on the surface in the central part of the block and then concurrent backfilling will commence from the 6th year onwards after the production commencement.

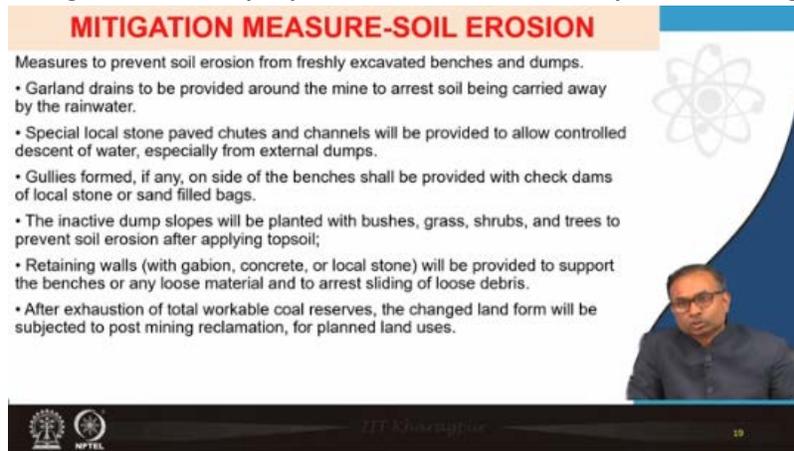
WASTE HANDLING AND DISPOSAL

- Top soil will be scrapped and stored in the designated place.
- Topsoil will be utilized in the embankment in the initial years, and will be spread over the reclaimed area in later phases during the progressive and final closure of the mine.
- OB generated in initial 5 yr will be dumped on the surface in the central part of the Block. Concurrent backfilling will commence from the 6th year of production commencement.
- Re-handling of the surface dump will commence after final year of the production and proposed to be completed by end of post closure period.



Rehandling of the surface dump will commence after the final year of the production and is proposed to be completed by end of post closure period. The mine closure is now a part of the mine plan and also when we are preparing the EIA and EMP. We consider the mine closure and we propose our environment management plan in line with the mine closure plan.

Mitigation measures for soil erosion. Measures to prevent soil erosion from freshly excavated benches and dumps. Garland drains to be provided around the mine to arrest the sediment being carried away by the rainwater. Normally we do the garland drains.



MITIGATION MEASURE-SOIL EROSION

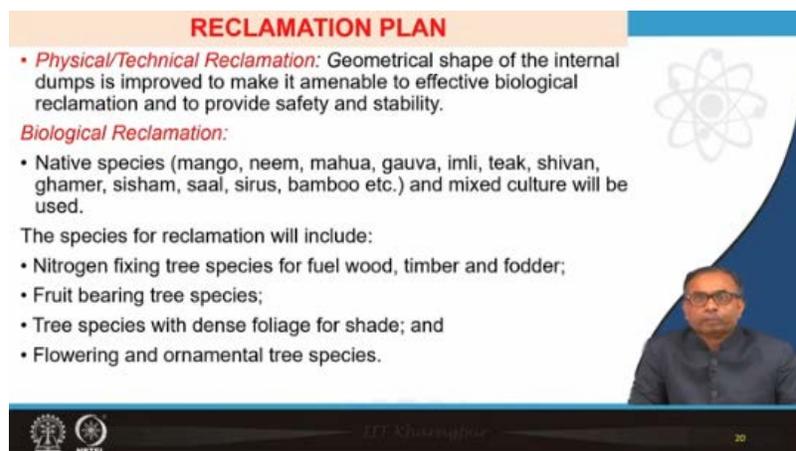
Measures to prevent soil erosion from freshly excavated benches and dumps.

- Garland drains to be provided around the mine to arrest soil being carried away by the rainwater.
- Special local stone paved chutes and channels will be provided to allow controlled descent of water, especially from external dumps.
- Gullies formed, if any, on side of the benches shall be provided with check dams of local stone or sand filled bags.
- The inactive dump slopes will be planted with bushes, grass, shrubs, and trees to prevent soil erosion after applying topsoil;
- Retaining walls (with gabion, concrete, or local stone) will be provided to support the benches or any loose material and to arrest sliding of loose debris.
- After exhaustion of total workable coal reserves, the changed land form will be subjected to post mining reclamation, for planned land uses.

19

Now special local stone paved chutes and channel will be provided to allow controlled descent of water especially from external dump. When the water descends from the dump, it may gain some speed and because of this high speed it will carry the sediment. So, now you reduce the speed by this arrangement. Gullies if formed on the side of the bench, shall be provided with check dam of local stones and sand filter bags retaining walls with gabion, concrete and local stone will be provided to support the benches or any loose material and to arrest this siding of loose debris. So, reclamation pond, this is one important part of the EIA. So, there are two types of reclamation.

One is the physical or technical reclamation, where we design the geometrical shape of the internal dumps to make them amenable to effective biological reclamation and also to



RECLAMATION PLAN

- **Physical/Technical Reclamation:** Geometrical shape of the internal dumps is improved to make it amenable to effective biological reclamation and to provide safety and stability.

Biological Reclamation:

- Native species (mango, neem, mahua, gauva, imli, teak, shivan, ghamer, sisham, saal, sirus, bamboo etc.) and mixed culture will be used.

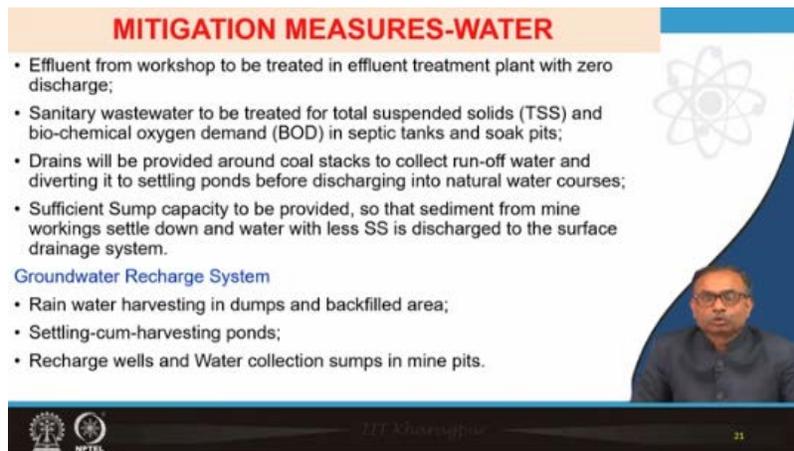
The species for reclamation will include:

- Nitrogen fixing tree species for fuel wood, timber and fodder;
- Fruit bearing tree species;
- Tree species with dense foliage for shade; and
- Flowering and ornamental tree species.

20

ensure the safety and stability of the dumps.

Now, biological reclamation will use native species available in that area, particularly mango, neem, mahua, guava, imli, teak, shivan, gomar, sisam, saal, syrus, bamboo, etc., and mixed culture will be used. We know that when we go for reclamation, mixed culture is preferable compared to monoculture. The species for reclamation will include nitrogen-fixing species, fuelwood and timber species, fodder, and fruit-bearing tree species, as this will generate revenue for local people. Tree species with dense foliage for shade and flowering or ornamental tree species will also be included. This is for commercial purposes to generate revenue for local people. Mitigation measures for water: effluent from workshops will be treated in an effluent treatment plant with zero discharge. Sanitary wastewater will be treated for the removal of TSS (total suspended solids) and the treatment of biochemical oxygen demand (BOD) in septic tanks and soak pits. Drains will be provided around the coal stacks so that runoff water is collected and directed to settling ponds.



MITIGATION MEASURES-WATER

- Effluent from workshop to be treated in effluent treatment plant with zero discharge;
- Sanitary wastewater to be treated for total suspended solids (TSS) and bio-chemical oxygen demand (BOD) in septic tanks and soak pits;
- Drains will be provided around coal stacks to collect run-off water and diverting it to settling ponds before discharging into natural water courses;
- Sufficient Sump capacity to be provided, so that sediment from mine workings settle down and water with less SS is discharged to the surface drainage system.

Groundwater Recharge System

- Rain water harvesting in dumps and backfilled area;
- Settling-cum-harvesting ponds;
- Recharge wells and Water collection sumps in mine pits.

The slide features a blue and white color scheme with a stylized atom logo in the top right. A video inset in the bottom right shows a man speaking. Logos for IIT Madras and NPTEL are visible in the bottom left corner, and the number 21 is in the bottom right corner.

where suspended solids can be removed, and then the runoff can be discharged into natural water streams. Sufficient sump capacity will be provided so that sediment from mine workings settles down, and water with fewer suspended solids is discharged into the surface drainage system. To mitigate adverse impacts on groundwater, we will implement a groundwater recharge system. Rainwater harvesting around the dumps and in backfilled areas will be executed. Settling-cum-harvesting ponds will be provided. Recharge wells and water collection sumps in mine pits will also be provided.

Now, noise and vibration are significant contributors to environmental degradation in mining. Major sources of noise include drilling and blasting operations, the operation of heavy earth-moving machinery like shovels, dumpers, and dozers, equipment in workshops, and crushers or other plants near the mining site.

IMPACT & MITIGATION MEASURES- NOISE

Major sources of noises:

- Drilling and Blasting operations
- Operation of HEMM like shovels, dumpers, dozers, etc.;
- Operation of equipment in workshop and plants
- Proper designing of plant & machinery by providing in-built mechanisms like **silencers, mufflers and acoustic enclosures and shock absorbing pads** at the foundation of vibrating equipment;
- Greenbelt around the quarry, plantation on both sides of the roads;
- To reduce noise exposure to workers: HEMMs with sound proof cabins; Personal protective devices to persons working in high noise areas

22

Proper design of plants and machinery includes inbuilt mechanisms like silencers, mufflers, acoustic enclosures, and shock-absorbing pads for vibrating equipment. Greenbelts should be developed around the quarry through plantation and along roadways to reduce noise exposure for workers who operate HEMM (Heavy Earth Moving Machinery). Therefore, HEMM should be equipped with soundproof cabins. Personal protective equipment (PPE) should be provided to personnel working in high-noise areas.

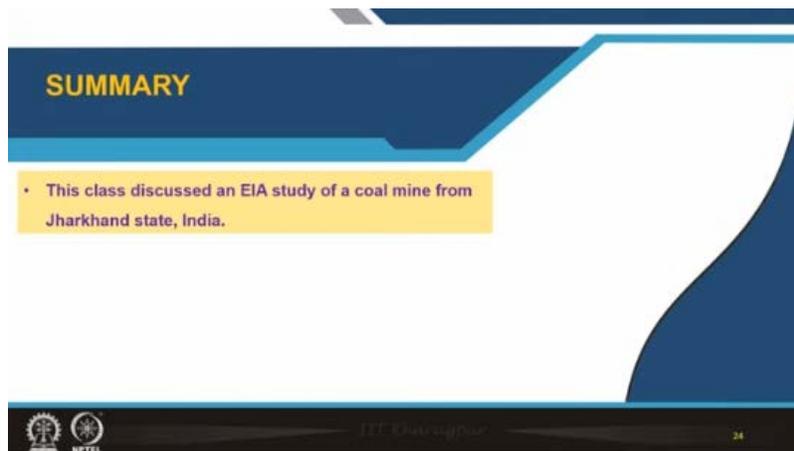
So, we have discussed the baseline environmental setting, environmental impacts, mitigation measures, and finally, environmental monitoring.

ENVIRONMENTAL MONITORING

- Post project environmental monitoring is important for evaluating performance of pollution control equipment installed in the project.
- Sampling and analysis of environmental parameters to be done as per guidelines of CPCB/ Jharkhand State Pollution Control Board (JSPCB).
- Disaster Management Plan (DMP) to mitigate the risks to be implemented for the project. The DMP will define responsibilities and resources to be made available to respond to emergencies envisaged.
- Training exercises will be held to ensure all personnel are familiar with their responsibilities and communication links are functioning effectively.

23

The EIA study recommends post-project environmental monitoring to evaluate the performance of pollution control equipment installed in the project. Sampling and analysis of environmental parameters will be conducted as per guidelines from the CPCB and the Jharkhand State Pollution Control Board. The EIA study also requires a disaster management plan, which will outline Disaster management plan: how to mitigate risks during mining operations and, in case of a disaster, define roles, responsibilities, and resources needed to respond to emergencies in the mines. For this purpose, training exercises will be held regularly to ensure all personnel are familiar with their responsibilities in emergencies and to verify communication links are functioning effectively. So, the disaster management plan is very important. We have come to the end of this class. In this session, we discussed an EIA study of a coal mine in Jharkhand, India. This reference is available in open-source; you can search for it online and review it further.



Last class, we talked about the EIA in general terms, and this class, we discussed an EIA case study that is an open-cast coal mine. So, taken together, both, I think you might have got a pretty good idea about how an EIA study is carried out, what is the utility of an EIA study, and what is the importance of an EIA study. I will end this class here, and I will see you in the next class. Thank you for your patient hearing. Thank you.