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Unit-II

MINERAL RESOURCES

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Minerals are naturally occurring, inorganic substances with a defined chemical composition and crystalline structure. They are a vital component of the geosphere, forming the building blocks of rocks and serving as crucial resources for human development.

1. Minerals in the Geosphere

Definition and Formation:

- Minerals are formed through geological processes such as crystallization from magma, precipitation from solutions, or metamorphism under high pressure and temperature.
- They are distributed in the Earth's crust, mantle, and core, with specific minerals characterizing different layers.

Role in the Geosphere:

- **Structural Component:** Minerals constitute rocks, which form the lithosphere.
- **Resource Base:** Provide essential raw materials for industries, energy, and agriculture.
- **Indicator of Geological Processes:** Mineral composition helps in studying Earth's history and plate tectonics.

2. Types of Minerals

Minerals are broadly classified into:

(a) Metallic Minerals:

- Contain metals in their chemical composition.
- **Examples:** Iron (hematite), aluminum (bauxite), copper (chalcopyrite), and gold.
- **Characteristics:**
    - High conductivity and malleability.
    - Often associated with igneous and metamorphic rocks.

(b) Non-Metallic Minerals:

- Do not contain metals and are used in industries for their chemical and physical properties.
- **Examples:** Limestone, gypsum, mica, and quartz.
- **Characteristics:**
    - Poor conductivity and lack of metallic luster.
    - Found in sedimentary and metamorphic rocks.

(c) Energy Minerals:

- Provide energy resources such as coal, petroleum, and uranium.
- **Examples:** Coal, oil shale, natural gas, and thorium.

3. Extraction of Minerals

Mining Techniques:

Mineral extraction involves various mining methods depending on the type, location, and value of the mineral deposit.

Surface Mining:

- Involves removing overburden to access mineral deposits near the surface.
- **Types:** Open-pit mining, strip mining, and quarrying.

Underground Mining:

- Used for deep-seated mineral deposits.
- **Techniques:** Shaft mining and drift mining.

Placer Mining:

- Extracts minerals from alluvial deposits using water.
- Commonly used for gold, tin, and gemstones.

In-situ Leaching:

- Involves injecting chemicals into the ground to dissolve minerals, which are then pumped to the surface.

4. Mining - Metal and Non-Metal Resources

Metal Resources:

- Includes iron, copper, aluminum, gold, and nickel.
- Extracted primarily for industrial applications such as construction, transportation, and electronics.

Non-Metal Resources:

- Includes limestone, gypsum, phosphate, and clay.
- Essential for industries like cement manufacturing, fertilizers, and ceramics.

5. Exploitation of Mineral Resources

Reasons for Exploitation:

- Rising global demand for minerals due to industrialization and urbanization.
- Need for technological advancements requiring rare earth elements.
- Economic growth fueled by export of mineral resources.

Consequences of Over-Exploitation:

- Depletion of non-renewable resources.
- Increased energy consumption for deeper and lower-grade deposits.
- Social conflicts over land and resource ownership.

Case Study: Dehradun–Mussoorie Mine Belt

The Dehradun–Mussoorie belt in Uttarakhand, India, is historically significant due to its extensive limestone mining activities. This case study highlights the ecological, social, and economic impacts of unregulated mining in this region and the subsequent interventions to mitigate the damage.

1. Introduction to the Region

- ***Geography and Significance***

- The Dehradun–Mussoorie region is part of the Shivalik and Lesser Himalayan ranges.
- Known for its rich limestone deposits, this area has been extensively mined since the early 20th century.
- Limestone from this belt was used for industrial purposes, particularly in cement and steel manufacturing.

- ***Ecological Sensitivity***

- The region is characterized by dense forests, diverse wildlife, and significant water resources, including springs and rivers like the Ganga and Yamuna.
- The area also serves as a buffer zone between the plains and the fragile Himalayan ecosystem.

2. Mining Activities in the Dehradun–Mussoorie Belt

- ***Extent of Mining***

- Mining was carried out across a large area, often unregulated and without adequate planning.
- Techniques such as blasting and open-pit mining were used, causing significant disruption to the landscape.

- ***Economic Importance***

- Limestone mining contributed to local and national economies, providing raw materials for industries.
- It created employment opportunities for local communities.

3. Environmental and Social Impacts

- ***Environmental Degradation***

1. **Deforestation and Habitat Loss:**
    - Large-scale deforestation occurred to access limestone deposits, disrupting local biodiversity.
2. **Soil Erosion:**
    - Removal of vegetation and mining activities caused severe soil erosion, leading to landslides.
3. **Water Resources:**
    - Mining disrupted natural water systems, reducing groundwater recharge and drying up springs.
    - Increased siltation in rivers impacted water quality downstream.
4. **Air and Noise Pollution:**
    - Dust from blasting and excavation contributed to air pollution, affecting local health.
    - Continuous blasting caused noise pollution, disturbing local fauna.

- ***Impact on Local Communities***

1. **Livelihoods:**
    - While mining created jobs, it also displaced traditional livelihoods like agriculture and forestry.
2. **Health Issues:**
    - Mining workers and nearby residents faced respiratory problems due to dust exposure.
3. **Loss of Cultural Sites:**
    - Sacred groves and other culturally significant locations were destroyed.

4. Legal and Policy Interventions

- ***Supreme Court Intervention (1983):***
- The unchecked mining activities in the Dehradun–Mussoorie belt drew public attention, leading to a landmark case: **Rural Litigation and Entitlement Kendra (RLEK) vs. State of Uttar Pradesh**.
- The Supreme Court of India ordered the closure of several limestone mines in the region, citing environmental concerns and the violation of constitutional rights to a healthy environment.
- ***Establishment of Doon Valley as an Eco-Sensitive Zone:***
- Following the court's directive, the Indian government declared the Doon Valley an eco-sensitive zone.
- Strict regulations were imposed on mining activities, including:
    - Prohibition of open-pit mining.
    - Restoration and afforestation of mined areas.
- ***Policy Changes:***

5. Restoration Efforts and Current Status

- ***Afforestation Projects:***
- Large-scale reforestation initiatives were undertaken to restore degraded landscapes.
- Native tree species were planted to rebuild ecosystems.
- ***Promotion of Alternative Livelihoods:***
- Efforts were made to promote sustainable livelihoods like eco-tourism, organic farming, and handicrafts.
- Training programs were introduced to help local communities transition from mining-related jobs.

6. Lessons Learned

- **Need for Sustainable Practices:**
  - The case underscores the importance of balancing resource extraction with environmental conservation.
- **Role of Judiciary in Environmental Protection:**
  - Judicial intervention was crucial in preventing further degradation and setting legal precedents for environmental cases.
- **Community Involvement:**
  - Engaging local communities in restoration and sustainable practices ensures long-term success.
- **Holistic Management:**
  - Effective environmental management requires an integrated approach, combining legal, ecological, and social strategies.

REFERENCE

- 1. Environmental Encyclopedia, Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. (2001) , Jaico Publishing House.
- 2. Text book of Environmental Studies, Eranch Bharucha (2005), Universities Press.
- 3. Environmental Studies, Kumarasamy K, Alagappa Moses A and Vasanthy M (2004), Bharathidasan University Publishers.
- 4. Environmental Science and Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press. 5. Instant notes Ecology, Aulay Mackenzie, Andy S. Ball and Sonia R. Virdee (2002), Bios Scientific Pub. Ltd.,
- 6. Environmental Science, Physical Principals and Application, Egbert Boeker and rienk van Grondelle (2001), John Wiley & Sons.
- 7. Environmental Science, Santra, S.C (2005), New Central Book Agency (P) Ltd.,


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