

Unit-I

A. ENVIRONMENT

1.1 DEFINITION

What is Environment and why do we now notice so much interest in Environmental Studies in recent years?

Environment is the sum total of all conditions and influences that affect the development and life of all organisms on earth. The living organisms vary from the lowest micro-organisms such as bacteria, virus, fungus, etc. to the highest, including man. Each organism has its own environment (physical and biological).

The word “environment” originates from “environ” which means things that surround. As per definition of the Environment Protection Act, environment includes all the physical and biological surroundings and their interactions.

The study of environment or rather environmental studies is a multi-disciplinary subject which needs knowledge interest from physical sciences (physics, chemistry, mathematics), biological sciences (botany, zoology, microbiology, biochemistry), social sciences, economics, sociology, education, geography) etc. Obviously, environmental studies has a broad base, which requires integrated approach for dealing with the various aspects.

1.2 ECOLOGY

The word “Ecology” was coined by a German biologist in 1869 and is derived from the Greek word, “Oikos” meaning “House”. Ecology is the branch of science that deals with the study of interactions between living organisms and their physical environment. Both are closely inter-related and they have continuous interaction so that any change in the environment has an effect on the living organisms and vice-versa. Any unit of biosystem that includes all the organisms which function together (biotic community) in a given area where they interact with the physical environment is known as ecosystem.

The ecosystem is the functional unit in ecology as it consists of both the biotic community (living organisms) and the abiotic environment. The latter has close interaction essential for maintenance of life processes. The interaction is conducted by energy flow (solar energy) in the system and cycling of materials (natural cycles).

From the biological point of view, the ecosystem has the following constituents:

- (i) Inorganic substances (carbon, nitrogen, carbon dioxide, water, etc.) involved in natural cycles.
- (ii) Organic compounds (proteins, carbohydrates, humic substances) etc.
- (iii) Air, water and substrate environment including the climatic regime and other physical factors.
- (iv) Producers, autotrophic (i.e., self-sustaining organisms) green plants that can manufacture food from simple inorganic substances.
- (v) Heterotrophic (i.e., that depend on others for nourishment) organisms, mainly bacteria, fungi and animals which live on other organisms or particulate organic matter.
- (vi) Micro-consumers, decomposers, mainly bacteria, fungi which obtain their energy by breaking down dead tissues or by absorbing dissolved organic matter, extracted from plants or other organisms. The decomposers release

inorganic nutrients that are utilised by producers. They also supply food for macro-consumers or heterotrophic organisms. Bacteria, fungi (and animals) often excrete hormone-like substances that inhibit or stimulate other biotic components of the ecosystem.

Typical profiles of a grassland ecosystem and of a pond ecosystem are shown in Fig. 1.1.

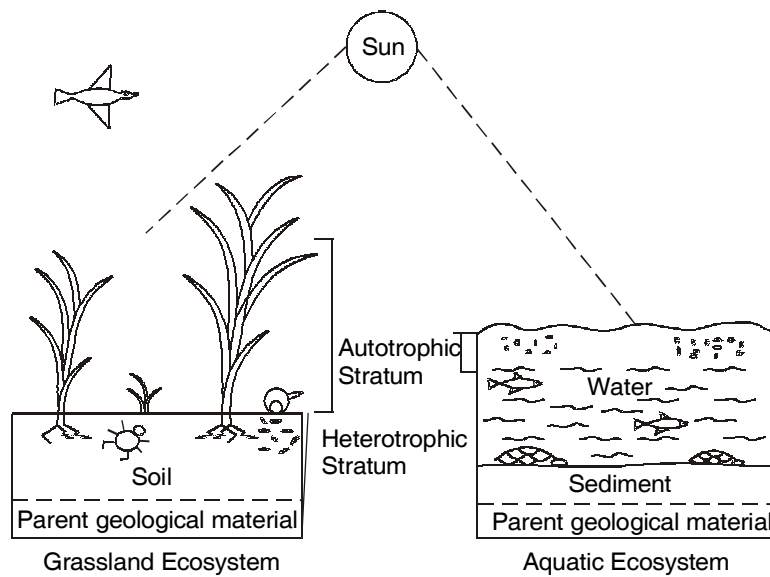


Fig. 1.1: Grassland and pond ecosystems

The common features of all ecosystems—terrestrial, freshwater, marine and agricultural—are the interactions between the autotrophic and the heterotrophic components. The major autotrophic metabolism occurs in the upper “green belt” stratum where solar energy is available while the intense heterotrophic metabolism occurs in the lower “brown belt” where organic matter accumulates in soils and sediments.

1.2.1 Biomes

The Biome is a very large land community unit where the plant species are more or less uniform. It provides a basis for

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natural ecological classification. The main biomes of the world are the Tundra; Temperate, Coniferous and Deciduous forests, Temperate grassland; Tropical Savanna; Desert and Tropical Rain Forests.

The *Tundra Biome* is in the polar region (north of latitude 60° North)—it is characterised by absence of trees, dwarf plants and an upper ground surface which is wet, spongy and rough.

Temperate Coniferous Forest Biome Coniferous forests occur in cold regions with high rainfall, long winters and short summers.

Temperate Deciduous Forest Biome These are high altitude regions about 3000–4000 metres above sea level as in the Himalayas. Here pines, fir and juniper trees are found.

Temperate Grassland Biome This type of grassland occurs where there is about 25 to 75 cm of rainfall per year. Such grasslands are found as tall grass prairies, short grass prairies of North America and also in South America, steppes of Southern Russia and Asia.

Tropical Savanna Biome These are tropical grasslands with scattered drought-resistant trees. These are found in eastern Africa, Australia and South America.

Desert Biome These are found in very dry environment where temperature changes from very hot to very cold.

Tropical Rainforest Biome These occur near the equator and offer the most diverse communities on earth with fairly high temperature and humidity. The annual rainfall is more than 200–225 cm. Here one finds dense vegetation consisting of tall trees covered with creepers and orchids, numerous herbs and shrubs. Tropical rainforest is the habitat of numerous vertebrate and invertebrate animals.

1.3 SCOPE

Environmental studies as a subject has a wide scope. It encompasses a large number of areas and aspects, which may be summarized as follows.

Natural resources — their conservation and management

Ecology and biodiversity

- Environmental pollution and control
- Social issues in relation to development and environment
- Human population and environment

These are the basic aspects of environmental studies which have a direct relevance to every section of the society. Environmental studies can also be highly specialized concentrating on more technical aspects like environmental science, environmental engineering or environmental management.

In the recent years, the scope of environmental studies has expanded dramatically the world over. Several career options have emerged in this field that are broadly categorized as:

- (i) *Research & Development (R & D) in environment:* Skilled environmental scientists have an important role to play in examining various environmental problems in a scientific manner and carry out R& D activities for developing cleaner technologies and promoting sustainable development.

There is a need for trained manpower at every level to deal with environmental issues. Environmental management and environmental engineering are emerging as new career opportunities for environmental protection and management. With the pollution control laws becoming more stringent, industries are finding it difficult to dispose off the wastes produced. In order to avoid expensive litigation, companies are now trying to adopt green technologies, which would reduce pollution.

Investing in pollution control technologies will reduce pollution as well as cut on costs for effluent

treatment. Market for pollution control technology is increasing the world over. Cleaning up of the wastes produced is another potential market. It is estimated to be more than \$100 billion per year for all American business. Germany and Japan having more stringent laws for many years have gained more experience in reducing effluents. Still there is a \$ 200 billion market for cleaning up the former East Germany alone. In India also the Pollution Control Boards are seriously implementing pollution control laws and insisting on upgradation of effluents to meet the prescribed standards before they are discharged on land or into a water body. Many companies not complying with the orders have been closed or ordered to shift.

- (ii) *Green advocacy*: With increasing emphasis on implementing various Acts and laws related to environment, need for environmental lawyers has emerged, who should be able to plead the cases related to water and air pollution forest, wildlife etc.
- (iii) *Green marketing*: While ensuring the quality of products with ISO mark, now there is an increasing emphasis on marketing goods that are environment friendly. Such products have ecomark or ISO 14000 certification. Environmental auditors and environmental managers would be in great demand in the coming years.
- (iv) *Green media*: Environmental awareness can be spread amongst masses through mass media like television, radio, newspaper, magazines, hoardings, advertisements etc. for which environmentally educated persons are required.
- (v) *Environment consultancy*: Many non- government organizations (NGOs), industries and government bodies are engaging environmental consultants for systematically studying and tackling environment related problems.

1.4 IMPORTANCE OF ENVIRONMENT

Environment belongs to all and is important to all. Whatever be the occupation or age of a person, he will be affected by environment and also he will affect the environment by his deeds. That is why we find an internationally observed environment calendar to mark some important aspect or issue of environment.

ENVIRONMENTAL CALENDER

World Wetland Day	February 2
World Forest Day	March 21
World Day for Water	March 22
World Meteorological Day	March 23
Earth Day	April 22
International Biodiversity Day	May 22
Anti-tobacco Day	May 31
World Environment Day	June 5
World Ocean Day	June 8
World Population Day	July 11
Ozone Week	Sept. 16–23
World Car-free Day	Sept. 22
Green Consumer Day	Sept. 28
World farm Animal's Day	Oct. 2
World Habitat Day	Oct. 3
World Animal Welfare Day	Oct. 4
Wildlife Week	Oct. 1–7
World Conservation Day	Oct. 24
International Day for Natural Disaster Reduction	Oct. 13
International Day for Biological Diversity	Dec. 29

Global Vs. Local Nature of Environment

Environment is one subject that is actually global as well as local in nature.

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Issues like global warming, depletion of ozone layer, dwindling forests and energy resources, loss of global biodiversity etc. which are going to affect the mankind as a whole are global in nature and for that we have to think and plan globally.

However, there are some environmental problems which are of localized importance. For dealing with local environmental issues, e.g impact of mining or hydro-electric project in an area, problems of disposal and management of solid waste, river or lake pollution, soil erosion, water logging and salinization of soil, fluorosis problem in local population, arsenic pollution of groundwater etc., we have to think and act locally.

In order to make people aware about those aspects of environment with which they are so intimately associated, it is very important to make every one environmentally educated.

Individualistic Nature of Environment

Environmental studies is very important since it deals with the most mundane problems of life where each individual matters, like dealing with safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and sustainable development. If we want to live in a clean, healthy, aesthetically beautiful, safe and secure environment for a long time and wish to hand over a clean and safe earth to our children, grandchildren and great grandchildren, it is most essential to understand the basics of environment.

1.5 NEED FOR PUBLIC AWARENESS

International Efforts for Environment

Environmental issues received international attention about 36 years back in Stockholm Conference, held on 5th June, 1972. Since then we celebrate **World Environment**

Day on 5th June. At the United Nations Conference on **Environment and Development** held at Rio de Janeiro, in 1992, known popularly as **Earth Summit**, and ten years later, the **World Summit on Sustainable Development**, held at Johannesburg in 2002, key issues of global environmental concern were highlighted. Attention of general public was drawn towards the deteriorating environmental conditions all over the world.

Award of the Nobel Peace Prize (2004) to an environmentalist, for the first time, came as a landmark decision, showing increasing global concern towards environmental issues and recognition to efforts being made for environmental conservation and protection.

Public Awareness for Environment

The goals of sustainable development cannot be achieved by any government at its own level until the public has a participatory role in it. Public participation is possible only when the public is aware about the ecological and environmental issues.

The public has to be educated about the fact that if we are degrading our environment we are actually harming our own selves. This is because we are a part of the complex network of environment where every component is linked up. It is all the more important to educate the people that sometimes the adverse impact of environment are not experienced until a threshold is reached. So we may be caught unawares by a disaster.

A drive by the government to ban the littering of polythene cannot be successful until the public understands the environmental implications of the same. The public has to be made aware that by littering polythene, we are not only damaging the environment, but posing serious threat to our health.

There is a Chinese proverb “*If you plan for one year, plant rice, if you plan for 10 years, plant trees and if you plan for 100 years, educate people.*” If we want to protect and manage our planet earth on sustainable basis, we have no other option but to make all persons environmentally educated.

1.6 ECOSYSTEMS

Ecosystems of the world are studied on the basis of their principal habitats. Among the environmental segments, lithosphere and hydrosphere are the major habitats for a wide variety of flora and fauna.

Land-based Ecosystem

Land (terrestrial) ecosystems depend largely on the climate and soil. Higher plants and animals have evolved on land. For example, seed plants, insects, warm-blooded vertebrates and micro-organisms dominate on land now. The major terrestrial communities consist of herbaceous plants, shrubs, grass and also woody trees besides numerous insects, arthropods, birds, etc.

Marine Ecosystem

Oceans occupy 70 per cent of earth's surface, offering habitat to numerous plants (mainly algae), animals like zoo plankton, shrimps, oysters, fishes, reptiles, birds and mammals. They serve as the sink of a large quantity of run-off and wastes from land.

Marine water has a high salt content (about 3.5 % by weight) and poor fertility due to lack of nitrates and phosphates as compared to freshwater. Marine life is abundant near the shore and in the continental shelf. The species include commercial fishes, large sea mammals like whales and seals.

Freshwater Ecosystem

Freshwater bodies (ponds, lakes, rivers, springs) are rich in nutrients (nitrates, phosphates) and provide good habitat for phytoplankton, zooplankton, aquatic plants and fishes.

Wetland Ecosystems

Wetlands are transitional lands between terrestrial and eco-systems where water stands at 2.5 to 300 cm during most of the year. They include valuable natural ecosystem harbouring a wide variety of plants, animals, fishes and micro-organisms. They are at present in danger due to increasing urbanization as in the case of eastern part of Kolkata.

Mangroves (Forest between Land and Sea)

Mangroves are important forest communities in tidal zones or equatorial and tropical coasts. For example, the Sunderbans in the Gangetic estuarine delta touching the Bay of Bengal offer important mangroves, habitat of wild animals including Royal Bengal Tiger and of interesting plant species.

1.7 SUSTAINABLE ECOSYSTEM

The developing countries face today critical situation on economic and environmental fronts. For economic growth they have to give priority to agricultural industrial bases but at the cost of environment. The resource base, once depleted, sets in chain of environmental degradation which finally weakens the economy. Our population explosion remains the core issue. Our development policy should be such that the ecosystem is sustainable, i.e., it contains the element of renewability. This requires sound management strategy which ensures the continuation of socio-economic development in the long run.

The important components of sustainable development/ ecosystem are:

- Population stabilisation
- Integrated land use planning
- Conservation of biodiversity
- Air and water pollution control
- Renewable energy resources
- Recycling of wastes and residues
- Environmental education and awareness at all levels.

1.8 HUMAN ACTIVITIES AND ENVIRONMENT

Food: World grain production increased almost three times during the last 50 years. But at the same time population growth increased in the developing or Third World countries at such rate that it surpassed food production. Each year about 40 million people in the developing countries die of malnutrition and starvation. In other words, our food shortage in some areas is killing every year as many people as were killed by the dropping of atom bomb on Hiroshima during World War II.

India is the third largest producer of the staple crops—wheat, rice, maize but about 300 million people are still undernourished (receiving less than 90 % of the minimum required calorie intake of 2500 calories/day). Our food crises are directly linked to population explosion (See also Unit-III).

Shelter, Economic and Social Security: India has the lowest man:land ratio—barely 0.48 ha. per capita. It has continuously declined since the 60s. Land is facing too much pressure on various fronts due to increasing population—housing (shelter), agriculture, industry, urbanisation etc. In order to satisfy his needs and greeds for better lifestyle, man has been exploiting the natural resources—forests, water bodies, minerals etc. excessively. This has led to environmental degradation and pollution which, in turn, have threatened his economic and social security and, as a matter of fact, his survival on earth.

B. HUMAN ACTIVITIES AND THEIR IMPACT ON ENVIRONMENT

For economic development and better living, man has sacrificed forest land for agriculture, industries, urbanization etc. This has brought in to trail environmental disaster and backfired on man himself endangering his existence on earth.

1.9 AGRICULTURE

The dawn of human civilization can be traced back to the discovery of agriculture almost 10,000 years ago. In the early period, man used the primitive practice of *slash and burn cultivation or shifting cultivation*, which is still prevalent in many tribal areas, as in North East India in the hill regions.

The two modes of agriculture—traditional and modern—are described below along with their impacts.

- (i) ***Traditional Agriculture and its Impact:*** It involves small plots, simple tools, natural water, organic fertilizer and several crops. The yield is, however, low but it is still used by about 50% of the world population. The impacts of this type of agriculture are as follows:
 - (a) *Depletion of Nutrients:* During slash and burn of trees in forests, the organic matter in soil is destroyed and within a short period most of the nutrients are taken up by the crops. Thus the soil becomes deficient in nutrients and compels the cultivators to shift to another area.
 - (b) *Deforestation:* Forest land is cleared by slash and burn of trees in forest for cultivation purposes. Frequent shifting of cultivation plots leads to deforestation i.e., loss of forest cover.
 - (c) *Soil Erosion:* As a result of deforestation, soil gets exposed to the weathering forces i.e., rain, wind and storms and is subjected to erosion. The net result is loss of top fertile soil.
- (ii) ***Modern Agriculture and its Impact:*** It is based on high input–high *output* technique using hybrid seeds of high-yielding variety and abundant irrigation water, fertilizers and pesticides. This is the basis of “*Green Revolution*” which boosted the production of wheat and India became self-sufficient in food. But

the fallout from Green Revolution has become evident since the 90s (1990) as shown below:

- (a) *Impacts from HYV (High-Yielding Varieties):* Application of seeds of HYV gave rise to monoculture i.e., the same species (genotype) grown over vast areas, such monoculture is vulnerable to attack by some pathogen, which spreads like wild fire, devastating crops over large areas.
- (b) *Fertilizer Problems:* Essential micronutrients—nitrogen, phosphorus and potassium (NPK) are supplied by chemical fertilizers. Indiscriminate use of chemical fertilizers causes micronutrient imbalance in the soil which ultimately loses productivity.
- (c) *Nitrate Pollution:* From agricultural fields nitrogenous fertilizers leach into the soil and finally contaminate groundwater. When the nitrate level of groundwater exceeds 25 mg/l, they can cause a serious health hazard known as “*Blue Baby Syndrome*”, which affects mostly infants even leading to their death.
- (d) *Eutrophication:* Agricultural run-off water contains fertilizer components, particularly nitrogen and phosphorus, which reaches nearby waterbodies and causes their overnourishment. Excessive use of these fertilizers leads to overnourishment of the lakes/waterbodies and gives rise to the phenomenon of eutrophication (eu = more, trophication = nutrition). As a result, there is excessive growth of algal species, which is known as *algal bloom*. The waterbody or lake soon gets filled up with algal species which quickly complete their life cycle and die thus adding a lot of organic matter. Dissolved oxygen in the lake is consumed and fish get killed

so that the lake becomes a dead pool of water devoid of plants and animals. Thus the lake ecosystem gets degraded due to eutrophication.

- (e) **Pesticide Side Effects:** Several thousand pesticides are used in agriculture for destroying pests and boosting crop production. In the early period of human civilization arsenic, sulphur, lead and mercury were used to kill pests. From 1940 synthetic organic pesticides have been used. Among these, DDT (dichlorodiphenyl trichloroethane), discovered by Paul Mueller (1939), deserves special mention. During 1940-1950, it saved 5 million lives from malaria, typhus etc. and also protected crops from huge losses. But DDT and other pesticides show a number of harmful side-effects on environment.
 - (a) *Inducing Pest Resistance and Yielding New Pests:* In course of time new generations of pests develop resistance to pesticides so that they survive even after pesticide spray. At present, about two dozen pest species are known to be immune to all types of pesticides.
 - (b) *Biological Magnification/Amplification:* Many pesticides including DDT are non-biodegradable so that they persist in the food chain. At each step of the food chain the pesticide level gets more and more concentrated. This is the process of biological magnification or amplification. Thus, DDT builds up from 0.04 ppm in plankton to 75 ppm in fish-eating birds. Man occupies a high trophic level in the food chain and hence gets a high dose of pesticide, which is quite harmful.
- (iv) **Waterlogging:** Excessive irrigation of croplands for good growth of crop leads to waterlogging. In the absence of adequate drainage, excess water is

accumulated which seeps into the underlying water table. Pore spaces in the soil get fully drenched with water and soil-air becomes deficient. The water table rises and the roots of plants have insufficient air for respiration. There is decline in crop yield with decrease in soil strength.

Punjab and Haryana have faced water-logging problems as a result of extensive irrigation by canal water or shallow tubewell water and consequently sharp decline in crop output.

- (v) **Salinity Problem:** In addition to waterlogging, salinity also rises from excessive irrigation water. The latter contains dissolved salts which under dry conditions evaporates leaving behind salts in the upper soil profile. Saline soils are characterized by accumulation of soluble salts such as sodium chloride, sodium sulphate, calcium chloride, magnesium chloride etc. in the soil profile.

Salinity causes stunted plant growth and reduces crop yield. Thousands of hectares of land in Haryana and Punjab have been affected by soil salinity.

The best method for getting rid of salinity is to flush out by applying freshwater to such soils.

1.10 INDUSTRY

Industries produce environmental hazards everywhere. They consume 37 per cent of world's energy and emit 50 per cent of world's CO₂, 90 per cent of SO_x and almost all the chemicals now threatening O₃ layer with depletion. Every year, they produce 2100 million tonnes of solid waste and 350 million tonnes of hazardous waste. In developing countries, small as well as big industries discharge untreated waste.

There is world-wide concern about the disposal of radioactive wastes from nuclear reactors. Nuclear reactor

accidents are expected to increase over the years. The stock of nuclear power stations is also ageing.

In developed countries, industries have enforced economy during the last two decades in the use of resources and energy consumption. It is a common practice for these industries to recycle and reuse water. The average person in a developed country still consumes 15 times more energy than in a poor country. However, in a developed country energy is being used more efficiently and the expected rate of increase of energy consumption is only 1.3 per cent per year.

1.11 TRANSPORT

Transport is a great consumer of land and energy. The length of motor ways has almost doubled in developed countries over the past two decades, reaching 1,500,00 km. in 1990. Transport consumes 30 per cent of world's energy (of which 82 per cent is consumed on roads) and produces 60 per cent CO-emissions, 42 per cent of NO_x and 40 per cent of hydrocarbon emissions.

But there is a hope of new cleaner transport becoming popular in future. Almost one-third of Brazil's cars run on pure ethanol, obtained from specially grown crops and many cars run on ethanol/petrol mixture. Natural gas is being used as a fuel in several countries including Italy where 3 lakh cars run on compressed natural gas (CNG).

Major efforts have been made in developed countries in reducing petrol consumption by 50 per cent of the amount used two decades ago. Auto-emissions have also been cleaned up. Use of lead-free petrol has curtailed Lead (Pb) emission by 87 per cent during 1980-1990.

1.12 MINING

Minerals find extensive use in domestic, agricultural, industrial and commercial sectors and thus form a very important part of any nation's economy.

Minerals are broadly of two types:

- (a) Non-metallic minerals e.g., graphite, diamond, quartz, feldspar etc.
- (b) Metallic minerals e.g., bauxite, laterite, hematite etc.

Since the early days of human civilization man has used metals extensively. That is why history labelled the eras as Bronze Age and Iron Age. The most abundantly used metals are Iron and Steel (Annual use 750 million tonnes) followed by Manganese, Copper, Chromium, Nickel and Aluminium.

Mining and processing of minerals involve major environmental concerns including disturbance of land, air pollution from dust and smelter emissions and water pollution from disrupted aquifers.

India is the producer of 84 minerals at an estimated annual value of Rs. 50,000 crore. Six major mines are known to cause severe environmental problems.

- (a) *Jadugoda Uranium Mine, Jharkhand*: Exposing local area and the population to radioactive hazards.
- (b) *Jharia Coal Mines, Jharkhand*: Underground fire causing land subsidence and displacement of people.
- (c) *Sukinder Chromite Mine, Orissa*: Seeping of hexavalent chromium into river posing serious health hazard. Chromium Cr^{+6} (hexavalent) is highly toxic.
- (d) *Kudremukh Iron Ore Mine, Karnataka*: Causing river pollution and threat to biodiversity.
- (e) *East-Coast Bauxite Mine, Orissa*: Land encroachment and rehabilitation issue.
- (f) *North-Eastern Coal Fields, Assam*: Very high sulphur contamination of groundwater.

Impacts of Mining: Mining involves extraction of minerals/fossil fuels from deep deposits in soil employing the techniques of sub-surface mining or surface mining. The former method is more dangerous and expensive including risks and accidents. The environmental damages are described as follows:

- (a) *Devegetation and Defacing of Landscape:* Large-scale devegetation or deforestation leads to ecological imbalances besides disfiguring the landscape. The huge debris and tailings spoil the environment of the region and make it vulnerable to soil erosion.
- (b) *Subsidence of Land:* Underground mining (e.g., coal) causes subsidence of the soil above resulting in tilting of buildings, cracks in soil/road, bending of rail tracks etc.
- (c) *Groundwater Contamination:* Mining disturbs the hydrological processes and also pollutes the ground water. Sulphur impurity in many areas gets converted into sulfuric acid through microbial action, which makes the water acidic.
The acid mine drainage often contaminates the nearby streams and lakes and damages aquatic life (plants and fish).
- (d) *Air Pollution:* Smelters in metal extraction processes in metallurgical industries emit huge volumes of air pollutants—sulphur oxides, soot, arsenic, lead, cadmium particles etc. These have public health hazards for local residents.
- (e) *Occupational Health Hazards:* Most of the miners suffer from various respiratory and skin diseases due to constant exposure to the suspended particulate matter and toxic substances. Such diseases include asthma, bronchitis, black-lung disease, asbestosis, silicosis etc.

1.13 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The inherent conflict between development and environment can be solved to a great extent by a sound environmental management plan which is based on balancing development with environment. The necessary tool for this is *Environmental Impact Assessment* (EIA). Development should not be treated as an economic goal but as a multi-

dimensional concept covering economic as well as political, social and cultural aspects of life of common man.

The basic objective of EIA is to identify, predict and evaluate the probable economic, environmental and social impacts of developmental activities and take necessary steps as remedial measures which will be a part of the overall environmental management plan (EMP).

It is the government's policy that any industrial project particularly major industry must obtain EIA clearance from the ministry of environment before approval by the planning commission. It may be mentioned that EIA is conducted by a team of experts in the field (environment), appointed by the Ministry of Environment, Government of India.

1.14 SUSTAINABLE DEVELOPMENT

As per the definition of the then director of World Health Organization (WHO), Prime Minister G.H. Bruntland (Norway), sustainable development means *"meeting the needs of the present without compromising the ability of future generations to meet their needs"*! Nowadays sustainable development is the keynote of many projects but only few of them achieve sustainable growth.

Overexploitation of natural resources, particularly by the developed countries, since 1970s is fast heading towards unsustainable growth and collapse of our life-support base. In 1992, the UN Conference on Environment and Development (UNCED) was held at Rio de Janeiro, Brazil. The Rio declaration on Agenda-21 adopts a global programme of action on sustainable development in social, economic and political contexts for the 21st century.

The important components of sustainable development are:

- Population stabilization (growth below 0.5 per cent)
- Integrated land-use planning
- Conservation of biodiversity

- Air and water pollution control
- Renewable energy resources
- Recycling of wastes and residues
- Environmental education and awareness at all levels

Questions

1. What is meant by
 - (a) Environment?
 - (b) Environmental studies?
2. What do you mean by ecosystem?
3. Illustrate land ecosystem and also aquatic ecosystem.
4. Classify the ecosystems on the basis of their habitats. Give examples.
5. What is sustainable ecosystem?
6. Give a short account of the impacts of agriculture on environment.
7. What is meant by
 - (a) Eutrophication?
 - (b) Waterlogging?
 - (c) Salinity of soil?
8. Enumerate the impacts of mining.
9. What is the significance of sustainable development? What are its main components?

What is a CONVENTION ?

“A meeting or formal assembly, of representatives or delegates, for discussion and action on particular matters of common concern”

● **Need of GLOBAL ENVIRONMENTAL CONVENTIONS ?**

- Protection of environment
- Promotion of sustainable development

Terms

● Protocol/Agreement/Treaty

- A **legally binding** official written agreement
- Establishes rights and obligations b/w each party

● Ratification

- A state indicates its **consent** to be bound to a treaty
- To enact the necessary **legislation** to give **domestic** effect to that treaty
- **Universal ratification** – 197 parties

List of Conventions

- ◎ 1971 – Ramsar Convention
- ◎ 1972 – UN Conference on Human Environment, Stockholm
- ◎ 1973 – Washington Convention
- ◎ 1985 – Vienna Convention
- ◎ 1989 – Basel Convention

- ◎ 1992 – UN Conference on Environment & Development (Earth Summit)
 - Biodiversity Convention, Nairobi
 - UN Framework Convention on Climate Change, New York
- ◎ 1998 – Rotterdam Convention
- ◎ 2001 – Stockholm Convention on Persistent Organic Pollutants
- ◎ 2002 – World Summit on Sustainable Development, Johannesburg, SA
- ◎ 2012 – United Nations Conference on Sustainable Development, Rio
- ◎ 2016 – Paris Agreement

Ramsar Convention – 1971



- “The Convention on Wetlands of International Importance, especially as Waterfowl Habitat”, Ramsar, Iran
- Also called “Convention on Wetlands”
- World Wetlands Day – Feb 2
- 169 contracting parties & 2266 Ramsar sites
- Mission:
 - Conservation & wise use of wetlands & their resources

Stockholm Conference – 1972



- First attempt to address inter-relationships of environment and development at global level
- Marks the birth of International Environmental Policy
- Objectives:
 - Recognize environmental education as a potential tool to better the lives of many nations
 - Engage the international community in environmental policy debate
- Outcome:
 - United Nations Environment Programme(UNEP)

● Principles:

- **Natural resources & wildlife** must be safeguarded
- **Renewable resources** must be maintained
- **Non-renewable resources** must be shared & not exhausted
- **Pollution** must not exceed environment's capacity to clean itself
- Prevent **oceanic pollution**
- Improve the environment & establish **standards**
- Environmental **education & research**
- Eliminate destructive **weapons**

CITES, Washington – 1973



- “Convention on International Trade in Endangered Species of Wild Fauna and Flora”
- International agreement to which States and regional organizations adhere voluntarily
- Objective:
 - To ensure that international trade in specimens of wild animals and plants does not threaten their survival
- Protection to more than 35,000 species of animals and plants
- 183 parties

- **Appendix – I** (About 1000 species)
 - Threatened with extinction or affected by trade
 - Commercial trade is **illegal**
- **Appendix – II** (About 34,500 species)
 - Not necessarily threatened with extinction, but may become so unless **trade is strictly regulated**
 - International trade is authorized by the granting export permit
- **Appendix – III** (about 200 species)
 - Species are **not necessarily threatened** with extinction **globally**
 - International trade is allowed only on presenting appropriate permits or certificates

Vienna Convention – 1985



- “The Vienna Convention for the Protection of the Ozone Layer”
- First Convention to achieve **universal ratification**
- Objectives:
 - To promote cooperation by systematic observations, research and information exchange on the effects of human activities on the ozone layer
 - To adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer



● Montreal Protocol – 1987

- Outcome of Vienna Convention
- Total elimination of **Ozone depleting substances**
- 197 parties
- To phase out production & consumption of CFCs
- **Multilateral fund** – developed countries contribute to help developing countries to achieve control measures
- **Ban on trade** in designated ozone-depleting chemicals
- World Ozone Day – 16th September 2017

Basel Convention – 1989



- “The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal”
- 186 parties
- Objective:
 - To protect human health and the environment against the adverse effects of hazardous wastes
- Do not cover **radio active wastes**

UNCED, Rio de Janeiro – 1992

- National & international policies redirected towards integration of environmental, economic & development objectives
- International community agreed on a plan of action on **sustainable development**
- Largest environmental conference - 172 parties



- The Summit's message, "nothing less than a transformation of our attitudes and behavior would bring about the necessary changes"
- Issues addressed:
 - Systematic scrutiny of patterns of **production**
 - Alternative sources of energy to replace **fossil fuels**
 - New reliance on **public transportation systems**
 - Awareness and concern over scarcity of **water**

● Principles:

- Meet environmental & developmental needs
- Healthy & productive life in harmony with nature
- Peace, development & environmental protection are interdependent & indivisible
- Polluter should bear cost of pollution
- Participation of all citizens
- EIA for proposed activities
- States have responsibility to protect environment

● Outcome:

- Commission on Sustainable Development (CSD)
- Agenda 21
- Declaration on Environment & Development
- Forest Principles
- Bio-diversity Convention
- Framework Convention on Climate Change
- Convention to Combat Desertification, Paris

Convention on Biological Diversity – 1992

- To develop national strategies for conservation & sustainable use of biological diversity

- Multilateral treaty – 196 parties

- Objectives:

 - Conservation of biological diversity

 - Sustainable use of the components of biological diversity

 - Fair and equitable sharing of the benefits

- International year of Biodiversity – 2010

- UN Decade on Biodiversity → 2011-2020



Convention on
Biological Diversity

● Cartagena Protocol on Biosafety , 2000

- Ensure the safe handling, transport and use of living **modified organisms**
- Protect biological diversity from the potential risks posed by genetically modified organisms
- Advance Informed Agreement
- Biosafety Clearing-House
- 171 parties

UNFCCC – 1992



United Nations
Framework Convention on
Climate Change

- Near-universal membership
- Objectives:
 - To stabilize **greenhouse gas** concentrations at a level that would prevent dangerous human induced interference with the climate system
 - Should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change
 - To ensure that food production is not threatened
 - To enable sustainable economic development

- Financial support to developing countries
- Share technologies
- Keeps tabs on the problem and what's being done about it
- Help developing countries limit emissions without hindering their economic progress
- Annual meeting of parties



● **Kyoto Protocol - 1997**

- **Set emission reduction targets** internationally
- UN member countries divided into
 - **Annex I countries:** Industrialized countries & economy is in transition
 - **Annex II countries:** Developed countries which pay for costs of developing countries
 - **Non-Annex I countries:** Developing countries
- Doha amendment in 2012



COP21 • CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

● **Paris Agreement on Climate Change, 2016**

- Will replace Kyoto Protocol on 31 January 2020
- 192 countries including India signed the agreement
- To limit rise in global temperature below 2°C
- To help developing nations to adapt the detrimental effects of global warming

● India's Commitments

- India – world's 4th largest carbon emitter
- Produce 40% of total electricity from sources other than fossil fuels
- Creating additional carbon sink through extra forest & tree cover by 2030
- Installing 175GW of renewable power capacity by 2022

Rotterdam Convention – 1998



- “Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade”
- Objectives:
 - Promote shared responsibility and cooperative efforts among Parties in the international trade hazardous chemicals to protect human health and the environment from potential harm
 - Environmentally sound use of hazardous chemicals

- **Annex III chemicals** - 50 chemicals
- **Prior Informed Consent (PIC)** procedure
- **Decision Guidance Document (DGD)** – scope, basic information, hazards, possible alternatives
- Exporters of hazardous chemicals should
 - Use proper labeling
 - Directions for safe handling
 - Inform to import nation on any restriction or ban

Stockholm Convention on Persistent Organic Pollutants - 2001



- Objective:

- To protect human health and the environment from persistent organic pollutants (POP)

- POP List

- **Annex A** → Prohibit or eliminate the production, use, and its import and export (Endosulfan)
 - **Annex B** → Restriction (DDT)
 - **Annex C** → Reduce or eliminate releases from unintentionally produced POPs

● Effects of POPs:

- Remain intact for exceptionally long periods
- Widely distributed throughout the environment by natural processes (soil, air, water...)
- Accumulate in the fatty tissue of living organisms
- Toxic to humans and wildlife
- Serious health effects
 - Cancer
 - Birth defects
 - Damage nervous systems, immune systems

Johannesburg Conference, 2002



- World Summit on Sustainable Development, South Africa
- Earth Summit 2002 (Rio+10)
- Objectives:
 - Reaffirm commitment to sustainable development via social, economical & environmental development
 - Vanish under-development
 - Basic requirements of human
 - Improve lives while preserving earth's resources

● Outcomes:

- Agreed to achieve 8 critical economic & social development priorities by 2015 (**Millennium Development Goals**)



UN Conference on Sustainable Development – 2012



- Earth Summit 2012 (Rio+20)
- Objectives:
 - Securing renewed political commitment for sustainable development
 - Assessing the progress and implementation gaps
 - Addressing new and emerging challenges

● Outcomes

○ **Sustainable Development Goals**

- Make UNEP the “leading global environmental authority”
- All nations reaffirmed commitments to phase out fossil fuel subsidies
- Outcome document – “Future We Want”



SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 AFFORDABLE AND CLEAN ENERGY



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



16 PEACE, JUSTICE AND STRONG INSTITUTIONS



17 PARTNERSHIPS FOR THE GOALS



SUSTAINABLE DEVELOPMENT GOALS