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SAIRAM
DIGITAL RESOURCES

YEAR
II

SEM
IV

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ENVIRONMENTAL SCIENCE AND ENGINEERING

SCIENCE & HUMANITIES



UNIT No. 3 NATURAL RESOURCES

3.3 Mineral resources

- Use and exploitation, environmental effects of extracting and using mineral resources.
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture.



Mineral Resources

Uses of minerals:

Mineral is an element or inorganic compound that occurs naturally. The main uses of minerals are as follows:

- ❖ Development of industrial plants and machinery
- ❖ Generation of energy e.g. coal, lignite, uranium
- ❖ Construction, housing, settlements
- ❖ Defense equipments- weapons, settlement
- ❖ Transportation means
- ❖ Communication-telephone wires, cables, electronic devices
- ❖ Medical system- particularly in Ayurvedic System
- ❖ Formation of alloys for various purposes
- ❖ Agriculture- as fertilizers, seed dressings and fungicides
- ❖ Jewellery- eg. Gold, silver, platinum, diamond

Environmental impacts of mineral extraction:

Major mines which are known for causing severe problems are given below:

- ❖ Jaduguda Uranium Mine, Jharkhand- exposing local people to radioactive hazards.
- ❖ Jharia coal mines, Jharkhand- underground fire leading to land subsidence and forced displacement of people.
- ❖ Sukinda chromite mines, Orissa- Seeping of hexavalent chromium into the river posing serious health hazard, Cr^{6+} being highly toxic and carcinogenic.
- ❖ Kudremukh iron ore mine, Karnataka- causing river pollution and threat to biodiversity.
- ❖ East coast Bauxite mine, Orissa-Land encroachment and issue of rehabilitation unsettled.
- ❖ North-Eastern Coal Fields, Assam-Very high sulphur contamination of groundwater.

Impacts of mining:

Mining is done to extract minerals from deep deposits in soil. Environmental damages caused by mining activities are as follows:

Devegetation and defacing of lands:

Mining requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of the landscape in the area.

Subsidence of land:

Subsidence of mining areas results in tilting of buildings, cracks in houses, buckling of roads, bending of rail tracks and leaking of gas from cracked pipe lines leading to disasters.

Groundwater contamination:

Mining pollutes the groundwater. Sulphur, usually present as an impurity in many ores, is known to get converted into sulphuric acid through microbial action, thereby making the water acidic.

Surface water pollution:

The acid mine drainage often contaminates the nearby streams and lakes. The acidic water, radioactive substances like uranium, and heavy metals also contaminate the water bodies and kill aquatic animals.

Air pollution:

In order to separate and purify the metal from other impurities in the ore, smelting is done which emits enormous quantities of air pollutants. Oxides of sulphur, arsenic, cadmium and lead etc. shoot up in the atmosphere near the smelters and the public suffers from several health problems.

Occupational Health Hazards:

Miners working in different type of mines suffer from asbestosis, silicosis, black lung disease etc

Remedial measures:

- ❖ Adopting eco-friendly mining technology
- ❖ Utilization of low grade ores by using microbial – leaching technique. In this method, the ores are inoculated with the desired strains of bacteria like Thiobacillus ferrooxidans, which remove the impurities and leave the pure mineral.
- ❖ Revegetating mined areas with appropriate plants
- ❖ Gradual restoration of flora

Case studies of mining:**1. Mining and quarrying in Udaipur**

- ❖ Soap stones, building stone, and dolomite mines spread over 15,000 hectares in Udaipur have caused many adverse impacts on the environment.
- ❖ About 150 tons of explosives are used per month in blasting.
- ❖ The Maton mines have badly polluted the Ahar river.

- ❖ The hills around the mines are suffering from acute soil erosion.
- ❖ The wastewater flows towards a big tank of " Bag Dara".
- ❖ Due to scarcity of water people are compelled to use this effluent for irrigation purposes.
- ❖ Animals like tiger, lion, deer, and birds have disappeared from the mining area.

2. Mining in Sariska Tiger Reserve in Aravallis

- ❖ The Aravalli range is spread over about 692 Km in North-west India covering Gujarat, Rajasthan, Haryana, and Delhi.
- ❖ The hill is rich in mineral resources.
- ❖ Mining operations within and around the Sariska Tiger reserve has left many areas permanently infertile and barren.
- ❖ The precious wild life is under serious threat.

Food Resources

Causes of World Food Problems?

- ❖ During the last 50 years world grain production has increased almost three times.
- ❖ The per capita production is increased by about 50%.
- ❖ At the same time population growth increased at such a rate in less developed countries.
- ❖ Every 40 million people die of undernourishment and malnutrition.
- ❖ This means that every year our food problem is killing as many people as were killed by the atomic bomb dropped on Hiroshima during World War II.
- ❖ This statistics emphasize the need to increase our food production, and also to control population growth.
- ❖ It is estimated that 300 millions are still undernourished.

Overgrazing:

Overgrazing can limit livestock production. Overgrazing occurs when too many animals graze for too long and exceed the carrying capacity of a grassland area.

Impact of overgrazing:

Land degradation: Overgrazing removes the grass cover. The humus content of the soil is decreased and it leads to poor, dry, compacted soil.

Soil erosion: The soil roots are very good binders of soil. When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.

Loss of useful species: Due to overgrazing the nutritious species like cenchrus, panicum etc. are replaced by thorny plants like Parthenium, Xanthium etc. These species do not have a good capacity of binding the soil particles and, therefore, the soil becomes more prone to soil erosion.

Traditional Agriculture and its impacts:

- ❖ Usually involves a small plot
- ❖ Simple tools
- ❖ Naturally available water
- ❖ Organic fertilizer and a mix of crops

Main impacts:

- ❖ Deforestation
- ❖ Soil erosion
- ❖ Depletion of nutrients

Modern Agriculture and its impacts:

- It makes use of hybrid seeds of selected and single crop variety.
- high-tech equipments, lots of energy subsidies in the form of fertilizers and, pesticides
- Irrigation water

Main impacts:

I. Impacts related to high yielding varieties (HYV):

The uses of HYVs encourage monoculture i.e. the same genotype is grown over vast areas. In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of the disease.

II. Fertilizer related problems:

a. Micronutrient imbalance:

Chemical fertilizers have nitrogen, phosphorus and potassium (N,P,K) which are essential macronutrients. Excessive use of fertilizers cause micronutrient imbalance. For example, excessive fertilizer use in Punjab and Haryana has caused deficiency of the micronutrient Zinc in the soils, which is affecting productivity of the soil.

b. Nitrate Pollution:

Nitrogenous fertilizers applied in the fields often leach deep into the soil and ultimately contaminate the groundwater. The nitrates get concentrated in the water and when their concentration exceeds 25 mg/L, they become the cause of a serious health hazard called "Blue Baby Syndrome" or methemoglobinemia. This disease affects the infants to the maximum extent causing even death.

c. Eutrophication:

A large proportion of nitrogen and phosphorus used in crop fields is washed off along with runoff water and reaches the water bodies causing over nourishment of the lakes, a process known as Eutrophication. (Eu=more, tropic=nutrition). Due to Eutrophication the lakes get invaded by algal blooms. These algal species grow very fast by rapidly using up the nutrients. The algal species quickly complete their life cycle and die thereby adding a lot of dead matter. The fishes are also killed and there is a lot of dead matter that starts decomposing.

Oxygen is consumed in the process of decomposition and very soon the water gets depleted of dissolved oxygen. This further affects aquatic fauna and ultimately anaerobic conditions are created where only pathogenic anaerobic bacteria can survive. Thus, due to excessive use of fertilizers in the agricultural fields the lake ecosystem gets degraded.

III. Pesticide related problems: Thousands of types of pesticides are used in agriculture.

The first generation pesticides include chemicals like sulphur, arsenic, lead or mercury to kill the pests. They have number of side effects as discussed below:

a. Creating resistance in pests and producing new pests: About 20 species of pests are now known which have become immune to all types of pesticides and are known as "Super pests".

b. Death of non-target organisms: Many insecticides not only kill the target species but also several non-target species that are useful to us.

c. Biological magnification: Many of the pesticides are non-biodegradable and keep on accumulating in the food chain, a process called biological magnification. This is very harmful.

IV. Water Logging: Over irrigation of croplands by farmers for good growth of their crop usually leads to water logging. Inadequate drainage caused excess water to accumulate underground and gradually formed a continuous column with the water table. Under waterlogged conditions, pore-spaces in the soil get fully drenched with water and the soil- air gets depleted. The water table rises while the roots of plants do not get adequate air for respiration, Mechanical strength of the soil declines, the crop plants get lodged and crop yield falls. In Punjab and Haryana, extensive areas have become waterlogged due to adequate canal water supply or tube-well water. Preventing excessive irrigation, sub-surface drainage technology and bio-drainage with trees like Eucalyptus are some of the remedial measures to prevent water logging.

V. Salinity Problem: At present one third of the total cultivable land area of the world is affected by salts. Saline soils are characterized by the accumulation of soluble salts like sodium chloride, sodium sulphate, calcium chloride, magnesium chloride etc. in the soil profile. Their electrical conductivity is more than 4 dS/m. Sodic soils have carbonates and bicarbonates of sodium, the pH usually exceeds 8.0 and the exchangeable sodium percentage (ESP) is more than 15%.

Remedy:

- (i) The most common method for getting rid of salts is to flush them out by applying more good quality water to such soils.
- (ii) Another method is laying an underground network of perforated drainage pipes for flushing out the salts slowly.

Case studies

Salinity and water logging in Punjab, Haryana and Rajasthan:

- The first alarming report of salt-affected wasteland formation due to irrigation practices came from Haryana in 1858.
- Several villages in Panipat, and Delhi lying in Western Yamuna Canal were suffering from salinity problems.
- The floods of 1947, 1950, 1952, 1954-55 in Punjab resulted in aggravated water logging with serious drainage problems.
- Introduction to canal irrigation in 1.3 m ha in Haryana resulted in a rise in water table followed by water-logging and salinity in many irrigated areas as a result of fall in crop productivity.
- Rajasthan too has suffered badly in this regard following the biggest irrigation project "Indira Gandhi Canal Project"

Video link:

Mineral resources: https://www.youtube.com/watch?v=HOtQ_iRq4Tk

Food resources: <https://www.youtube.com/watch?v=RjsThobgq7Q>

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