# ENVIRONMENTAL SCIENCE AND ENGINEERING

## UNIT-1

## INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

### Definition

**Environment** is derived from the French word **Environ** which means to encircle or surround.

**Environment is sum total of water, air, and land, inter-relationships among themselves and also with the human beings, other living organisms and property**. The above definition given in Environment Act, 1986 clearly indicates that environment includes all the physical and biological surroundings and their interactions.

### Scope

Scope of environmental science is broad. Some of the aspects of scope of environmental science are:

- Studying the interrelationships among biotic and abiotic components for sustainable human ecosystem,
- Carrying out impact analysis and environmental auditing for the further catastrophic activities,
- Developing and curbing the pollution from existing and new industries,
- Stopping the use of biological and nuclear weapons for destruction of human race,
- Managing the unpredictable disasters and so on.

There are some major issues like global warming, depletion of ozone layer, dwindling forests and energy resources, loss of global biodiversity etc., that are going to affect the mankind as a whole and for that we have to think globally.

### Need for public awareness

- Public awareness very essential to help understand pros and cons of environmental problems.
- The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and popularly known as Earth summit followed by the world summit on sustainable Development in 2002, have highlighted key issues of global environmental concern.
- Environmental pollution cannot be removed by laws alone.
- The proper implementation and especially public participation are important aspects.
- Public participation is possible only when the public is aware about the ecological and environmental issues.

- 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 educated about the fact that if we are degrading our environment we are actually harming ourselves.

## Forest resources

### Uses of Forests

### Commercial uses:

- Man depends heavily on a larger number of plant and animal products from forests for his daily needs.
- The chief product that forests supply is wood, which is used as fuel, raw material for various industries as pulp, paper, newsprint, board, timber for furniture items, other uses as in packing articles, matches, sports goods etc.
- Indian forests also supply minor products like gums, resins, dyes, tannins, fibers, etc.
- Many of the plants are utilized in preparing medicines and drugs; Total worth of which is estimated to be more than $300 billion per year.
- Many forests lands are used for mining, agriculture, grazing, and recreation and for development of dams.

### Ecological uses:

The ecological services provided by our forests may be summed up as follows:

- **Production of Oxygen**: The main green house gas carbondioxide is absorbed by the forests as a raw material for photo synthesis. Thus forest canopy acts as a sink for corbondioxide thereby reducing the problem of global warming caused by green house gas $CO_2$
- **Wild life habitat**: Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone.
- **Regulation of hydrological Cycle**: Forested watersheds act like giant sponges, absorbing the rainfall, slowing down the runoff. They control climate through transpiration of water and seed clouding.
- **Soil Conservation:** Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as wind breakers.
- **Pollution moderators**: Forests can absorb many toxic gases and can help in keeping the air pure and in preventing noise pollution.

### Over Exploitation of Forests

- Man depends heavily on forests for food, medicine, shelter, wood and fuel.

- ✓ With growing civilization the demands for raw material like timber, pulp, minerals, fuel wood etc. shot up resulting in large scale logging, mining, road-building and clearing of forests.
- ✓ Our forests contribute substantially to the national economy.
- ✓ The international timber trade alone is worth over US $ 40 billion per year.
- ✓ The devasting effects of deforestation in India include soil, water and wind erosion, estimated to cost over 16,400 crores every year.

**Deforestation**

- Deforestation means destruction of forests.
- The total forests area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.
- Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.
- Deforestation is a continuous process in India where about 1.3 hectares of forest land has been lost.
- The per capita availability of forest in India is 0.08 hectares per person which is much lower than the world average of 0.8 hectares.
- The presence of waste land is a sign of deforestation in India.

**Causes of Deforestation:**

Major causes of deforestation are listed below:

a) Development projects
b) Shifting cultivation
c) Fuel requirements
d) Construction of dams
e) Growing food needs

**Consequences of deforestation:**

Some of the effects of deforestation are listed below:

a) Effect on climate

1. Global warming
2. Less rainfall
3. Hot climate and others.

b) Effect on biodiversity

1. Loss of medicinal plants.
2. Loss of timber, fuel wood and others.

c) Effect on resources

1. Loss of land resource
2. Loss of soil fertility
3. Soil erosion
4. Drastic changes in biogeochemical cycles

d) Effect on economy

1. Increase in medicinal values
2. Demand of industrial products and others

e) Effect on food

1. Loss of fruit production
2. Loss of root based foods

**Case Studies**

**Desertification in hilly regions of the Himalayas:**

- Desertification in Himalayas, involving clearance of natural forests and plantation of monocultures like Pinus roxburghi, Eucalyptus camadulensis etc., have upset the ecosystem by changing various soil and biological properties.
- The area is invaded by exotic weeds. These areas are not able to recover and are losing their fertility.

**Disappearing Tea gardens in Chhota Nagpur:**

- Following the destruction of forest rain fall declined in Chhota Nagpur to such an extent that tea-gardens also disappeared from the region.

**Waning rain fall in Udhagamandalam:**

- The rainfall pattern was found to fluctuate with wooded land area in the hills. When the Nilgiri mountains had luxuriant forest cover annual rainfall used to be much higher.

**Timber Extraction**

- ✓ Logging for valuable timber such as teak and mahogany not only involves a few large trees per hectare but about a dozen more trees since they are strongly interlocked with each other by vines etc.
- ✓ Also road construction for making approach to the trees causes further damage to the forests.
- ✓ In India, firewood demand would continue to rise in future mostly consumed in rural areas, where alternative sources of energy, are yet to reach.

**Mining**

- Mining is the process of removing deposits of ores from substantially very well below the ground level.
- Mining is carried out to remove several minerals including coal.
- These mineral deposits invariably found in the forest region, and any operation of mining will naturally affect the forests.

- Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining.
- More than 80,000 ha of land of the country is presently under the stress of mining activities.

**Effects of mining resources:**

- Mining operation require removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
- Large scale of deforestation has been reported in Mussorie and Dehradun valley due to mining of various areas.
- Indiscriminate mining in Goa since 1961 has destroyed more than 50,000 ha of forest land.
- Mining of radioactive mineral in Kerala, Tamilnadu and Karnataka are posing similar threats of deforestation.

**Dams and their effects on forests and tribal people**

- Big dams and river valley projects have multi-purpose uses and have been referred to as "Temples of modern India".
- India has more than 1550 large dams, the maximum being in the state of Maharashtra (more than 600) followed by Gujarat (more than 250) and Madhya Pradesh (130).
- The highest one is Tehri dam, on river Bhagirathi in Utttaranchal and the largest in terms of capacity is Bhakra dam on river Sutlej.

**Effects on Tribal people**

- The greatest social cost of big dam is the widespread displacement of local people.
- It is estimated that the number of people affected directly or indirectly by all big irrigation projects in India over the past 50 years can be as high as 20 millions.
- The Hirakud dam, one of the largest dams executed in fifties, has displaced more than 20,000 people residing in 250 villages.

**Effects on forests**

Thousands of hectares of forests have been cleared for executing river valley projects which breaks the natural ecological balance of the region. Floods, landslides become more prevalent in such areas.

For example

- The Narmada sagar project alone has submerged 3.5 lakh hectares of best forest comprising of rich teak and bamboo forests.
- The Tehri dam submerged 1000 hectares of forest affecting about 430 species of plants according to the survey carried out by the botanical survey of India.

## Water Resources

## Uses of Water

- Due to its unique properties, water is of multiple uses for all living organisms.
- Water is absolutely essential for life.
- Most of the life processes take place in water contained in the body.
- Uptake of nutrients, their distribution in the body, regulation of temperature, and removal of wastes are all mediated through water.
- Human beings depend on water for almost every developmental activity.
- Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal power plants.
- Water shaped the earth's surface and regulates our climate.

## Over utilization of surface and ground water

- ✓ With increasing human population and rapid development, the world water withdrawal demands have increased many folds and a large proportion of the water withdrawn is polluted due to anthropogenic activities.
- ✓ Out of the total water reserves of the world, about 97% is salty water and only 3% is fresh water.
- ✓ Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water.

### Effects of over exploitation of water

- **Subsidence:** When ground water withdrawal is more than its recharge rate, the sediments in the aquifer (a layer of rock that is highly permeable and contains water) get compacted, a phenomenon knows as ground subsidence. It results in sinking of overlying land surface. Due to this structural damage in buildings, fracture in pipes etc., occurs.
- **Lowering of water table**: Mining of groundwater is done extensively for irrigating crop fields. However, excessive mining would cause lowering of water table.
- **Water logging**: When excessive irrigation is done with brackish water it raises the water table gradually leading to water-logging and salinity problems.

## Floods and drought

- ✓ Heavy rainfall often causes floods in the low-lying coastal areas.
- ✓ Prolonged downpour can also cause the over-flowing of lakes and rivers resulting into floods.
- ✓ When annual rainfall is below normal and less than evaporation, drought conditions are created.

### Causes of flood and drought:

- ❖ Deforestation, overgrazing, mining, rapid industrialization, global warming etc., have contributed largely to a sharp rise in the incidence of floods.
- ❖ Deforestation leads to desertification and drought too. When the trees are cut, the soil is subject to erosion by heavy rains, winds and sun.
- ❖ The removal of thin top layer of soil takes away the nutrients and the soil becomes useless.
- ❖ The eroded soils exhibit droughty tendency.

**Preventive measures:**

Clear knowledge in control of drought and desertification can be very useful for dealing with the problem.

- Carefully selected mixed cropping helps to optimize production and minimize the risks of crop failures.
- Social forestry and Wasteland development can prove quite effective to fight the problem, but it should be based on proper understanding of ecological requirement and natural process.

**Conflicts over water**

Indispensability of water and its unequal distribution has often led to inter-state or international disputes. Issues related to sharing of river water have been largely affecting our farmers and also shaking our governments. Many countries are engaged in bitter rivalries over this precious resource.

For instance,

- Argentina and Brazil, dispute each other's claims to the La Plata river,
- India and Pakistan fight over the rights to water from the Indus,
- Mexico and USA have come in conflict over the Colorado river,
- India and Bangladesh are fighting for Bhrahmaputra river, and
- Iran and Iraq contest for the water from Shatt-Al- Arab River.

Within India, water conflicts are still being continues between the states. For Eg.,

- Sharing of Krishna water between Karnataka and Andhra Pradesh,
- Sharing of Siruvani water between Tamilnadu and Kerala, and others.
- Sharing of Cauvery between Karnataka and Tamilnadu
- On June 2,1990, the Cauvery Water dispute Tribunal was set up which through an interim award directed Karnataka to ensure that 205 TMCF of water was made available in Tamil Nadu's Mettur dam every year, till a settlement was reached.
- In 1991-1992 due to good monsoon, there was no dispute. In 1995, the situation turned into a crisis due to delayed rains and an expert Committee was set up to look into the matter which found that there was a complex cropping pattern in Cauvery basin.
- Samba paddy in winter, Kuravai paddy in summer and some cash crops demanded intensive water; thus aggravating the water crisis.
- Proper selection of crop varieties, optimum use of water, better rationing are suggested as some measures to solve the problem

**Big-Dams –Benefits and Problems**

**Benefits:**

- ✓ River valley projects with big dams play a key role in the development process due to their multiple uses.
- ✓ These dams aim at providing employment for tribal people and raising the standard and quality of life.
- ✓ Dams can help in checking floods and generate electricity and reduce water and power shortage, provide irrigation water to lower areas, provide drinking water in remote areas and promote navigation, fishery etc.

**Problems:**

The impacts of big dams can be upstream as well as downstream levels.
The upstream problems include the following:

- ❖ Displacement of tribal people
- ❖ Loss of forests, flora and fauna
- ❖ Changes in fisheries
- ❖ Saltation and sedimentation of reservoirs
- ❖ Loss of non-forest land
- ❖ Stagnation and waterlogging near reservoir
- ❖ Breeding vectors and spread of vector –borne diseases
- ❖ Reservoir induces seismicity causing earthquakes
- ❖ Microclimatic changes
- ❖ Growth of aquatic weeds

The downstream problems include the following:

- ❖ Water logging and salinity due to over irrigation
- ❖ Microclimatic changes
- ❖ Reduced water flow and slit deposition in river
- ❖ Flash foods
- ❖ Salt water intrusion at river mouth
- ❖ Loss of land fertility
- ❖ Outbreak of vector-borne diseases like malaria.

## 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

Major reserves and important uses of some of the metals:

| **Metals** | **Major world reserves** | **Major uses** |
|---|---|---|
| Aluminium | Australia, Jamaica | Packing food items, transportation, utensils, electronics |
| Chromium | CIS(The common wealth of Independent states), South Africa | For making high strength steel alloys, in textiles and tanning industries |
| Copper | U.S.A, Canada, CIS | Electronic and electrical goods, building, construction, vessels |
| Iron | CIS, Canada, U.S.A | Heavy machinery, steel production transportation means. |
| Manganese | South Africa, CIS | For making high strength heat resistant steel alloys |
| Platinum | South Africa, CIS | Use in automobiles, catalytic converters, electronics, medical uses. |
| Gold | South Africa, CIS, Canada | Ornaments, medical use, electronic use, in aerospace |
| Silver | Canada, South Africa | Photography, electronic jewellery. |
| Nickel | CIS, Canada | Chemical industry, steel alloys |

Major uses of some of the non metallic minerals

| **Non-metal mineral** | **Major uses** |
|---|---|
| Silicate minerals | Sand and grovel for construction, bricks, paving etc. |
| Limestone | Used for concrete, building stone, used in agriculture for neutralizing acid soils, used in cement industry |
| Gypsum | Used in plaster wall-board, in agriculture |
| Potash, phosphorite | Used as fertilizers |
| Sulphur pyrites | Used in medicine, car battery, industry |

**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 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:

- o **Devegetation and defacing of lands:** Mining requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
- o **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 serious disasters.
- o **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.
- o **Surface water pollution:** The acid mine drainage often contaminates the nearby streams and lakes. The acidic water, radioactive substances like uranium, heavy metals also contaminate the water bodies and kill aquatic animals.
- o **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.
- o **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 ferroxidans, which remove the impurities and leave the pure mineral.
- Re-vegetating mined areas with appropriate plants
- Gradual restoration of flora
- Prevention of toxic drainage discharge.

**<u>Case studies</u>**

**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 environment.
- ♠ About 150 tones 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 waste water flows towards a big tank of " Bag Dara".
- ♠ Due to scarcity of water people are compelled to use this effluent for irrigation purpose.
- ♠ The 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 the North-west India covering Gujrat, 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

### 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.

### Impacts of overgrazing and agriculture.

**Overgrazing:**

Overgrazing can limit livestock production. Over grazing occurs when too many animals graze for too long and exceed the carrying capacity of a grass land 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.

**Agriculture:**

**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 verities (HYV**): The uses of HYVs encourage monoculture i.e. the same genotype is grown over vast areas. Incase 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 ground water. 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 methaemoglobinemia. 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 reach 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 lot of dead matter that starts getting decomposed. 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 forms a continuous column with the water table. Under water-logged 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 water-logged 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 underground network of perforated drainage pipes for flushing out the salts slowly.

**<u>Case studies</u>**

**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 raise 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 "Indhra Gandhi Canal Project"

## Energy resources

### Growing energy needs.

- ♠ Development in different sectors relies largely upon energy.
- ♠ Agriculture, industry, mining, transportation, lighting, cooling and heating in buildings all need energy.
- ♠ With the demands of growing population the world is facing further energy deficit.
- ♠ In developed countries like U.S.A and Canada an average person consumes 300 GJ per year.
- ♠ By contrast, an average man in a poor country like Bhutan, Nepal or Ethiopia consumes less than 1 GJ per year.
- ♠ This clearly shows that our life-style and standard of living are closely related to energy needs.

### Renewable and Non-Renewable energy sources

Life on earth depends upon a large number of things and services provided by nature, which are knows as energy resources.

Energy Resources are of two kinds.

I. **Renewable resources**: which are inexhaustive and can be regenerated within a given span of time eg. Forests, wildlife, wind energy, biomass energy etc. Solar energy is also a renewable form of energy as it is an inexhaustible source of energy.
II. **Non-renewable resources** which cannot be regenerated eg. Fossil fuels like coal, petroleum etc. Once we exhaust these reserves, the same cannot be replenished.

Even our renewable resources can become non-renewable if we exploit them to such extent their rate of consumption exceeds their rate of regeneration.

### Renewable energy resources:

I. **Solar energy:**
   - **a.** Sun releases enormous quantity of energy in the form of heat and light.
   - **b.** The solar energy received by the near earth space is approximately1.4 $kJ/s/m^2$ known as solar constant.

**c.** Now we have several techniques for harnessing solar energy.

**d.** Solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace and solar power plant are some important solar energy harvesting devices.

**II. Wind Energy**:

**a.** The high speed winds have a lot of energy in them as kinetic energy due to their motion.

**b.** Wind energy is very useful as it does not cause any air pollution.

**c.** After the installation cost, the wind energy is very cheap.

**III. Hydro power**:

**a.** The water flowing in a river is collected by constructing a big dam where the water is stored and allowed to fall from a height.

**b.** The blades of turbine located at the bottom of the dam move with the fast moving water which in turn rotates the generator and produces electricity.

**c.** Hydro power does not cause any pollution.

**d.** Hydro power projects help in controlling floods, used for irrigation, navigation etc.

**IV. Tidal energy**:

**a.** Ocean tides produced by gravitational forces of sun and moon contain enormous amounts of energy.

**b.** The tidal energy is harnessed by constructing a tidal barrage.

**c.** During high tide, the water flows into the reservoir of the barrage and turns the turbine, which in turn produces electricity by rotating the generators.

**d.** During low tide, when the sea-level is low, the sea water stored in the barrage reservoir flows out into the sea and again turns the turbines.

**V. Ocean thermal energy (OTE)**:

**a.** The energy available due to the difference in the temperature of water at the surface of the tropical oceans and at deeper levels is called OTE.

**b.** This energy is used to boil liquid like ammonia.

**c.** The high pressure vapours of the liquid formed by boiling are then used to turn the turbine of a generator and produce electricity.

**VI. Geothermal energy:**

**a.** The energy harnessed from hot rocks present inside the earth is called geothermal energy.

**b.** Sometimes the steam or boiling water underneath the earth does not find any place to come out.

**c.** We can drill a hole up to the hot rocks and by putting a pipe in it make the steam or hot water gush out through the pipe at high pressure which turns the turbine of a generator to produce electricity.

**VII. Biomass energy:**

**a.** Biomass is the organic matter produced by the plants or animals which include wood, crop, residues, cattle dung agricultural wastes etc.

**b.** The burning of biogas cause air pollution and produce a lot of ash.

**c.** It is therefore more useful to convert biomass into biogas or bio fuels.

**VIII. Biogas:**

**a.** Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide.

**b.** Biogas is produced by anaerobic degradation of animal wastes in the presence of water.
**c.** Anaerobic degradation means break down of organic matter by bacteria in the absence of oxygen.
**d.** Biogas has many advantages. It is clean, non-polluting and cheap.
**e.** There is direct supply of gas from the plant and there is no storage problem

**IX. Bio fuels:**

**a.** Biomass can be fermented to alcohols like ethanol and methanol which can be used as fuels.
**b.** Gasohol is common fuel in Brazil and Zimbabwe for running cars and buses.
**c.** Methanol is very useful since it burns at a lower temperature than gasoline or diesel.
**d.** Due to its high calorific value, hydrogen can serve as an excellent fuel.
**e.** Moreover it is non-polluting and can be easily produced.
**f.** Presently $H_2$ is used in the form of liquid hydrogen as a fuel in spaceships.

**Non -Renewable energy resources:**

**I. Coal:**

**a.** Coal was formed 255-250 million years ago in the hot, damp regions of the earth during the carboniferous age.
**b.** The ancient plants along the banks of rivers were buried after death into the soil and due to the heat and pressures gradually got converted into peat and coal over million years of time.
**c.** When coal burnt it produces carbon dioxide, which is a green house gas responsible for causing enhanced global warming.

**II. Petroleum:**

**a.** It is the life line of global economy.
**b.** Petroleum is a cleaner fuel as compared to coal as it burns completely and leaves no residue.
**c.** It is also easy to transport and use.
**d.** Crude petroleum is a complex mixture of alkane hydrocarbons.
**e.** Hence it has to be refined by the process of fractional distillation, during which we get large variety of products namely, petroleum gas, kerosene, petrol, diesel, fuel oil, lubricating oil, paraffin wax etc.
**f.** The petroleum gas is easily converted to liquid form under pressure as LPG.

**III. Natural gas:**

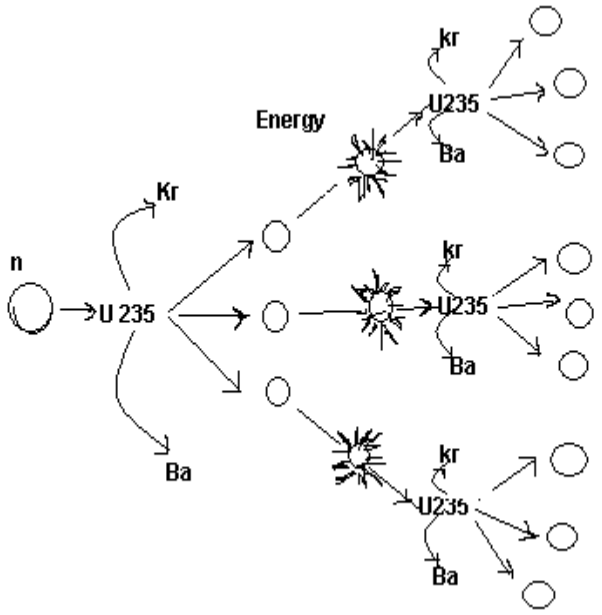
**a.** It is mainly composed of methane with small amounts of propane and ethane.
**b.** It is used as a domestic and industrial fuel in thermal power plants for generating electricity.
**c.** It is used as a source of hydrogen gas in fertilizer industry and as a source of carbon in tier industry.

**IV. Nuclear energy:**

**a.** Nuclear energy is known for its high destructive power.
**b.** Nuclear energy can be generated by two types of reactions:

**(i) Nuclear fission:** It is the nuclear reaction in which heavy isotopes are split into lighter nuclei on bombardment by neutrons. Fission reaction of $U^{235}$ is given below.

$$_{92}U^{235} +_{0}n1 \longrightarrow {}_{36}Kr^{92} + {}_{56}Ba^{141} + 3\ {}_{0}n^{1} + \text{energy}$$




**(ii) Nuclear fusion:** Here two isotopes of a light element are forced together at extremely high temperatures (1 billion ºC) until they fuse to form a heavier nucleus releasing enormous amount of energy in the process.

$$_{1}H^{2}+{}_{1}H^{2} \longrightarrow {}_{3}He^{2}+{}_{0}n^{1}+\text{energy}$$

Nuclear energy has tremendous potential but any leakage from the reactor may cause devastating nuclear pollution. Disposal of the nuclear waste is also a big problem.

## Land Resources

**Land as a resource**

- We depend upon land for our food, fibre, and fuel wood.
- About 200-1000 years are needed for the formation of one inch or 2.5 cm soil, depending upon the climate and the soil type.
- But, when rate of erosion is faster than rate of renewal, then the soil becomes a non-renewable resource

**Land degradation**

- With increasing population growth the demands for land for producing food, fibre and fuel wood is also increasing.
- Hence there is more and more pressure on limited land resources which are getting degraded due to over-exploitation.

- ❖ Soil erosion, water-logging, salinization and contamination of the soil with industrial wastes like fly-ash, press-mud or heavy metals all cause degradation of land.

**Man induced landslides**

- ♠ Various anthropogenic activities like hydroelectric projects, large dams, reservoirs, construction of roads and railway lines, construction of buildings, mining etc are responsible for clearing of large forested areas.
- ♠ Earlier there were few reports of landslides between Rishikesh and Byasi on Badrinath Highway area. But, after the highway was constructed, 15 landslides occurred in a single year.
- ♠ During the construction of roads, mining activities etc. huge portions of fragile mountainous areas are cut or destroyed by dynamite and thrown into adjacent valleys and streams.
- ♠ These land masses weaken the already fragile mountain slopes and lead to landslides.
- ♠ They also increase the turbidity of various nearby streams, thereby reducing their productivity.

**Soil erosion**

- ✓ Soil erosion is defined as the movement of soil components, especially surface litter and top soil from one place to another.
- ✓ Soil erosion results in the loss of fertility because it is the top soil layer which is fertile.

Soil erosion is basically of two types based upon the cause of erosion:

a) **Normal erosion or geological erosion:** caused by the gradual removal of top soil by natural processes which bring equilibrium between physical, biological and hydrological activities and maintain a natural balance between erosion and renewal.
b) **Accelerate erosion**: This is mainly caused by man made activities and the rate of erosion is much faster than the rate of formation of soil. Overgrazing, deforestation and mining are some important activities causing accelerated erosion

There are two types of agents which cause soil erosion. They are climatic agents and biotic agents.

**I. Climatic Agents – Water and Wind:**

Water affects soil erosion in the form of rain. **Water induced soil erosion** is of following types:

a) **Sheet erosion:** When there is uniform removal of a thin layer of soil from a large surface area, it is called sheet erosion.
b) **Rill erosion:** when there is rainfall and rapidly running water produces finger-shaped grooves or rills over the area, it is called rill erosion.
c) **Gully erosion:** When the rainfall is very heavy, deeper cavities or gullies are formed, which may be U or V shaped.
**Slip erosion:** This occurs due to heavy rainfall on slopes of hills and mountains.
d) **Stream bank erosion**: During the rainy season, when fast running streams take a turn in some other direction, they cut the soil and make caves in the bank

**Wind erosion** is responsible for the following three types of soil movements:

a) **Saltation:** This occurs under the influence of direct pressure of stormy wind and the soil particles of 1-1.5 mm diameter move up in vertical direction.
b) **Suspension**: Here fine soil particles (less than 1mm diameter) which are suspended on the air are kicked up and taken away to distant places.
c) **Surface creep:** Here the large particles (5-10 mm diameter) creep over the soil surface along with wind.

**II. Biotic Agents:**

**a.** Excessive grazing, mining, and deforestation are the major biotic agents responsible for soil erosion.
**b.** Deforestation without reforestation, overgrazing by cattle, surface mining without land reclamation, irrigation techniques that lead to salt build- up, water logged soil, make the top soil vulnerable to erosion.

**Soil conservation practices:**

In order to prevent soil erosion and conserve the soil the following practices are employed.

1. **Conventional till farming:**
   a. In traditional method the soil is broken up and smoothed to make a planting surface.
   b. This disturbs the soil and makes it susceptible to erosion.
   c. Conservational till farming, popularly known as no-till-farming causes minimum disturbance to the top soil.
   d. Here special tillers break up and loosen the subsurface soil without turning over the top soil.
   e. The tilting machines make slits in the soil and inject seeds, fertilizers, and little water in the slit, so that crop grows successfully.
2. **Contour farming:**
   a. On gentle slopes, crops are grown in rows across, rather up and down.
   b. This practice is knows as contour farming.
   c. It helps to hold soil and slow down loss of soil through run-off water.
3. **Terracing:**

a. It is used on still steeper slopes are converted into a series of broad terraces which run across the contour.
b. Terracing retains water for crops at all levels and cuts down soil erosion.

4. **Strip cropping** :
    a. Here strops of crops are alternated with strips of soil saving crops like grasses or grass- legume mixture.
    b. What ever run-off comes from the cropped soil is retained by the strip of cover-crop and this reduces soil erosion.
5. **Alley cropping:**
    a. It is a form of inter – cropping in which crops are planted between rows of trees or shrubs. This is also called **Agro forestry**.
    b. Even when the crop is harvested, the soil is not fallow because trees and shrubs still remain on the soil holding the soil particles and prevent soil erosion.
6. **Wind breaks or shelterbelts**:
    a. The trees are planted in long rows along the cultivated land boundary so that wind is blocked.
    b. **)** The wind speed is substantially reduced which helps in preventing wind erosion of soil.

**Desertification**

- ★ Desertification is characterized by devegitation and loss of vegetal over, depletion of groundwater, salinization and severe soil erosion.
- ★ Desertification leads to the conversion of irrigated croplands to desert like conditions in which agricultural productivity falls.
- ★ Moderate desertification produce 10-25% drop in productivity.
- ★ Severe desertification cause 25-50% drop while very severe desertification results in 50% drop in productivity.

**Causes of Desertification**: The major man made activities responsible for desertification are as follows.

I. **Deforestation**:
    **a.** Deforestation means destruction of forests.
    **b.** The total forests area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.
    **c.** Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.

II. **Overgrazing:**
    **a.** Overgrazing can limit livestock production.
    **b.** Over grazing occurs when too many animals graze for too long and exceed the carrying capacity of a grass land area.
    **c.** Overgrazing removes the grass cover.
    **d.** The humus content of the soil is decreased and it leads to poor, dry, compacted soil.
    **e.** The soil roots are very good binders of soil.
    **f.** When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.

**g.** The dry barren land reflects more of the suns heat, changing wind patterns leading to further desertification.

**III. Mining and quarrying**:

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

## Conservation of natural resources: role of an individual

Different natural resources like forests, water, soil, food, mineral and energy resources play a vital role in the development of a nation. While conservation efforts are underway at National as well as International level, the individual efforts for conservation of natural resources can go a long way.

**Conserve Water**

- Don't keep water taps running while brushing, shaving, washing or bathing.
- Check for water leaks in pipes and toilets and repair them promptly. A small pin-hole sized leak will lead to the wastage of 640 liters of water in a month.
- Use drip irrigation and sprinkling irrigation to improve irrigation efficiency and reduce evaporation.
- Install a small system to capture rain water and collect normally wasted used water from sinks, cloth-washers, bathtubs etc. which can be used for watering the plants
- Build rain water harvesting system in your house. Even the President of India is doing this.

**Conserve energy**

- Turn off lights, fans and other appliances when not in use.
- Obtain as much heat as possible from natural sources. Dry the clothes in sun instead of drier if it is a sunny day.
- Use solar cooker for cooking your food on sunny days which will be more nutritious and will cut down on your LPG expenses.
- Grow deciduous trees and climbers at proper places outside your home to cut off intense heat of summers and get a cool breeze and shade. This will cut off your electricity charges on coolers and air-conditioners.
- Try riding bicycle or just walk down small distances instead of using your car or scooter.

**Protect the soil**

- While constructing your house, don't uproot the trees as far as possible. Plant the disturbed areas with a fast growing native ground cover.
- Make compost from your kitchen waste and use it for your kitchen-garden or flower-pots.
- Do not irrigate the plants using a strong flow of water, as it would wash off the soil.
- If you own agricultural fields, do not over-irrigate your fields without proper drainage to prevent water logging and salinisation .
- Use mixed cropping so that some specific soil nutrients do not get depleted.

**Promote Sustainable Agriculture**

- Do not waste food. Take as much as you can eat
- Reduce the use of pesticides.

- Fertilize your crop primarily with organic fertilizers.
- Eat local and seasonal vegetables. This saves lot of energy on transport, storage and preservation.
- Control pests by a combination of cultivation and biological control methods.

**Equitable use of resources for sustainable life style**

- There is a big divide in the world as North and South, the more developed countries (MDC'S) and less developed countries (LDC'S), the haves and the have nots.
- The MDC's have only 22% of world's population, but they use 88% of its natural resources, 73% of its energy and command 85% of its income.
- As the rich nations continue to grow, they will reach a limit.
- If they have a growth rat of 10% every year, they will show 1024 times increase in the next 70 years.
- Will this much of growth be sustainable? The answer is 'No' because many of our earth's resources are limited and even the renewable resources will become unsustainable if their use exceeds their regeneration.
- Thus, the solution to this problem is to have more equitable distribution of resources and wealth.
- We cannot expect the poor countries to stop growth in order to check pollution because development brings employment and the main problem of these countries is to tackle poverty.
- The poor in the LDC'S are at least able to sustain their life.
- Unless they are provided with such basic resources, we cannot think of rooting out the problems related to dirty, unhygienic, polluted, disease infested settlements of these people-which contribute to unsustainability.
- Thus, the two basic causes of unsustainability are over population in poor countries who have under consumption of resources and over consumption of resources by the rich countries, which generate wastes.
- In order to achieve sustainable life styles it is desirable to achieve a more balanced and equitable distribution of global resources and income to meet everyone's basic needs.
- The rich countries will have to lower down their consumption levels while the bare minimum needs of the poor have to be fulfilled by providing them resources.
- A fairer sharing of resources will narrow down the gap between the rich and the poor and will lead to sustainable development for all and not just for a privileged group.

.
. .

# UNIT-2

# ECOSYSTEMS AND BIODIVERSITY

## Concept of Ecosystem

- ★ The term Ecology was coined by Earnst Haeckel in 1869. It is derived from the Greek words Oikos- home + logos- study.
- ★ So ecology deals with the study of organisms in their natural home interacting with their surroundings.
- ★ An ecosystem is a group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter.
- ★ Now ecology is often defined as "the study of ecosystems".
- ★ The ecosystem is a unit or a system which is composed of a number of subunits that are all directly or indirectly linked with each other.
- ★ They may be freely exchanging energy and matter from outside—an open ecosystem or may be isolated from outside—a closed ecosystem.

## Structure of an ecosystem

The structure of an ecosystem explains the relationship between the abiotic (nonliving) and the biotic (living) components.

1. **Biotic Structure**
   - **a.** The plants, animals and microorganisms present in an ecosystem from the biotic component.

**b.** These organisms have different nutritional behaviour and status in the ecosystems and are accordingly known as Producers or Consumers, based on how they get their food.

**2. Abiotic structure**

**a.** The physical and chemical components of an ecosystem constitute its abiotic structure.

**b.** It includes climatic factors, edaphic (soil) factors, geographical factors, energy, nutrients and toxic substances.

## Functional Attributes

Every ecosystem performs under natural conditions in a systematic way. It receives energy from the sun and passes it on through various biotic components and in facts, all life depends upon this flow of energy.

The major functional attributes of an ecosystem are as follows:

1) Food chain, food webs and trophic structure
2) Energy flow
3) Cycling of nutrients (Biogeochemical cycles)
4) Primary and Secondary production
5) Ecosystem development and regulation

## Producers:

- Producers are mainly the green plants, which can synthesize their food themselves by making use of carbon dioxide present in the air and water in the presence of sunlight by involving chlorophyll, the green pigment present in the leaves, through the process of photosynthesis.
- They are also known as photo autotrophs (auto=self; troph=food, photo=light).
- There are some microorganisms also which can produce organic matter to some extent through oxidation of certain chemicals in the absence of sunlight.
- They are known as chemosynthetic organisms or chemo-autotophs.
- For instance in the ocean depths, where there is no sunlight, chemoautotrophic sulphur bacteria make use of the heat generated by the decay of radioactive elements present in the earth's core and released in ocean's depths.
- They use this heat to convert dissolved hydrogen sulphide ($H_2S$) and carbon dioxide ($CO_2$) into organic compounds.

## Consumers:

All organisms which get their organic food by feeding upon other organisms are called consumers, which are of the following types.

**i. Herbivores (plant eaters):** They feed directly on producers and hence also known as primary consumers. e.g. rabbit, insect, man.

ii. **Carnivores (meat eaters):** They feed other consumers. If they feed on herbivores they are called secondary consumers (e.g. frog) and if they feed on the carnivores (snake, big fish etc.) they are known as tertiary carnivores/consumers.
iii. **Omnivores:** They feed on both plants and animals. E.g. humans, rat, fox, many birds.
iv. **Detritivores (Detritus feeders or Saprotrophs**): They feed on the parts of dead organisms, wastes of living organisms, their castoffs and partially decomposed matter e.g. beetles, termites, ants, crabs, earthworms etc.

**Decomposers:**

- ♠ Decomposers derive their nutrition by breaking down the complex organic molecules to simpler organic compounds and ultimately into inorganic nutrients.
- ♠ Various bacteria and fungi are decomposers.
- ♠ In all the ecosystems, this biotic structure prevails.
- ♠ However, in some, it is the primary producers which predominate (e.g. in forests, agroecosystems) while in others the decomposers predominate (e.g. deep ocean).

**Food Chains**

- ✓ The sequence of eating and being eaten in an ecosystem is known as food chain.
- ✓ All organisms, living or dead, are potential food for some other organism and thus, there is essentially no waste in the functioning of a natural ecosystem.
- ✓ A caterpillar eats a plant leaf, a sparrow eats the caterpillar, a cat or a hawk eats the sparrow and when they all die, they are all consumed by microorganism like bacteria or fungi (decomposers) which break down the organic matter and convert it into simple inorganic substances that can again be used by the plants-the primary producers.
- ✓ Some common examples of simple food chains are:
    - o **Grass → grasshopper→ Frog → Snake →Hawk (Grassland ecosystem)**
    - o **Phytoplanktons → water fleas → small fish → Tuna (Pond ecosystem)**
    - o **Lichens → reindeer → Man (Arctic tundra)**
- ✓ Each organism in the ecosystem is assigned a feeding level or trophic level depending on its nutritional status.
- ✓ Thus, in the grassland food chain, grasshopper occupies the I trophic level, frog the II and snake and hawk occupy the III and the IV trophic levels, respectively.

In nature, we come across two major types of food chains:

1. **Grazing food chain:** It starts with green plants (primary producers) and culminates in carnivores. Example: Grass→ Rabbit→ Fox
2. **Detritus food chain:** It starts with dead organic matter which the detritivores and decomposers consume. Partially decomposed dead organic matter and even the decomposers are consumed by detritivores and their predators.
   Examples: Leaf litter→ algae→ crabs→ small carnivorous fish→ large carnivorous fish (Mangrove ecosystem)

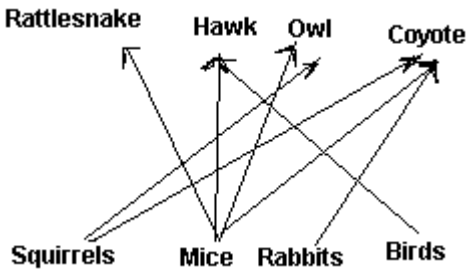
Dead organic matter→ fungi→ bacteria (Forest ecosystem)

Both the food chains occur together in natural ecosystems, but grazing food chain usually predominates.

## Food Web

- Food web is a network of food chains where different types of organisms are connected at different trophic level, so that there are a number of options of eating and being eaten at each trophic level.
- In a tropical region, the ecosystems are much more complex.
- They have rich species diversity and therefore, the food webs are much more complex.
- Food webs give greater stability to the ecosystem.
- In a linear food chain, if one species becomes extinct or one species suffers then the species in the subsequent trophic levels are also affected.
- In a food web, on the other hand, there are a number of options available at each trophic level.
- So if one species is affected, it does not affect other trophic levels so seriously.

For Example: Hawk eats both mice and birds. Coyote eats mice, rabbits and birds.




## Significance of food chains and food webs:

- Food chains and food webs play a very significant role in the ecosystem because the two most important functions of energy flow and nutrient cycling take place through them.
- They help maintain the ecological balance.
- Food chains show a unique property of biological magnification of some chemicals.

## Ecological Pyramids

Graphic representation of trophic structure and function of an ecosystem, starting with producers at the base and successive trophic levels forming the apex is known as an ecological pyramid.

Ecological pyramids are of three types:

I. **Pyramid of numbers**:

a. It represents the number of individual organisms at each trophic level.
b. We may have upright or inverted pyramid of numbers, depending upon the type of ecosystem and food chain as shown in Fig.1
c. A grassland ecosystem (Fig. 1) and a pond ecosystem show an upright pyramid of numbers.
d. The producers in the grasslands are grasses and that in a pond are phytoplankton (algae etc.), which are small in size and very large in number.
e. So the producers form a broad base.
f. The herbivores in grassland are insects while tertiary carnivores are hawks or other birds which are gradually less and less in number and hence the pyramid apex becomes gradually narrower forming an upright pyramid.

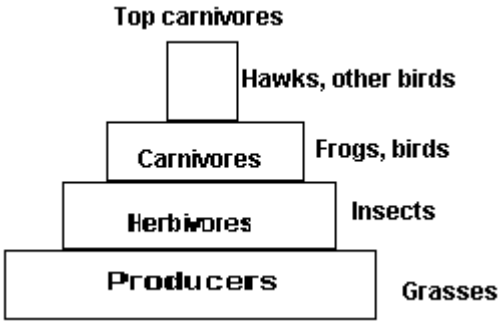


Fig: 1. Grassland ecosystem

**II. Pyramid of biomass:**

a. It is based upon the total biomass (dry matter) at each trophic level in a food chain.
b. The pyramid of biomass can also be upright or inverted. Fig.2. show pyramids of biomass in an aquatic ecosystem.
c. The pond ecosystem shows an inverted pyramid of biomass (Fig. 2).
d. The total biomass of producers (phytoplanktons) is much less as compared to herbivores (zooplanktons, insects), carnivores (Small fish) and tertiary carnivores (big fish). Thus the pyramid takes an inverted shape with narrow base and broad apex.

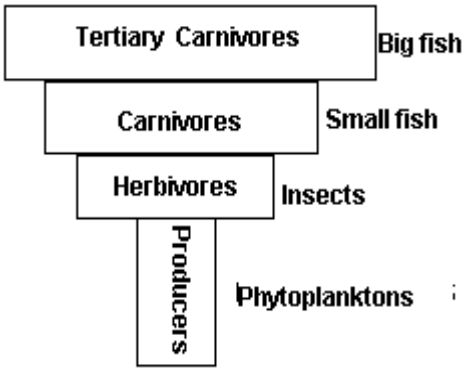


Fig:2 Pyramid of biomass in pond

**III. Pyramid of Energy**:

a. The amount of energy present at each trophic level is considered for this type of pyramid of energy gives the best representation of the tropic relationships and it is always upright.
b. There is a sharp decline in energy level of each successive trophic level as we move from producers to top carnivores. Therefore, the pyramid of energy is always upright as shown in Fig.3.

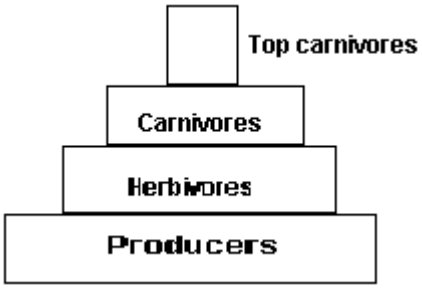



Fig:3. Pyramid of energy

## Energy Flow in an Ecosystem

Flow of energy in an ecosystem takes place through the food chain and it is this energy flow which keeps the ecosystem going. The most important feature of this energy flow is that it is unidirectional or one-way flow. Unlike the nutrients, (like carbon, nitrogen, phosphorus etc.) energy is not reused in the food chain. Also, the flow of energy follows the two laws of Thermodynamics:

**I law of thermodynamics** states that energy can neither be created nor be destroyed but it can be transferred from one form to another. The solar energy captured by the green plants (producers) gets converted into biochemical energy of plants and later into that of consumers.

**II law of Thermodynamics** states that energy dissipates as it is used or in other words, it gets converted from a more concentrated to dispersed form. As energy flows through the food chain, there occurs dissipation of energy at every trophic level.

## Ecological Succession

Ecological succession is defined as an orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem known as climax.

Ecological successions starting on different types of areas or substrata are named differently as follows:

**(i) Hydrarch or Hydrosere**: Starting in watery area like pond, swamp, bog
**(ii) Mesarch:** starting in an area of adequate moisture.
**(iii) Xerarch or Xerosere**: Starting in a dry area with little moisture. They can be of the following types:

| | | |
|---|---|---|
| Lithosere | : | starting on a bare rock |
| Psammosere | : | starting on sand |
| Halosere | : | starting on saline soil |

**Process of Succession**

**The process of succession** takes place in a systematic order of sequential steps as follows:

i. **Nudation**: It is the development of a bare area, without any life form. The bare area may be caused due to several anthropogenic activities.
ii. **Invasion:** It is the successful establishment of one or more species on a bare area through dispersal or migration, followed by ecesis or establishment.
iii. **Competition and coaction**: As the number of individuals grows there is competition, for space, water and nutrition. They influence each other in a number of ways, known as coaction.
iv. **Reaction** : The living organisms have a strong influence on the environment which is modified to a large extent and this is known as reaction.
v. **Stabilization** : The succession ultimately culminates in a more or less stable community called climax which is in equilibrium with the environment

Let us consider very briefly two types of succession.

A. **Hydrosere (Hydrarch**) : This type of succession starts in a water body like pond. A number of intermediate stages come and ultimately it culminates in a climax community which is a forest.
B. **Xerosere (Xerarch**) : This type of succession originates on a bare rock, which lacks water and organic matter. Interestingly, here also the climax community is a forest, although the intermediate stages are very different.

**<u>Forest Ecosystem</u>**

Depending upon the climate conditions, forest may be classified as:

(a) **Trophical Rain Forests**: They are evergreen broadleaf forests found near the equator. They are characterized by high temperature, high humidity and high rainfall, all of which favour the growth of trees.
(b) **Trophical deciduous forests**: They are found a little away from the equator and are characterized by a warm climate the year round. Rain occurs only during monsoon.
(c) **Trophical scrub forests**: They are found in areas where the day season is even longer.
(d) **Temperate rain forests**: They are found in temperate areas with adequate rainfall. These are dominated by trees like pines, firs, redwoods etc.
(e) **Temperate deciduous forests**: They are found in areas with moderate temperatures.
(f) **Evergreen coniferous forests (Boreal Forests)**: They are found just south of arctic tundra. Here winters are long, cold and dry. Sunlight is available for a few hours only.

The abiotic environment of forest ecosystem includes the nutrients present in the soil in forest floor which is usually rich in dead and decaying organic matter.

**Producers**: Producers are mainly big trees, some shrubs and ground vegetation.

**Primary consumers**: Primary consumers are insects like ants, flies, beetles, spiders, and big animals like elephants, deer, squirrels etc.

**Secondary consumers**: Secondary consumers are carnivores like snakes, lizards, foxes, birds etc.,

**Tertiary consumers**: Tertiary consumers are animals like tiger, lion etc.

**Decomposers:** Decomposers are bacteria fungi which are found in soil on the forest floor. Rate of decomposition in trophical or sub-trophical forests is more rapid than that in the temperate zones.

## Grassland Ecosystem:

The grassland ecosystem occupies about 10% of the earth's surface. The abiotic environment includes nutrient like nitrates, sulphates or phosphates and trace elements present in the soil, gases, like $CO_2$ present in the atmosphere and water etc.

Three types of grasslands are found to occur in different climatic regions:

**(a) Tropical grasslands**: They occur near the borders of tropical rain forests in regions of high average temperature and low to moderate rainfall.
**(b) Temperate grasslands**: They are usually found on flat, gentle sloped hills, winters are very cold but summers are hot and dry.
**(c) Polar grass lands**: they are found in arctic polar region where severe cold and strong, frigid winds along with ice and snow create too harsh a climate for trees to grow.

**Producers:** Producers are mainly grass and some herbs, shrubs, and few scattered trees.

**Primary consumers**: Primary consumers are grazing animals such as cow, sheep, deer, house, kangaroo, etc. Some insects and spiders have also been included as primary consumers.

**Secondary consumers**: Secondary consumers are animals like fox, jackals, snakes, lizards, frogs and birds etc.

**Tertiary consumers**: Decomposers are bacteria, moulds and fungi, like penicillium, Aspergillus etc. The minerals and other nutrients are thus brought back to the soil and are made available to the producers.
Flow chart: Food chain

Grass→ Grass hoper →Lizard
Grass → Rabbit→ Fox → Lion

## Desert Ecosystem

- Desert occurs in the region where the average rainfall is less than 25 cm.
- The abiotic environment of a desert ecosystem includes water which is scarce.

- The atmosphere is very very dry and hence it is a poor insulator.
- That is why in deserts the soil gets cooled up quickly, making the nights cool.

Deserts are of three major types, based on climatic conditions:

i. **Tropical deserts** like Sahara in Africa and Thar Desert, Rajasthan, India are the driest of all with only a few species.
ii. **Temperature deserts** like Mojave in Southern California where day time temperatures are very hot in summer but cool in winters.
iii. **Cold deserts** like Gobi desert in China have cold winters and warm summers.

**Producers:** the chief producers are shrubs, bushes and some trees whose roots are very extensive and stems and leaves are modified to store water and to reduce loss of water as a result of transpiration. Low plants such as mosses and blue green algae are minor producers.

**Primary consumers**: Primary consumers are animals like rabbits which get water from succulent plants. They do not drink water even if it is freely available. Camel is also a primary consumer of the desert.

**Secondary consumers**: Secondary consumers are carnivores like reptiles having impervious skin which minimize loss water from the surface of body.

**Tertiary consumers**: The tertiary consumers are mainly birds which conserve warer by excreting solid uric acid.

**Decomposers:** Decomposers are bacteria and fungi which can thrive in hot climate conditions. Because of scarcity of flora and fauna, the dead organic matter available is much less and therefore decomposers are also less in number.
Flow Chart: Food chain

Shrub→ Rabbits→ Reptiles→ Birds

## Aquatic ecosystems

Aquatic ecosystems dealing with water bodies and the biotic communities present in them are either freshwater or marine. Let us consider some important aquatic ecosystems.

**(i) Pond ecosystems**:

a. It is a small freshwater aquatic ecosystem where water is stagnant.
b. Ponds may be seasonal in nature i.e. receiving enough water during rainy season.
c. Ponds are usually shallow water bodies which play a very important role in the villages where most of the activities center around ponds.
d. They contain several types of algae, aquatic plants, insects, fishes, and birds.
e. The ponds are, however, very often exposed to tremendous anthropogenic pressures.
f. They are used for washing clothes, bathing, swimming, cattle bathing and drinking etc. and therefore get polluted.

**(ii) Lake ecosystems**:

a. Lakes are usually big freshwater bodies with standing water.
b. They have shallow water zone called Littoral zone, an open-water zone called Limnetic zone and deep bottom area where light penetration is negligible, known as profundal zone(Fig.4).

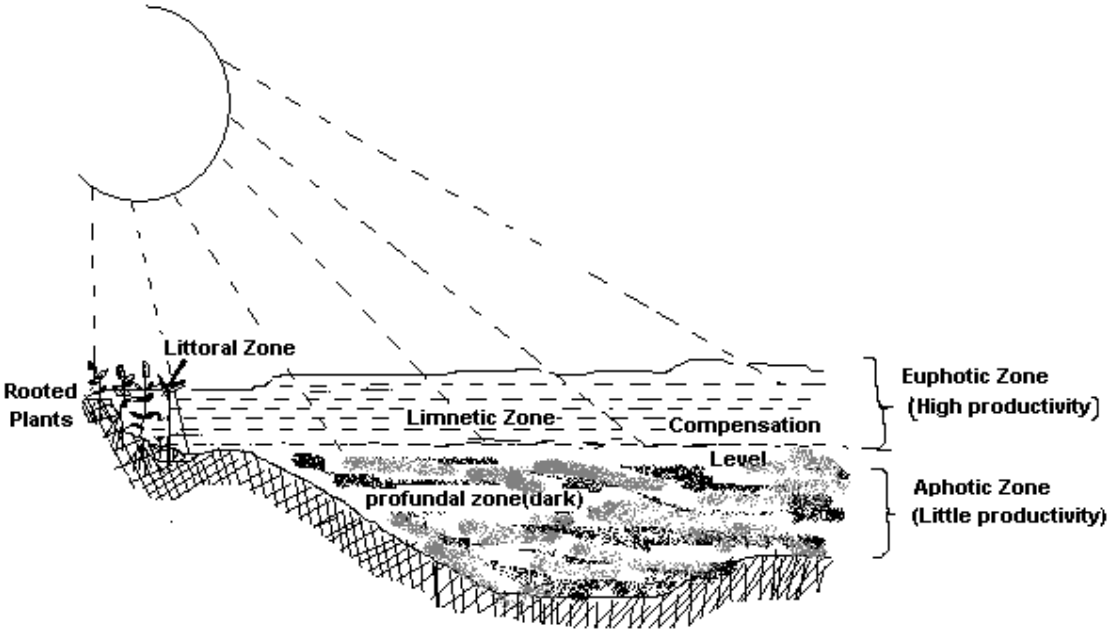



Fig:4 Zonation in a lake ecosystem

**Organisms:** Lakes have several types of organisms:

**(i)** **Planktons** that float on the surface of waters e.g. phytoplanktons like algae and zooplanktons like rotifers.
**(ii)** **Nektons** that swim e.g. fishes.
**(iii)** **Neustons** that rest or swim on the surface.
**(iv)** **Benthos** that are attached to bottom sediments e.g. snails.
**(v)** **Periphytons** that are attached or clinging to other plants or any other surface e.g. crustaceans.

**Stratification:**

The lakes show stratification or zonation based on temperature differences. During summer, the top waters become warmer than the bottom waters. Therefore, only the warm top layer circulates without mixing with the colder layer, thus forming a distinct zonation:

**Epyilimnion**: Warm, lighter, circulating surface layer.
**Hypolimnion**: Cold,viscous,non-circulating bottom layer

**Types of lakes:**

**(a) Oligotrophic lakes** which have low nutrient concentrations.
**(b) Eutrophic lakes** which are over nourished by nutrients like nitrogen and phosphorus, usually as a result of agricultural run-off or municipal sewage discharge. They are covered with "algal blooms" e.g. Dal lake.
**(c) Dystrophic lakes** that have low pH, high humic acid content and brown waters e.g. bog lakes.
**(d) Endemic lakes** that are very ancient, deep and have endemic fauna which are restricted only to that lake e.g. the Lake Baikal in Russia.
**(e) Artificial lakes or impoundments** that are created due to construction of dams e.g. Govindsagar Lake at Bhakra-Nangal.

**(iii) Streams:**

- These are freshwater aquatic ecosystems where water current is a major controlling factor, oxygen and nutrient in the water is more uniform and land-water exchange is more extensive.
- Although stream organisms have to face more extremes of temperature and action of currents as compared to pond or lake organisms, but they do not have to face oxygen deficiency under natural conditions.
- This is because the streams are shallow, have a large surface exposed to air and constant motion which churns the water and provides abundant oxygen.
- Their dissolved oxygen level is higher than that of ponds even though the green plants are much less in number.
- The stream animals usually have a narrow range of tolerance to oxygen.
- That is the reason why they are very susceptible to any organic pollution which depletes dissolved oxygen in the water.
- Thus, streams are the worst victims of industrial development.

**(iv) River ecosystems:**

- Rivers are large streams that flow downward from mountain highlands and flowing through the plains fall into the sea.
- So the river ecosystems show a series of different conditions.
- **The mountain highland** part has cold, clear waters rushing down as water falls with large amounts of dissolves oxygen.
- **In the second phase** on the gentle slopes, the waters are warmer and support a luxuriant growth of plants and less oxygen requiring fishes.
- **In the third phase**, the river waters are very rich in biotic diversity. Moving down the hills, rivers shape the land. They bring with them lots of silt rich in nutrients which are deposited in the plains and in the delta before teaching the ocean.

**(v) Oceans:**

- These are gigantic reservoirs of water covering more than 70% of our earth's surface and play a key role in the survival of about 2,50,000 marine species, serving as food for humans and other organisms, give a huge variety of sea-products and drugs.
- Oceans provide us iron, phosphorus, magnesium, oil, natural gas, sand and gravel.

- Oceans are the major sinks of carbondioxide and play an important role in regulating many biogeochemical cycles and hydrological cycle, thereby regulating the earth's climate.

The oceans have two major life zones: (Fig:5)

**Coastal zone:** It is relatively warm, nutrient rich shallow water. Due to high nutrients and ample sunlight this is the zone of high primary productivity.

**Open sea**: It is the deeper part of the ocean, away from the continental shelf. It is vertically divided into three regions:

- ✓ **Euphotic zone** which receives abundant light and shows high photosynthetic activity.
- ✓ **Bathyal zone** receives dim light and is usually geologically active.
- ✓ **Abyssal zone** is the dark zone, 2000 to 5000 meters deep. The abyssal zone has no primary source of energy i.e. solar energy. It is the world's largest ecological unit but it is an incomplete ecosystem.

## Estuary

- ❖ Estuary is a partially enclosed coastal area at the mouth of a river where fresh water and salty seawater meet.
- ❖ These are the transition zones which are strongly affected by tidal action.
- ❖ Constant mixing of water stirs up the silt which makes the nutrients available for the primary producers.
- ❖ The organisms present in estuaries show a wide range of tolerance to temperature and salinity.
- ❖ Such organisms are known as eurythermal and euryhaline. Coastal bays and tidal marshes are examples of estuaries.
- ❖ Estuary has a rich biodiversity and many of the species are endemic.
- ❖ There are many migratory species of fishes like eels and salmons in which half of the life is spent in fresh water and half in salty water.
- ❖ For them estuaries are ideal places for resting during migration, where they also get abundant food.
- ❖ Estuaries are highly productive ecosystems.
- ❖ The river flow and tidal action provide energy for estuary thereby enhancing its productivity.
- ❖ Estuaries are of much use to human beings due to their high food potential.
- ❖ However, these ecosystems need to be managed judiciously and protected from pollution.

# Introduction to Biodiversity

## Definition

**Biodiversity** refers to the variety and variability among all groups of living organisms and the ecosystem complexes in which they occur.

In the convention of Biological diversity (1992) biodiversity has been defined as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.

**Genetic diversity**

- ★ Genetic Diversity is the basic source of biodiversity.
- ★ The genes found in organisms can form enormous number of combinations each of which gives rise to some variability.
- ★ Genes are the basic units of hereditary information transmitted from one generation to other.
- ★ When the genes within the same species show different versions due to new combinations, it is called genetic variability.
- ★ For example, all rice varieties belong to the species oryza sativa, but there are thousands of wild and cultivated verities of rice which show variations at the genetic level and differ in their color, size, shape, aroma and nutrient content of the grain. This is the genetic diversity of rice

**Species diversity**

- ♦ Species Diversity is the variability found within the population of a species or between different species of a community.
- ♦ It represents broadly the species richness and their abundance in a community.
- ♦ There are two popular indices of measuring species diversity known as *Shannon-wiener index* and *Simpson index.*

What is the number of species in this biosphere?

- ➢ The estimates of actual number vary widely due to incomplete and indirect data.
- ➢ The current estimates given by Wilson in 1992 put the total number of living species in a range of 10 million to 50 million.
- ➢ Till now only about 1.5 million living and 300,000 fossil species have been actually described and given scientific names.

**Ecosystem diversity**

- Ecosystem diversity is the diversity of ecological complexity showing variations in trophic structure, food-webs, nutrient cycling etc.
- The ecosystems also show variations with respect to physical parameters like moisture, temperature, altitude, precipitation etc.
- The ecosystem diversity is of great value that must be kept intact.
- This diversity has developed over millions of years of evolution.
- If we destroy this diversity, it would disrupt the ecological balance.
- We cannot even replace the diversity of one ecosystem by that of another.
- Coniferous trees of boreal forests cannot take up the function of the trees of trophicl deciduous forest lands and vice versa.

**Biogeographical classification of India:**

Biogeography comprising of phytogeography and zoogeography deals with the aspects of plants and animals. There are around ten biogeographic regions in India.

| S.No | **Biogeographic Zone** | **Biotic province** | **Total area (sq.km.)** |
|---|---|---|---|
| 1 | Trans-Himalayan | Upper Regions | 186200 |
| 2 | Himalayan | North-West Himalayas | 6900 |
| | | West Himalayas | 720000 |
| | | central Himalayas | 123000 |
| | | East Himalayas | 83000 |
| 3 | Desert | Kutch | 45000 |
| | | Thar | 180000 |
| | | Ladakh | NA |
| 4 | Semi-Arid | Central India | 107600 |
| | | Gujarat-Rajwara | 400400 |
| 5 | Western Ghats | Malabar Coast | 59700 |
| | | Western Ghat Mountains | 99300 |
| 6 | Deccan Peninsula | Deccan Plateau South | 378000 |
| | | Central Plateau | 341000 |
| | | Eastern Plateau | 198000 |
| | | Chotta Nagpur | 217000 |
| | | Central Highlands | 287000 |
| 7 | Gangetic Plain | Upper Gangetic Plain | 206400 |
| | | Lower Gangetic Plain | 153000 |
| 8 | North-East India | Brahmaputra Valley | 65200 |
| | | North-Eastern Hills | 106200 |
| 9 | Islands | Andaman Islands | 6397 |
| | | Nicobar Islands | 1930 |
| | | Lakshadweep Islands | 180 |
| 10 | Coast | West Coast | 6500 |
| | | East Coast | 6500 |

## Value of biodiversity

The value of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is enormous. The multiple uses of biodiversity value have been classified by McNeely et al in 1990 as follows:

**(i)** **Consumptive use value**: these are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fibre etc.

a. **Food**: A large number of wild plants are consumed by human beings as food. About 80,000 edible plant species have been reported from wild. About 90% of present day food crops have been domesticated from wild tropical plants. A large number of wild animals are also our sources of food.

b. **Drugs and medicines:**
    i. About 75% of the world's population depends upon plants or plant extracts for medicines.
    ii. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium.
    iii. Likewise, we get Tetracyclin from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree, while Digitalin is obtained from foxglove which is an effective cure for heart ailments.
    iv. Recently vinblastin and vincristine, two anticancer drugs, have been obtained from periwinkle plant, which possesses anticancer alkaloids.

Our forests have been used since ages for fuel wood. The fossil furls coal, petroleum and natural gas are also products of fossilized biodiversity.

**(ii) Productive use values**:

a. These are the commercially usable values where the product is marketed and sold.
b. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, lac from lac insects etc, all of which are traded in the market.
c. Many industries are dependent upon the productive use values of biodiversity e.g. –the paper and pulp industry, plywood industry, railway sleeper industry, silk industry, ivory-works, leather industry, pearl industry etc.

**(iii) Social value**:

a. These are the values associated with the social life, customs, and religion of the people.
b. Many of the plants are considered holy and sacred in our country like Tulsi, peepul, Mango, and Lotus etc.
c. The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped.
d. Many animals like Cow, Snake, and Peacock also have significant place in our psycho-spiritual arena.

**(iv) Ethical value**:

a. It is also sometimes known as existence value. It involves ethical issues like "all life must be preserved".
b. The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure.
c. We are not deriving anything direct from Kangaroo, Zebra or Giraffe, but we all strongly feel that these species should exist in nature.

**(v) Aesthetic value**:

a. No one of us would like to visit vast stretches of barren lands with no signs of visible life.
b. People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as eco-tourism.
c. Ecotourism is estimated to generate about 12 billion dollars of revenue annually.

**(vi) Option values**:

a. These values include the potentials of biodiversity that are presently unknown and need to be explored.
b. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depths of a marine ecosystem, or a tropical rain forest.
c. Thus option value is the value of knowing that there are biological resources existing on this biosphere that may one day prove to be an effective option for something important in the future.

**(vii) Ecosystem service value**:

a. It refers to the services provided by ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, prevention floods, cycling of water, their role as carbon sinks, pollutant absorption and reduction of the threat of global warming etc.

## Global Biodiversity

- Following the 1992 "Earth summit" at Rio de Janeiro, it become evident that there is a growing need to know and scientifically name, the huge number of species which are still unknown on this earth.
- Tropical deforestation alone is reducing the biodiversity by half a percentage every year.
- Terrestrial biodiversity of the earth is best described as biomes, which are the largest ecological units present in different geographic areas and are named after the dominant vegetation e.g. the tropical rainforests, tall grass prairies, savannas, desert, tundra etc.
- Out of the 3000 plants identified by National Cancer Research Institute as sources of cancer fighting chemicals, 70% come from tropical rain forests.
- There is an estimated 1,25,000 flowering plant species in tropical forests.
- However, till now we know only 1-3% of these species.
- Temperature forests have much less biodiversity, but there is much better documentation of the species. Globally, we have roughly 1,70,000 flowering plants, 30,000 vertebrates and about 2,50,000 other groups of species that have been described.
- Table 1 shows the estimated number of some known living species in different taxonomic groups:

Table:1 Living species estimates (World Resource Institute, 1999)

| Taxonomic group | Number |
|---|---|
| Bacteria & Cyanobacteria | 5,000 |
| Protozoans | 31,000 |
| Algae | 27,000 |
| Jelly fish, Corals etc. | 10,000 |
| Amphibians | 4,000 |
| Reptiles | 5,000 |
| Birds | 9,000 |
| Mammals | 4,000 |

## Biological diversity at National Level

- Every country is characterized by its own biodiversity depending mainly on its climate.
- India has a rich biological diversity of flora and fauna. Overall six percent of the global species are found in India.
- It is estimated that India ranks $10^{th}$ among the plant rich countries of the world, $11^{th}$ in terms of number of endemic species of higher vertebrates and $6^{th}$ among the centers of diversity and origin of agricultural crops.
- The total number of living species identified in our country is 1,50,000.
- Out of a total 25 biodiversity hot-spots in the world, India possesses two.
- India is also one of the 12 mega-biodiversity countries in the world.

**Regional or local biodiversity**

Biodiversity at regional level is better understood by categorizing species richness into four types, based upon their spatial distribution as discussed below:

(i) **Point richness** refers to the number of species that can be found at a single point in a given space.

(ii) **Alpha ($\alpha$) richness** refers to the number of species found in a small homogenous area.

(iii) **Beta ($\beta$) richness** refers to the rate of change in species composition across different habitats.

(iv) **Gamma ($\gamma$) richness** refers to the rate of change across large landscape gradients.

$\alpha$- richness is strongly correlated with physical environmental variables. $\beta$- richness means that the cumulative number of species increases as more heterogonous habitats are taken into consideration.

**India as mega diversity nation**

India is one of the 12 mega diversity countries in the world. The Ministry of Environment and forests, Govt. of India (2000) records 47,000 species of plants and 81,000 species of animals which is about 7% and 6.5% respectively of global flora and fauna.

**Endemism**: Species, which are restricted only to a particular area, are known as endemic. India shows a good number of endemic species.

**Center of origin**: A large number of species are known to have originated in India. Nearly 5000 species of flowering plants had their origin in India.

**Marine diversity**: Along 7500 km long coastline of our country in the mangroves, estuaries, coral reefs, back waters etc. there exists a rich biodiversity. More than 340 species of corals of the world are found here. ]

A large proportion of the Indian Biodiversity is still unexplored. There are about 93 major wet lands, coral reefs and mangroves which need to be studied in detail.

**Hot spots of biodiversity**

- ♠ Areas, which exhibit high species richness as well as high species endemism, are termed as hot spots of biodiversity.
- ♠ The term was introduced by Myers (1988).
- ♠ There are 25 such hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats.
- ♠ These hot spots covering less than 2% of the world's land are found to have about 50% of the terrestrial biodiversity.
- ♠ About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots.
- ♠ After the tropical rain forests, the second highest number of endemic plant species are found in the Mediterranean (Mittermeier).
- ♠ Earlier 12 hot spots were identified on a global level.
- ♠ Later Myers et al (2000) recognized 25 hot spots.
- ♠ Two of these hotspots lie in India extending into neighbouring countries namely, Indo-Burma region (covering Eastern Himalayas) and Western Ghats – Sri Lanka region.
- ♠ The Indian hot spots are not only rich in floral wealth and endemic species of plants but also reptiles, amphibians, swallow tailed butterflies and some mammals.

**(a) Eastern Himalayas**:

a. They display an ultra-varied topography that fosters species diversity and endemism.
b. Certain species like Sapria himalayana, a parasitic angiosperm was sighted only twice in this region in the last 70 years.
c. Out of the world's recorded flora 30% are endemic to India of which 35,000 are in the Himalayas.

**(b) Western Ghats:**

a. It extends along a 17,000 $Km^2$ strip of forests in Maharashtra, Karnataka, Tamil Nadu and Kerala and has 40% of the total endemic plant species.
b. 62% amphibians and 50% lizards are endemic to Western Ghats.
c. The major centers of diversity are Agastyamalai Hills and Silent Valley-_the New Amambalam Reserve Basin.
d. It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded.
e. Although the hotspots are characterized by endemism, interestingly, a few species are common to both the hotspots in India.

## Threats to Biodiversity

- ✓ Extinction or elimination of a species is a natural process of evolution.
- ✓ In the geologic period the earth has experienced mass extinctions.
- ✓ During evolution, species have died out and have been replaced by others.
- ✓ The process of extinction has become particularly fast in the recent years of human civilization.
- ✓ One of the estimates by the noted ecologist, E.O. Wilson puts the figure of extinction at 10,000 species per year or 27 per day! This starling figure raises an alarm regarding the serious threat to biodiversity.

Let us consider some of the major causes and issues related to threats to biodiversity.

**(i) Loss of Habitat**

- Destruction and loss of natural habitat is the single largest cause of biodiversity loss. Billions of hectares of forests and grasslands have been cleared over the past 10,000 years for conversion into agriculture lands, pastures, settlement areas or development projects.
- There has been a rapid disappearance of tropical forests in our country also, at a rate of about 0.6% per year.
- With the current rate of loss of forest habitat, it is estimated that 20-25% of the global flora would be lost within a few years.
- Marine biodiversity is also under serious threat due to large scale destruction of the fragile breeding and feeding grounds of our oceanic fish and other species, as a result of human intervention.

**(ii) Poaching**

- Illegal trade of wildlife products by killing prohibited endangered animals i.e. poaching is another threat to wildlife.
- Despite international ban on trade in products from endangered species, smuggling of wild life items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues.
- The cost of elephant tusks can go up to $100 per kg; the leopard fur coat is sold at $ 100,000 in Japan while bird catchers can fetch up to $ 10,000 for a rare hyacinth macaw, a beautiful coloured bird, from Brazil.

**(iii) Man-Wildlife conflict**

- Instances of man animal conflicts keep on coming to lime light from several states in our country.
- In Sambalpur, Orissa 195 humans were killed in the last 5 years by elephants.
- In retaliation the villagers killed 98 elephants and badly injured 30 elephants.
- Several instances of killing of elephants in the border regions of Kote-Chamarajanagar belt in Mysore have been reported recently.
- The man-elephant conflict in this region has arisen because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops.
- The agonized villagers electrocute the elephants and sometimes hide explosives in the sugarcane fields, which explode as the elephants intrude into their fields.
- In the early 2004, a man-eating tiger was reported to kill 16 Nepalese people and one 4-year old child inside the Royal Chitwan National Park of Kathmandu.
- In June, 2004 two men were killed by the leopards in Powai, Mumbai.

**Cause of Man-animal conflicts:**

**(i)** Dwindling habitats of tigers, elephants and bears due to shrinking forest cover compels them to move outside the forest and attack the field or sometimes even humans.

**(ii)** Usually the ill, weak and injured animals have tendency to attack man. Also, the female tigress attacks the human if she feels that her newborn cubs are in danger. But the biggest problem is that if human-flesh is tasted once then the tiger does not eat any other animal.

**(iii)** Earlier, forest departments used to cultivate paddy, sugarcane etc. within the sanctuaries when the favourite staple food of elephants i.e. bamboo leaves were not abailable. Now due to lack of such practices the animals move out of the forest in search of food.

**(iv)** Very often the villagers put electric wiring around their ripe crop fields. The elephants get injured, suffer in pain and turn violent.

**(v)** The cash compensation paid by the government in lieu of the damage caused to the farmers crop is not enough. The agonized farmer therefore gets revengeful and kills the wild animals.

**Remedial Measures to Curb the Conflict:**

**(i)** Tiger Conservation Project (TCP) has made provisions for making available vehicles, tranquillizer guns, and binoculars to tactfully deal with any imminent danger.

**(ii)** Adequate crop compensation and cattle compensation scheme must be started.

**(iii)** Solar powered fencing should be provided along with electric current proof trenches to prevent the animals from straying fields.

**(iv)** Cropping pattern should be changed near forest borders and adequate fruits and water should be made available for the elephants within forest zones.

**(v)** Wild life corridors should be provided for mass migration of big animals during unfavorable periods.

**Endangered species of India**

- The International Union for Conservation of Nature and Natural Resources (IUCN) publishes the Red Data Book which includes the list of endangered species of plants and animals.
- The red data symbolizes the warning signal for those species which are endangered and if not protected are likely to become extinct in near future.
- In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare.
- Existence of about 150 mammals and 150 species of birds is estimated to be threatened while an unknown number of species of insects are endangered.
- A few species of endangered reptiles, birds, mammals and plants are given below:
    - **Reptiles:** Green sea turtle, tortoise, python
    - **Birds:** Great Indian bustard, Peacock, Pelican, Great Indian Hornbill, Siberian
    - **Carnivorous Mammals:** Indian wolf, red fox, red panda, tiger, leopard, Indian, lion, golden cat, desert cat
    - **Primates:** Hoolock gibbon, capped monkey, golden monkey
    - **Plants:** A large number of species of orchids, Rododendrons, medicinal plants like Rauvolfia serpentina, the sandal, wood tree santalum, cycas beddonei etc

.

The Zoological Survey of India reported that Cheetah, Pink headed duck and mountain quail have already become extinct from India.

- A species is said to e extinct when it is not seen in the wild for 50 years at a stretch eg. Dodo, Passenger pigeon.
- A species is said to be endangered when its number has been reduced to a critical level. If such a species is not protected and conserved, it is in immediate danger of extinction.
- A species is said to be in vulnerable category if its population is facing continuous decline due to overexploitation or habitat destruction.
- Species which are not endangered or vulnerable at present, but are at a risk are categorized as rare species.

**Endemic species:**

- The species are only found among a particular people or in a particular region are knows as endemic species.
- Out of about 47, 00 species of plants in our country 7000 are endemic.
- Some of the important endemic flora includes orchids and species like sapria himalayana, Uvaria lureda, Nepenthes khasiana etc.
- A large number out of total of 81,000 species of animals in our country is endemic.
- The western ghats are particularly rich in amphibians and reptiles.
- About 62%amphiians and 50% lizards are endemic to Western Ghats.
- Different species of monitor lizard, reticulated python are some important endemic species of our country.

**Conservation of Biodiversity**

The enormous value of biodiversity due to their genetic, commercial, medical, esthetic, ecological and optional importance emphasizes the need to conserve biodiversity.

There are two approaches of biodiversity conservation:

**(a) In situ conservation (within habitat):** This is achieved by protection of wild flora and fauna in nature itself. E.g. Biosphere Reserves, National Parks, Sanctuaries, Reserve Forests etc.

**(b) Ex situ conservation (outside habitats):** This is done by establishment of gene banks, seed banks, zoos, botanical gardens, culture collections etc.

**In Situ conservation:**

At present in our country we have:

- ★ 7 major Biosphere reserves,
- ★ 80 National Parks,
- ★ 420 wild-life sanctuaries and
- ★ 120 Botanical gardens
- ★ They totally cover 4% of the geographic area.

**The Biosphere Reserves** conserve some representative ecosystems as a whole for long-term in situ conservation. In India we have:

- ✓ Nanda Devi (U.P.),
- ✓ Nokrek (Meghalaya),
- ✓ Manas (Assam),
- ✓ Sunderbans (West Bengal),
- ✓ Gulf of Mannar (Tamil Nadu),
- ✓ Nilgiri (Karnataka, Kerala, Tamil Nadu),
- ✓ Great Nicobars and Similipal (Orrisa)

**A National Park** is an area dedicated for the conservation of wildlife along with its environment. It is also meant for enjoyment through tourism but without impairing the environment. Grazing of domestic animals, all private rights and forestry activities are prohibited within a National Park. Each National Park usually aims at conservation specifically of some particular species of wildlife along with others.

Some major National Parks of our country are enlisted in the Table 2 below:

Table 2 Some important National parks in India

| Name of National Park | State | Important Wildlife |
|---|---|---|
| Kaziranga | Assam | One horned Rhino |
| Gir National Park | Gujarat | Indian Lion |
| Bandipur | Karnataka | Elephant |
| Periyar | Kerala | Elephant, Tiger |
| Sariska | Rajasthan | Tiger |

**Wildlife sanctuaries** are also protected areas where killing, hunting, shooting or capturing of wildlife is prohibited except under the control of highest authority. Some major wildlife sanctuaries of our country are shown in table 3.

Table 3 Some Important Wildlife Sanctuaries of India

| Name of Sanctuary | State | Major Wild Life |
|---|---|---|
| Ghana Bird Sanctuary | Rajasthan | 3oo species of birds (including migratory) |
| Sultanpur Bird Sanctuary | Haryana | Migratory birds |
| Mudamalai Wildlife Sanctuary | Tamil Nadu | Tiger, elephant, Leopard |

| | | |
|---|---|---|
| Vedanthangal Bird Sanctuary | Tamil Nadu | Water birds |
| Wild Ass Sanctuary | Gujarat | Wild ass, wolf, nilgai, chinkara |

For plants, there is one gene sanctuary for Citrus (Lemon family) and one for pitcher plant (an insect eating plant) in Northeast India.

## Ex Situ Conservation:

This type of conservation is mainly done for conservation of crop varieties. In India, we have the following important gene bank/seed bank facilities:

**(i)** National Bureau of Plant Genetic Resources (NBPGR) is located in New Delhi. Here agricultural and horticultural crops and their wild relatives are preserved by cryo-preservation of seeds, pollen etc. by using liquid nitrogen at a temperature as low as – 196 degree Celsious. Varieties of rice, turnip, radish, tomato, onion, carrot, chilli, tobacco etc. have been preserved successfully in liquid nitrogen for several years without losing seed viability.

**(ii)** National Bureau of Animal Genetic Resources (NBAGR) located at Karnal, Haryana. It preserves the semen of domesticated bovine animals.

**(iii)** National Facility for Plant Tissue Culture Repository (NFPTCR) for the development of a facility of conservation of varieties of crop plants/trees by tissue culture. This facility has been created within the NBPGR.

For the protection and conservation of certain animals, there have been specific projects in our country e.g. Project Tiger, Girl Lion Project, Crocodile Breeding Project, Project Elephant, Snow Leopard Project etc.

# UNIT – 3
# Environmental pollution

## Objectives:

In this topic we are going to deal about different types of pollution and due to this types of pollution how our environment is facing disasters and calamities.

## Introduction:

Environmental pollution can be defined as “the unfavorable alteration of our surroundings”

## Types of pollutants:

1. Bio degradable pollutants - decompose rapidly by natural processes.
2. Non- degradable pollutants- do not decompose or slowly decompose in the environment.

Pollution are of different kinds

1. Air pollution
2. water pollution
3. soil pollution
4. marine pollution
5. noise pollution
6. thermal pollution and
7. Nuclear hazards

## Air pollution:

It may be defined as " the presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings , plants and animals

## Sources of air pollution:

a) Natural pollution - volcanic eruptions, forest fires, biological decay, etc.
b) Man – made activities – Thermal power plants, agricultural activities etc.

## Classification:

1. Primary pollutant – these are those emitted directly in the atmosphere in harmful form like CO, NO etc
2. Secondary pollutant – these may react with one another or with the basic components of air to form new pollutants.

## Control Measures:

**1. Source control:**

a) Use only unleaded petrol
b) Use petroleum products and other fuels that have low sulphur and ash content
c) Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
d) Industries and waste disposal sites should be situated outside the city centre .
e) Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.

2. **Control measures in Industrial centers** :

a) Emission rates should be restricted to permissible levels
b) Incorporation of air pollution control equipments in the design of the plant lay out .

## Water pollution:

It may be defined as " the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

**Types, effects and sources of water pollution:**

1. Infectious agents: - Bacteria, viruses, protozoa and parasitic worms.
   Sources :- Human and animal wastes.
   Effects : Variety of diseases.
2. Oxygen demanding wastes:- Animal manure and plant debris that can be decomposed by aerobic bacteria.
   Sources : - Sewage , paper mills, and food processing facilities
   Effects: Wastes can degrade quality by depleting water of dissolved oxygen.
3. In organic Chemicals : - Water soluble inorganic chemicals.
   1. Acids
   2. Compounds of toxic metals such as lead , arsenic and selenium
   3. Salts such as Nacl in ocean water .

   Effects : Genetic mutations, birth defects and certain cancers.

**Thermal pollution (Heat):**

Example : Excessive heat.

Human source : Water cooling of electric power plants and some types of industrial plants . Almost all of all water withdrawn in United states for cooling electric power plants.

Effects:

1. Lowers dissolved oxygen levels and makes aquatic organisms more vulnerable to disease and toxic chemicals
2. When a power plant first opens or shuts down for repair, fish and other organisms adapted to a particular temperature range can be killed b the abrupt change in water temperature known as thermal shock

**Control measures of water pollution:**

1. The administration of water pollution should be in the hands of state or central government.
2. Industrial plants should be based on recycling operations, because it will not only stop the discharge of industrial wastes into natural water sources but by products can be extracted from the wastes.
3. Plants, trees and forests control pollution and they acts as natural air conditioners.
4. Highly qualified and experienced persons should be consulted from time to time for effective control of water pollution.
5. Basic and applied research in pubic health engineering should be encouraged.

**Soil Pollution:**

It may be defined as “the contamination of soul by human and natural activities which may cause harmful effects on living beings”.

**Types:**

1.Industrial wastes

Sources and effects:- pulp and paper mills, chemical industries, oil refineries , sugar factories etc., These pollutants affect and alter the chemical and biological properties of soil. As a result , hazardous chemicals can enter into human food chain from the soil, disturb the bio chemical process an d finally lead to serious effects.

2.Urban wastes

Sources and effects:- Plastcs, Glasses, metallic cans, fibers, papers , rubbers , street sweepings, and other discarded manufactured products. These are also dangerous.

3.Agricultural practices

Sources and effects:- Huge quantities of fertilizers, pesticides, herbicides , weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry , are reported to cause soil pollution.

4.Radioactive pollutants

Sources and effects: These are resulting from explosions of nuclear dust and radio active wastes penetrate the soil and accumulate there by creating land pollution.

5.Biological agents.

Sources and effects: Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

**Control measures of soil pollution**

The pressure on intensification of farm activities increases for two reasons

1. population growth
2. Decrease of the available farm land due to urbanization

The soil pollution can be controlled by

1. forestry an d farm practices
2. Proper dumping of unwanted materials
3. Production of natural fertilizers
4. Proper Hygienic condition
5. Public awareness
6. Recycling and Reuse of wastes
7. Ban on Toxic chemicals.

**Marine pollution:**

It may be defined as “ the discharge of waste substances into the sea resulting in harm to living resources hazards to human health, hindrance to fishery and impairment of quality for use of sea water”.

Source of marine pollution:

The coastal zones contains rich heritage , coral reefs, wetlands, and seagrass beds.

Effects of marine pollutants:

1. The presence of heavy metals and organic pollutants cause more damage in birds as thinning of eggshell and tissue damage of egg.

2. Oil spilling causes abnormally low body temperature in birds resulting in hypothermia.
3. Oil films are able to retard significantly the rate of oxygen uptake by water.

**Control measures of marine pollution**

1. Plants for conserving marine biodiversity must be taken into account of human needs.
2. People should be educated about marine ecosystems and the benefits offered by them.
3. Local communities must be involved in protecting and managing their coastal resources
4. Social and economic incentives must be offered for conserving and sustainable use of marine resources.
5. Governments must manage their own water while extending cooperation to the neighboring states.

**Noise pollution:**

It may be defined as " the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings"

**Types of noise:**

1. Industrial noise
2. Transport noise
3. Neighborhood noise

**Effects of Noise pollution**

1. This affects human health, comfort and efficiency.
2. It causes muscles to contract leading to nervous breakdown, tension
3. It affects health efficiency and behavior.
4. In addition to serious loss of hearing due to excessive noise, impulsive noise also causes psychological and pathological disorders.
5. Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise etc.

**Control and preventing measures**

1. Source control – acoustic treatment to machine surface , design changes , limiting the operational timings
2. Transmission path intervention- the source inside a sound insulating enclosure, construction of a noise barrier or provision of sound absorbing materials
3. Oiling – Proper oiling will reduce the noise from the machines.

**Thermal pollution :**

It may be defined as the " addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise causes significant departures from the normal activities of aquatic communities in water"

**Sources of thermal pollution**

1. Nuclear power plants
2. Coal fired power plants
3. Industrial effluents
4. Domestic sewage
5. Hydro – electric power.

**Effects of thermal pollution**

a) Reduction in dissolved oxygen
b) Increase in Toxicity
c) Interference wwith biological activities
d) Interference with reproduction
e) Direct mortality
f) Food storage for fish

**Control measures of thermal pollution:**

a) Cooling towers: - This is used as a coolant
 1) wet cooling tower
 2) Dry cooling tower
b) Cooling ponds
c) Spray ponds
d) Artificial lakes – The heated effluents can be discharged into the lake at one end and the water for cooling purposes from the other end.

**Nuclear Hazards:**

The radiation hazard in the environment comes from ultraviolet, visible, cosmic rays and micro wave radiation which produces genetic mutation in man.

Sources of Nuclear Hazards:

1. Natural Sources – which is in space which emit cosmic rays
2. Man made sources ( Anthropogenic sources) These are nuclear power plants, X-rays , nuclear accidents, nuclear bombs, diagnostic kits etc

**Effects of Nuclear Hazards:**

1. Exposure of the brain and central nervous system ot high doses of radiation causes delirium, convulsions and death within hours or days.

2. The use of eye is vulnerable to radiation. As its cell die, they become opaque forming cataracts that impair sight.
3. Acute radiation sickness ios marked by vomiting , bleeding of gums and in severe cases mouth ulcers.
4. Nausea and vomiting often begin a few hours after the gastrointestinal tract is exposed . Infection of the intestinal wall can kill weeks afterwards.
5. Unborn children are vulnerable to brain damage or mental retardation , especially if irradiation occurs during formation of the central nervous system in early pregnancy.

**Control measures:**

1. Nuclear devices should never be exploded in air.
2. In nuclear reactors, closed cycle coolant system with gaseous coolant may be used to prevent extraneous activitation products.
3. Containments may also be employed to decrease the radio active emissions.
4. Extreme care should be exercis3ed in the disposal of industrial wastes contaminated with radio nuclides.
5. Use of high chimneys and ventilations at the working place where radioactive contamination is high. It seems to be an effective way for dispersing pollutants.

**Solid Waste Management:**

Management of solid waste is very important in order to minimize the adverse effects of solid wastes.

Types of solid wastes:

1. Urban wastes

Sources – a) Domestic wastes – Food waste, Cloth, Waste paper etc

B) Commercial wastes – Packing material, cans, bottles , polythene etc.

C) Construction Wastes – Wood, concrete debris etc.

D) Bio medical wastes – Anatomical wastes , infectious wastes etc.,

2. Industrial wastes

Sources – a) Nuclear power plants – generates radioactive wastes

B Thermal power plants – produces fly ash in large quantities

3. Chemical industries

Produces large quantities of hazardous and toxic materials

**Steps involved in solid waste management :**

1. Reduce , Reuse and Recycle of materials – raw materials re usage should be reduced , reuse of waste materials should be reduced and recycling of the discarded materials into new useful products should also be reduced.
2. Discarding wastes

a) Land fill : Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thick refuse, covered with selected earth fill of 20cm thickness

b) Incineration: It is a hygienic way of disposing the solid waste. It is a thermal process and is very effective for detoxification of all combustible pathogens

c) Composting: It is another popular method practiced in many cities in our country. In this method , bulk organic waste is converted into a fertilizing manure by biological action.

**Role of an individual in prevention of pollution:**

1. Plant more trees
2. Help more in pollution prevention than pollution control
3. Use water, energy and other resoucrces efficiently
4. Purchase recyclable, recycled and environmentally safe products
5. reduce deforestation
6. Remove NO from motar vehicular exhaust
7. Use of eco friendly products.

**Case studies:**

1. Effluents treatment at MRL , Chennai
2. The Bhopal gas tragedy
3. Arsenic pollution in ground water
4. Soft drink bottling unit
5. Mercury wastes
6. Palar river pollution
7. The miniamatta epidemic ( marine pollution)

**Disaster management**

**Hazard**

It is a perceived natural event which threatens both life and property

**Disaster**

A disaster is the realization of this hazard

It is defined as the geological process and it is an event concentrated in time and space in which a society or subdivision of a society undergoes severe danger and causes loss of its members and physical property.

**Types**

1. Natural disasters – refers to those disasters that are generated by natural phenomena
2. Man made disasters – refers to the disasters resulting from man made hazards.

**Floods**

Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks the excess of water overflows on the surroundings causes floods.

Causes of floods

1. Heavy rain, rainfall during cyclone causes floods
2. sudden snow melt also raises the quantity of water in streams and causes flood
3. sudden and excess release of impounded water behind dams
4. clearing of forests for agriculture has also increased severity of floods.

**Flood management**

1. Encroachment of flood ways should be banned
2. Building walls prevent spilling out the flood water over flood plains
3. Diverting excess water through channels or canals to areas like lake, rivers etc., where water is not sufficient,
4. Optical and microwave data from IRS is also used for flood management
5. Flood forecasts and flood warning are also given by the central water commission

**Cyclones:**

It is a meterological process, intense depressions forming over the open oceans and moving towards the land.

**Effect:**

1. The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy
2. Cyclone occurance slow down the developmental activities of the area

**Cyclone management:**

1. Satellite images are used by meterological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
2. Radar system is used to detect the cyclone and is beign used for cyclone warning

**Case studies**

Cyclone in orissa – 1999

**Land slides:**

The movement of earthy materials like coherent rock, mud, soil and debris from higher to lower region to gravitational pull is called land sliedes

**Causes:**

1. Movement of heavy vehicles on the unstable sloppy regions create landslides
2. Earthquake, shocks, vibrations and cyclone create landslide

**Earth quakes:**

An earthquake is an sudden vibration caused on earth surface with the sudden release of tremendous energy stored in rocks under the earth's crust.

**Causes:**

1.Disequilibrium in any part of the earth crust
2. Underground Nuclear testing
3. Decrease of underground water level.

**Effect:**

Damage the settlements and transport systems

Collapses houses and their structures
Deformation of ground surface
Tsunami

**Earthquake management:**

Constructing earthquake resistant building
Wooden houses are preferred
Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes.

**Tsunami:**

A tsunami is a large wave that is generated in a water body when the seafloor is deformed by seismic activity. This activity displaces the overlying water in the ocean.

**Causes of tsunami**

1. Seismic activities like earthquakes, landslides, volcanic eruptions, explosions, can generate tsunami.
2. Deformation of the sea floor due to the movement of plates.

**Concept of Tsunami**

A tsunami is not a single wave but a series of waves like the ordinary waves which we see on a ses.

**Effects on Tsunami**

1. Tsunami attacks mostly the coastlines, causing devastating property, damage and loss of life
2. Tsunami can kill lot of human beings, livestock's, etc
3. Tsunami may also spread lot of water borne diseases.

**Tsunami Management**

Earthquakes under the water are monitored by sensors on the floor of the sea.
The sensors send the information of floating buoys on the surface, whenever they detect any changes in pressure of the sea
The information is then relayed to satellites, which passes it on to the earth stations.
Finally the country make the people alert through the media to take all necessary precautions.

**Case studies:**

Tsunami in India

**Field study of local polluted site**

Tirupur in Tamilnadu
Pallavaram in chennai

# UNIT -4

# ECO SYSTEM



## 4.1. Introduction

Eco system is a functional unit consisting of all living organism such as plants, animals and microbes in a given area and all non living physical and chemical factors of environment linked

together through nutrient cycling and energy flow. The functioning of an eco system is important because all its components are dynamic and the responsible for the creating on the unique state of ……. Environment relationship.

## 4.2. Objectives

After studying this unit you should be able to

1. Learn the concept of eco system
2. Understand the structure and function of eco system
3. Relationship between food chain food web and ecological pyramid.

## 4.3. Concept of an Eco System

The term ecosystem is coined by an English botanist in 1935 by A.G. Tansley. The term ecosystem is derived from two wards “Eco” and “System”. Eco refers to environment, and system means an interacting and interdependent complex. Hence ecosystem means a system of organisms interacting with their environment. AG Tansley defined Ecosystem as the system resulting from integration of all the living and non living factors of environment. It can also be defined as organic community of plants and animals viewed with in its physical environment or habitat. According to Britannica has defined as a unit that includes all the organisms (Biological factors) in a given area interacting with environment (Physical factors) so that a flow of energy leads to a clearly defined traffic (nutrient requiring) structure, biodiversity and material cycle (exchange of materials between living and non living)

From above definition it is clear that any unit of bio system that includes all organisms which function together in a given area where they interact with physical environment is known as eco system.

## 4.4 Characteristics Features of Eco System:

Eco system has certain characteristics feature they include as follows :

1. The concept of eco system is very broad and flexible: It can be applied to any situation where organisms function together with their non living environment in such a way there is interchange of materials between them even if the system lasts only for a short time. Example : A pond in a field or forest or dessert.

2. Eco system is a functional unit : It consist both biotic and abiotic environmentd. The abiotic environment has close interaction, essential for maintenance of life processes. The interaction is conducted by energy flow in the system and cycling of materials.

3. Eco system is an open system.

4. It is broad and flexible.

5. A eco system is major structural unit of ecology.

6. The structure of eco system is related to its species diversity. A more complex structure has higher species diversity.

7. The function of an eco system is related to energy flow and material cycling through and with in the systems.

8. The relative amount of energy needed to maintain an eco system depends on its structure. The more complex structure needs lesser energy to maintain itself.

9. The environment and energy fixation in any given eco system are limited. They can not be exceeded with out causing serious adverse effects.

10. Ecosystem is a self regulating and self sustaining system.

11. Ecosystems are not isolated units in the biosphere but are interconnected. There many natural ecosystems. Examples : desserts, forest, mountains.

## 4.4 – Main Functions of Eco System

The main functions of an ecosystem are :

1. FLOW OF ENERGY : Takes place from sun to the producers, from producers to consumers and from consumers to decomposers.

2. CYCLIC USE OF MATERIALS : The chemical elements composing the aboitic components are circulated in an ecosystem starting from nutrient pool (soil) to producers, producers to consumers to decomposers and lastly, back to the nutrient pool.

3. ECO-REGULATION : Boitic and basic components are regulated by each other. Hence this ensures and maintains an ecosystem.

## 4.6 – Structure and Function of an Ecosystem

An ecosystem is a system which comprises not only organic and inorganic elements but also energy components. It is a total assemblage of components entering into interactions of a group of organisms.

Ecosystem has two components. They are

1. Biotic components comprising of all living organisms
2. Abiotic components comprising of physical or non living environment.

### 4.6.1 – Biotic Components of an Ecosystem

Biotic components comprising of all living organisms are usually classified into two categories on the basis of their traffic or nutritional relationships they are.

a. Autotrophs
b. Heterotrophs

Autotrophs :

1. Autotrophic organisms are produces their own food. Example: Green plans and certain bacteria.
2. They get energy from sun through photosynthesis and produce food.
3. They produce food not only from but also for other organisms. Hence they are also called producers.

Heterotrophs :

1. Heterotrophs or heterotrophic organism are those organisms which depend directly or indirectly on Autotrophs for their food.
2. Since they depend on Autotrophs they are called as consumers.

Define Autotrophs

Autotrophic organisms produces their own food. Eg. Green plants

Functionally Biotic Components

| PRODUCERS | CONSUMERS | DECOMPOSERS |
|---|---|---|
| 1. Autorophs, which are Capable of producing food, 2. they produce food from Non living, inorganic Substances Eg. Green Plants, algae, bacteria etc. | 1. Are hetrotrophs<br>2. They consume food produced by producers<br>3. They also include animals which eat plants (herbivores) and animals which eat other animals (carnivores) | 1. It includes micro organisms like bacteria and fungi<br>2. They decompose the dead organisms into simpler components.<br>3. After decomposing They release inorganic nutrients or matter in to the environment. |

Primary : Are herbivores they feed on green plants Eg. Rabbits, deer, elephants etc.

Secondary : Are carnivores. They feed on other plant eating animals. Eg: Snakes Fox.

Territory : Are top carnivores. They feed on other carnivores or flesh eating animals. Eg: Tiger, Lion.

Dependencies for Food:

In an eco system there are four types of dependencies for food for living organisms. They are:

1. Producers, depending, upon abiotic or inorganic substances.
2. Primary consumers, depending on the producers.
3. Secondary consumers, depending on the primary consumers.
4. Tertiary consumers, depending on secondary consumers.

Trophic Levels :

It may be noted that, in the ecosystem, the transfer of food energy takes place in some hierarchical order. The food energy passes from one group of organisms to other groups of organisms at different levels. These levels are called trophic levels, which mean feeding level of group of organisms. There are four trophic levels. They are :

| | TROPHIC LEVELS |
|---|---|
| TROPHIC LEVELS 1 | Includes producers or Autotrophs which produce their own food by converting solar energy into chemical energy in the form of organic substances, such as carbohydrates and also food for other organisms. The green plants belong to this category. |
| TROPHIC LEVELS 2 | Includes primary consumers who don not produce their own food, but use plants as their food. Examples are grass-eating animals like cattle, sheep, goats, deer, and rabbit etc. which are called herbivores. |
| TROPHIC LEVELS 3 | Includes animals which depend upon other animals for their food. They are carnivores (flesh-eating animals) like tiger, lion, etc. Which eat mainly herbivores. |
| TROPHIC LEVELS 4 | Includes animals which obtain their food from animals included in trophic level 3 |

### 4.6.2 – Abiotic Components of an Eco System

It refers to non-living or physical eco-system of physical environmental factors. The important abiotic, non-living or physical environmental factors are:

* WATER :

It is necessity for all living organisms. Most organisms require water for survival. Water from rainfall, surface water, underground water and humidity influences all types of life on land. Water is responsible for pattern of habitats on land. For plants, water is essential for photosynthesis. Absence of water is responsible for migration of animals.

* SOIL :

It plays an important role in the ecosystem. Soil is the home of many organisms. Soil plays an important role in plant growth. Soil provides all the nutrients, such as calcium, nitrate, phosphate, etc. Which the plants require. The fertility of soil determines agricultural production.

* AIR :

It is a mixture of gases, such as nitrogen, oxygen, carbon dioxide, etc. Air has significant effect on plants and other living organisms of the ecosystem. Carbon dioxide in the air affects the rate of photosynthesis. An increase in carbon dioxide concentration results in greenhouse effect and warming up of the earth.

* TEMPERATURE

Temperature is one of the important factors of the ecosystem. It has the direct effect on all the organisms on the earth. Each organism has minimum, maximum and optimum temperature for life. The distribution and functioning of animals is influenced by temperature directly. Temperature has also indirect effect, in the sense that modifies other factors such humidity, availability of water, etc. it influences the behaviour of plants, animals and even human beings.

* LIGHT :

It is one of the important factors of the ecosystem. It is the source of energy for all the life on land. It is an essential factor for the formation of chlorophyll. It influences flowering and reproduction of plants. It is responsible for mating, reproduction, migration, etc. of animals. It is essential for human life.

## 4.7 Functioning of the Eco System

It consists of all living organisms, such as plants, animals and microbes in a given area, and all non-living physical and chemical factors of environment, linked together through nutrient cycling and energy flow. The functioning (i.e., pattern of working of an ecosystem is important, because all its components are dynamic and are responsible for the creation of the unique state of man-environment relationship.

1. Energy Flow
2. Productivity
3. Biogeochemical Cycling.

### 4.7.1 Energy Flow

On an average, only about one percent of the total sun's energy reaching the earth's surface is utilized for photosynthesis by plants. In the food chains at various trophic levels, there is a loss of certain amount of energy in the form of heat. Further, the flow of energy is always unidirectional and gradually tapering, i.e., the energy transferred to a trophic level is much less than that reaching the previous trophic level.

Ten Percent Law :

According to this law, there is a gradual decline in the amount of energy available as we move from one trophic level to next trophic level i.e. from the producer level to the next higher level. Infact only 10% of the total energy available at the producer level is available at the next level and so on.

Example : A green plant receives 1,000 joules of solar energy, out of which only 1% solar energy is utilized by the plant (the rest being reflected back to the atmosphere), the plant utilizes only 10 joules. Next, when a herbivore consumes this plant, it will get only 10% of 10 joules of energy i.e., 1 joule, the remaining 0 joules of energy will be lost to the environment as heat. Next, when a carnivore which consumes the herbivore will get only 10% of 1 joule of energy i.e., 0.1 joule, the remaining 0.9 joule will be lost to the environment.

Pyramid of Energy :

If the energy flow in an ecosystem is represented in the shape of a pyramid, it is always upright. The pyramid of energy represents the total quality of energy at each trophic level of food chain.

### 4.7.2 – Productivity of Ecosystem:

Meaning of productivity:

Productivity of an ecosystem means the amount of organic matter produced or accumulated by plants or the producers per unit of time and area. According to Sexena and term productivity of ecosystem denotes the amount of organic matter accumulated in any unit of time.

Types of Productivity :

1. Primary Productivity
2. Secondary Productivity
3. Net Productivity.

Primary Productivity:

It refers to the rate at which radiant energy is stored by green plants through photosynthetic activities to produce organic substances. It is the amount of organic matter made in a given time by green plants in an ecosystem.

* Net Primary Production:

It is the amount of organic matter produced or stored in plants tissues in excess of that used up by the plants during respiration.

* Gross Primary Production:

It is the total organic matter used up in respiration during a particular period.

Secondary Productivity:

Secondary productivity refers to the capacity of energy storage at the consumer level or second trophic level. IT actually remains mobile from one organism to another and does not live insitu like primary productivity.

Net Productivity:

Net productivity refers to the rate of storage of organic matter not used or consumed by the consumers at the consumer level or second trophic level. It is the rate of increase of biomass of the primary, producers, which has been left out by the consumers.

### 4.7.3 : Biological Cycling

The cycling of chemical elements within an ecosystem is called ecosystem mineral cycling. Ecosystem mineral cycling connects biological cycles to geological cycles. Chemical elements cycle within an eco-system from organism to organism through water, air, soils and rocks.

There are 3 main chemical cycles they are :

**Hydrological Cycle :**

The hydrological cycle or water cycle is the most important cycle. It involves interchange of water between the earth surface and the atmosphere through rainfall and transpiration. The water from water bodies like ocean, sea, river, lakes etc. gets evaporated by solar energy. These water vapours, after cooling and condensation, form clouds, and result in rainfall, snowfall, etc. A large part of the rainfall occurs in ocean and seas. A sizable part of water goes back to the ocean and seas. A sizable parts of water infiltrate into the soil and become underground water or table water. A small quantity of water is absorbed by the plants and other animals, and the same is released during respiration and transpiration of plants. Thus, there is a continuous cycling of water.

Carbon Cycle :

Carbon cycle plays an important role. The small amount of carbon dioxide in the atmosphere is the only source of carbon that passes through the organism along with the food chains. Carbon moves from the atmosphere to the green plants, then to animals and finally to the other micro organisms that return into the atmosphere through decomposition of dead organic matter. The carbon dioxide has unique property of absorbing infrared radiation, and it helps in keeping the earth warm. Excess of carbon dioxide lead to rise in the temperature.

Oxygen Cycle :

Oxygen is about 21% of the atmosphere. It is also available in the bound states as oxides and carbonates in rocks and in water. The plants release oxygen in water during photosynthesis. Again, gaseous oxygen is used in the respiration of all the organisms and in the oxidation of the organic matter. Another phase of the oxygen is the ozone layer of the outer stratosphere which serves an important function of protecting the life from the ionizing ultraviolet waves.

## 4.8 Ecological Succession

An ecosystem is never static. Its structure and function changes with time in a orderly way and such a change can be predicted.

Ecological succession for the orderly changes in communities. However, the idea of ecological succession was formally presented by the American ecologist. Clements, in 1961.

In the progressive transformation or orientation of a biological community, plant and animal species come into an area and alter the environmental conditions in favour of new plant and animal species. This process is known as ecological succession. So, ecological succession may be defined as “an orderly process of changes in the community structure and function with time through modifications in the physical environment which ultimately culminates in a stable ecosystem known as climax”.

Odum preferred to call the orderly changes in communities as ecosystem developed rather than ecological succession. He defined ecosystem development in terms of three parameters, viz., (i) an orderly process of biological community development that involves changes in species structure, (ii) the modification of the physical environment by the biological community and (iii) culmination in a stabilized ecosystem in which maximum biomass and symbiotic function between organisms are maintained per unit of available energy flow.

Clements, in 1916, while stydying plant communities, defined ecological succession, as “the natural process by which the same locality becomes successively colonized by different groups or communities of plants”.

### Features of Ecological Succession :

Ecological succession has certain characteristic features. Those features are :

(i) Ecological succession is an orderly process of changes in the biological community structure and function with time through modifications in the environment.

(ii) The orderly or progressive process of changes in the biological community ultimately results in a stable ecosystem known as climax or climax community.

(iii) The climax community is characterized by maximum biomass and symbiotic (i.e. mutually beneficial) linkages between organisms, which is maintanined quite efficiently per unit of available energy.

(iv) The complete process of ecological succession may take hundreds or thousands of years, and entails a number of intermediate communities, known as seral communities or seres.

(v) The community establishing first in the area is called the pioneer community.

(vi) During the early stages of ecological succession, the rate of primary production (P) exceeds the total community respiration ® during a given time. In such cases, P/R ratio is greater than 1. This type of succession is known as autotrophic succession. This type of succession includes early and continued dominance of autotrophic organisms like green plants.

Where some external factor reduces the P/R ratio is less than 1, the succession is termed as heterotrophs succession. This type of succession is dominated by hetrotrophs, such as bacteria, actiomyceles, fungi and animals.

(vii) In both cases (i.e., in both autotrophic succession and heterotrophic succession), P/R ratio tends to approach which is the characteristic of climax stage.

## Causes of Ecological Succession :

The causes for ecological succession are of three types. They are :

### (a) Initial or Initiating Causes :

Initiating causes are climatic causes, such as erosion of soil, fire, etc. and biotic causes, such as activities of organisms, etc. which produce the bare area or destroy the existing population in an area.

(b) Ecesis or Continuing Causes :

Continuing causes are edaphic features of the area, such as migration, aggregation, competition, reaction, etc. which cause successive changes in population.

© Stabilising or Stability Causes :

These ae causes like the climate of the area, which causes the stablisation of the community.

Types of Ecological Succession:

There are two basic types of ecological succession. They are :

1. Primary Succession
2. Secondary Succession

Primary succession takes place when plants and animals colonise a previously desolate area, such as sand dune, bare rocks, new volcanic island, etc.

2. Secondary Succession:

Secondary succession starts from a previously built up community where a sudden change in climatic factor, biotic intervention, fire, etc. causes the existing community to disappear.

Besides the above two types of ecological succession, there are also many other types of ecological succession, depending mainly upon the nature of the environment, especially based upon moisture relations.

Type other types of ecological succession are :

(a) Hydrosere or Hydrarch :

This type of ecological succession starts in regions where water is plenty, say, in pond, lake, river, swamp, etc. This type of succession starts with the colonization of some phytoplankton’s, which form the pioneer plant community, and finally terminates into a forest, which is a climax community.

(b) Mesosere or mesarch :

This type of ecological succession starts in an area where adequate moisture conditions are present. The original substratum contains sufficient amount of water and organic matter. The pioneers to colonize this primitive substratum are lichens, mosses, algae and other micro organisms, and through a series of successive several stages of herbaceous and shrub, the succession finally terminates into a forest, which constitutes the climax community.

© Xerosere or Xerarch :

This type of succession starts in areas where moisture is present in minimum amount, such as dry deserts, rocks, etc. The original substratum is deficient in water and lacks any organic matter. The pioneers to colonise this primitive substratum are crustoge, type of lichens, etc. and through a series of successive several stages, the succession finally terminates into a forest, which constitutes the climax community.

It may be noted that xerarch can be further divided into (i) lithosere, (iiu) psammosere and (iii) halosere.

Lithosere starts on a bare rock, Psammosere starts on sand. Holosere starts on saline soil.

From a study of the various types of ecological succession, it is clear that ecological succession tends to move towards mesic (i.e., moderate) conditions whether it starts from a xeric (i.e., dry) condition or a hydric (i.e., moist) condition, and culminates in a stable climax community, which is usually a forest.

## 4.9 Food Chain

Food chain refers to the transfer of food energy from one category of organisms to another category of organism through a repeated process of eating and being eaten in other words, it is a series of links in which food energy is passed from one living body to another living body within a natural community. The sequential process of eating any being eaten which forms a linear chain is called food chain.

In a food chain, food or energy transfer take place from producers to consumers to decomposers. A food chain does not normally consist of more than five traphic levels and fifth trophic level does not contain enough energy to support further level.

### 4.10 Food Web

A food chain in an ecosystem are not isolated from one another but are inter connected with one another since most consumer have multiple food siyrces bad nabt soecues are oret ti several predations and parastics. Different food chains are often into remarked to form food web. The inter locking or interlinking pattern of food chain is called the food web.

The significance of food chain and food web are as follows :

Food chain and food webs play a very important role in the ecosystem because the energy low and nutrient cycling take a place through food chain and food web.

Food chain also help in maintaining and regularly the population size of different animals thus help to maintain and regulated the ecological balance.

### 4.11 Ecology Pyramids

A study of successive levels of the food chain in terms of energy flow, biomass and numbers of individuals at different levels clearly shows that there will be a decrease in the availability of energy biomass, and the number of individuals from the autotrophy to the primary, secondary and tertiary consumers. Since there is a gradual decrease of energy, biomass and the number of individuals starting from the autotrophs to the carnivorous consumers at different levels, these plants and animals in the food chain may be arranged into what are called “ecological pyramids.”

To understand it better we should know what food chain is. A food chain is the flow of energy from one organism to the next and to the next and to the next. Organisms in a food chain are grouped into trophic levels – from the Greek word for nourishment, trophikos – based on how many links they are removed from the primary producers. Trophic levels may consist of either a

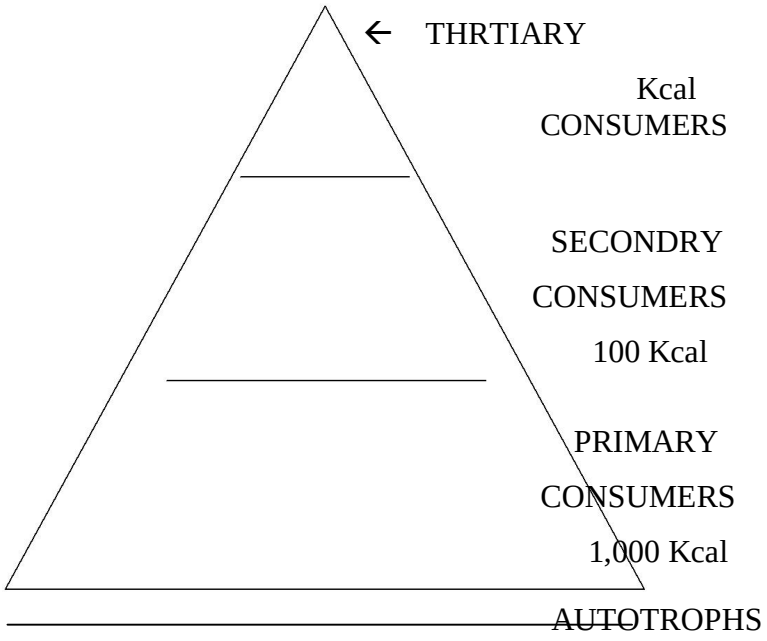
single species or a group of species that are presumed to share both predators and prey. They usually start with a primary producer and end with a carnivore.

The Ecological pyramids are divided into three types and they include :

- Pyramid of energy
- Pyramid of biomass
- Pyramid of numbers

**Pyramid of Energy**

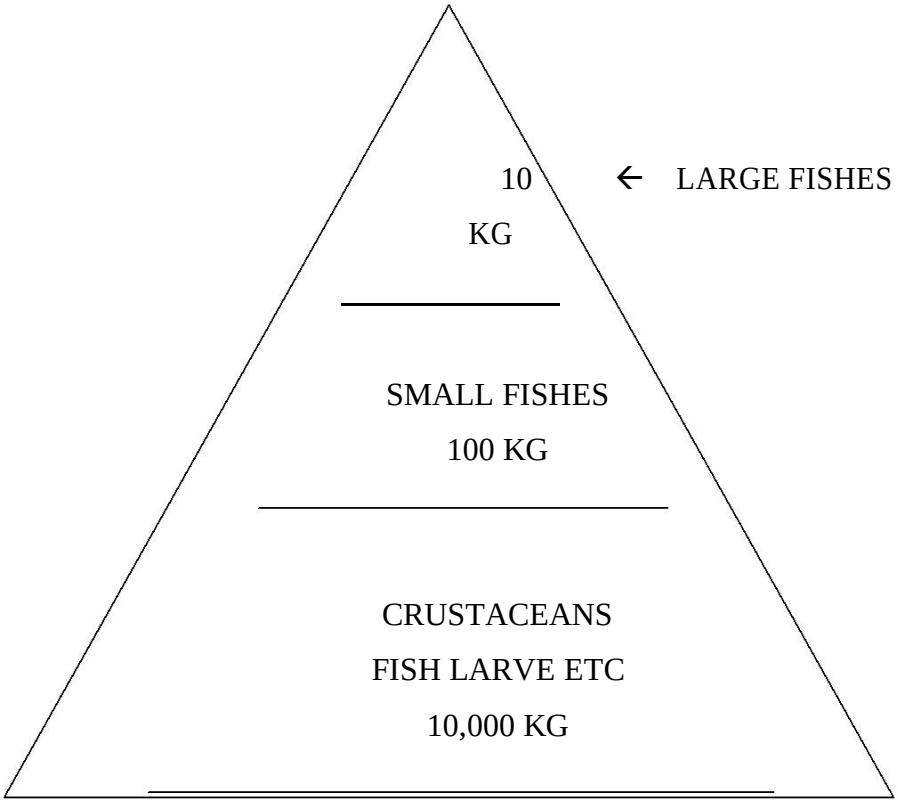
Here there will be gradual decrease in the availability of energy from the autotrophs to the higher trophic levels. In other words, there is a decrease in energy flow from autotrophs onwards at the successive trophic levels. In the course of energy flow from one organism to the other, there is considerable loss of energy in the form of heat. More energy is available in the autotrophs than in the primary consumers. The least amount of available energy will be in the tertiary consumers. The pyramid of energy may be represented as in fig.



Therefore, the shorter the food chain, the greater is the amount of energy available at the top.

**The Pyramid of Biomass :**

Here there will be a gradual decrease in the biomass from the autotrophs to the higher trophic levels. This may be illustrated by studying the trophic levels in a pond. The biomass in autotrophs like algae, green flagellates, green plants etc. is the maximum. The biomass is considerably less in the next trophic level occupied by primary consumers like crustaceans, fish larvae, etc. There is a further reduction in the amount of biomass in the next trophic level occupied by secondary consumers like small fishes. The least amount of biomass is present in the last trophic level. The pyramid of biomas may be represented as in the fig.



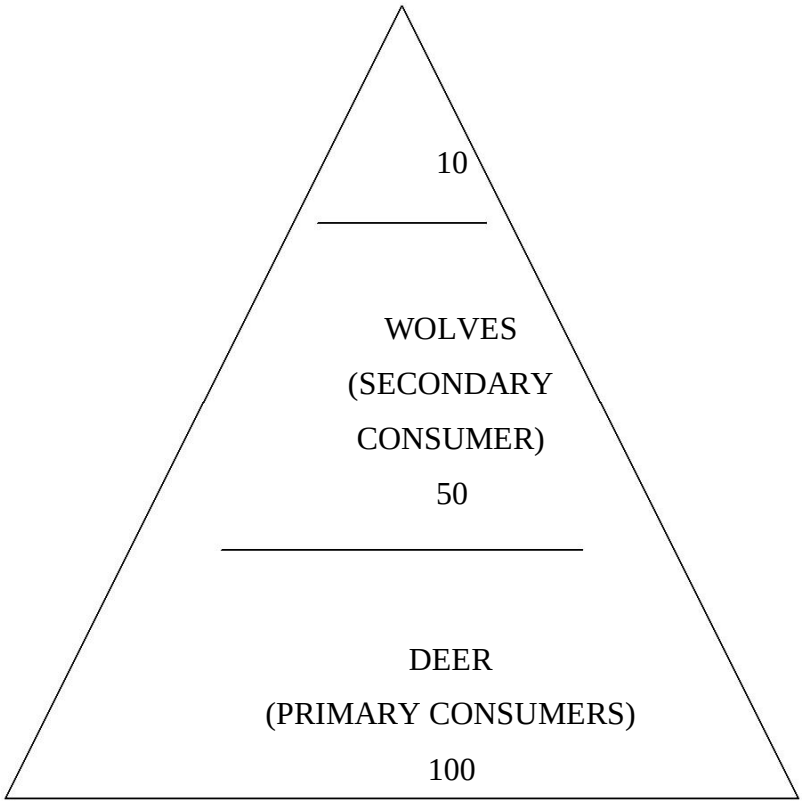
ALGAE, GREEN FLAGELLATES,

GREEN PLANTS ETC.

10,000 KG

**Pyramid of Numbers**

(a) Here there will be a gradual decrease in the number of individuals from the lower to the higher trophic levels. This may be studied by taking the example of trophic levels in grasslands. The grasses occupy the lowest trophic level and they are abundantly present in the grassland ecosystem. The deer occupy the second level; their number is less when compared to the grasses (autotrophs). The wolves, which feed upon the deer, are far less in number when compared to the number of deer. The lions, which occupy the next trophic level, feed upon the wolves, and the number of individuals in the last trophic level is greatly reduced. The pyramid of numbers may be represented as in the fig.

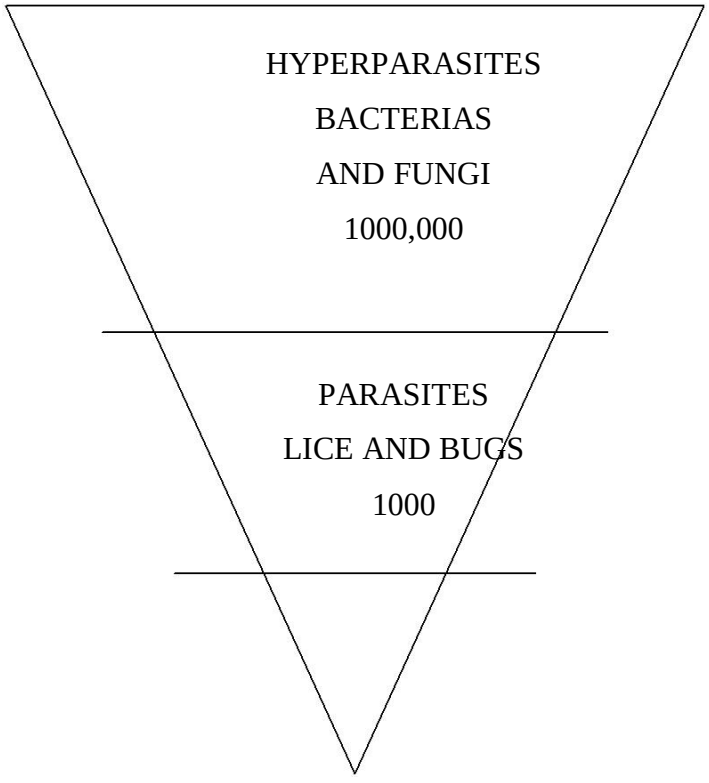


GRASSES (AUTOTROPHS)

1,000,000

B) The Pyramid of numbers in a parasitic food chain (or inverted pyramid):

In the parastic food chain, the pyramid of numbers is found to be inverted. Here, a single plant or tree (producer) might support a variety of herbivores like fruit eating birds. These herbivores in turn support a variety of parasites like lice and bugs, which outnumber the herbivores. Subsequently, each parasite might support a number of hyperparasites like bacteria, fungi, which will out number the parasites. Thus from the producer level onwards towards the consumers, in the parasitic food chain, there is gradual increase in the number of organisms instead of the usual decrease. The pyramid of numbers in a parasitic food chain may be represented as shown in fig.



FRUIT EATING

BIRDS

10

PLANT

1

## 4.12 Summary

All the organisms in an ecosystem are consumes or hetero trophs that depend directly or indirectly on the producers. Life on earth receives the energy it needs from the sum and is inexhaustible. The essential elements are present fixed amounts and it needs to be recycled. Thus ecosystem means a system of organision interacting with their environment.

## 4.13 Keywords

## 4.14 Exercise

1. Define ecological succession
2. What is food Web?
3. How are ecological pyramids divided?
4. Define the term Eco system
5. What are the main components of Eco system?
6. What are different types of consumer?
7. List the abiotic factors of ecosystem.
8. What is a bio glochemical cycle?
9. Define the productivity of ecosystem?
10. What is a bio glochemical cycle?
11. Define the productivity of ecosystem ?

# UNIT-V

## THE ENVIRONMENT AND HUMAN HEALTH.

Environment is defined as man along with his surroundings, which consists of biotic, abiotic and sociological components. Therefore, when we cause danger to these components, which surrounds us, they in turn affect our health. The environmental dangers created by man are many: Population explosion, unregulated urbanization, creating water, air and landscape pollution, deforestation, desertification, use of pesticides in agriculture etc. Every one of these has implications for the health of the individual as well as society as a whole. None can be ignored because the scale of potential calamity is increasing day by day. Health hazards may be arising from: water contamination or pollution, air pollution, use of pesticides enters through food chain, radiation effect of nuclear water, diseases caused from improper disposal of solid wastes and also due to noise pollution.

**Human rights:**

1. Human rights means that a human being must enjoy on this earth

2. Foundation of human was laid in 13th century. But positive hopes for all people for a happy, dignified and secured living condition wee raised only after "Universal Declaration of Human Rights (UNDHR) by UNO on 1012.1948

3. It highlights on protection to all individuals against injustice and human right violation

4. UNDHR defines specific rights to life, liberty, security, freedom of thought, association, freedom of movement right of equal pay for equal work, right to form or join union, right to health care, education etc.

5. Universal declaration rights are universal but disparity between developing and developed countries.
6. Poverty and population leads to violation of human rights.

   WHO estimates one out of every five is malnourished, lacks clean drinking water, lacks hygienic conditions and health facilities. - One out of 3 lack fuel for cooking - 1/5 is desperately poor -every year 40 million people die due to contaminated water

7. Acute scarcity of employment

8. Merit of universal education and child labour prevention is of much less importance than his struggle for existence

9. Developed and developing country gives importance only to „respect to human rights" and non social – economic rights" respectively.

**Role Of Information Technology In Environment And Human Health:**

Computer based instruments for environment studies: There are several on-line use instruments by which data can be collected automatically at fixed interval of time. Eg.

1. Instruments for monitoring and analysis of meteorological parameters, the acoustic sounding system, radar is used
2. Atomic absorption spectrophotometer (AAS) – performs complex chemical and heavy metal analysis in water and waste water.
3. Inductive coupled plasma spectrometer (ICPS), attached with powerful computers to facilitate easy manipulations, is used for waste water analysis.

**Application of computers in the field of Environment & human health:**

1. Unknown parameters can be stimulated by computer techniques
2. EIA(Environmental Impact Assessment) problems can be analyzed
3. Inventories of emission sources are compiled and maintained
4. Net-work analysis, statistical analysis and the status of environmental pollutions can be high lighted
5. Comprehensive administrative system can be developed by using computer network techniques.
6. Remote sensing-Graphical Interface System are useful for coral reef mapping and ocean resources. They are also useful to access the loss of biodiversity/hot spots etc.

**Human rights:**

1. Human rights means that a human being must enjoy on this earth

2. Foundation of human was laid in 13th century. But positive hopes for all people for a happy, dignified and secured living condition wee raised only after "Universal Declaration of Human Rights (UNDHR) by UNO on 1012.1948

3. It highlights on protection to all individuals against injustice and human right violation
4. UNDHR defines specific rights to life, liberty, security, freedom of thought, association, freedom of movement right of equal pay for equal work, right to form or join union, right to health care, education etc.

5. Universal declaration rights are universal but disparity between developing and developed countries.

6. Poverty and population leads to violation of human rights.

WHO estimates -One out of every five is malnourished, lacks clean drinking water, lacks hygienic conditions and health facilities. -one out of 3 lack fuel for cooking -1/5 is desperately poor -every year 40 million people die due to contaminated water.

7. Acute scarcity of employment .

8. Merit of universal education and child labour prevention is of much less importance than his struggle for existence

9. Developed and developing country give importance only to „respect to human rights‟ and „non social – economic rights‟ respectively.

**Importance of women and children:**

Women and children constitute 3/4th if human population. They are the most important segment of human society. Women mother children, the future generation, and the children are the pillars of future development.

**Conditions of Women and Children:**

Though women and children are the most important segments of human society, they are the mostdisadvantaged sections of the society all over the world, particularly in developing and under-developedcountries of the world. Women suffer from sexual abuse, violence at home, deprivation of theirfundamental rights, exploitation, gender bias, etc throughout the world. Similarly, children also sufferfrom sexual abuse, denial of fundamental rights and exploitation particularly in the under-developed anddeveloping countries of the world.

Article 25 of the Universal, Declaration of Human Rights lays down that every one has the right to education. Education should be free, at least in primary and secondary schools. Primary schools education should be compulsory. Higher education should be equally available to all on the basis of merit. But many countries including India, who have ratified this Declaration, have failed to fulfill these requirements. For instance, in India, over 60% of the children of school-going age are not going to schools. Though child labour is legally prohibited in India, a large number of children of school-goingage are working in hotels, households and even in hazardous factories like factories producing fireworks. Females and girls are under nourished. Female workers are not paid equal pay as male workers for the same or equal work. Women are not respected at home, in work places and even in public places.

**Need for Women and Child Welfare:**

As stated above, women and children are badly exploited. Further the welfare of the children is closelyinter-linked with the welfare of women. Again, the welfare of men and the development of the societyand the nation also largely depends on the welfare if women, The future development of a nationdepends largely on the welfare of the present children. For these reasons, there should be adequatewomen and child welfare programmes.

**Programmes for women and Child welfare:**

The programmes for the women and child welfare should have the following:

i. Sufficient attention should be paid to the removal of the problem of malnutrition of women andchildren.
ii. Inculcating of good manners and responsible and co-operative citizenship
iii. Sexual abuse of women and children should be checked
iv. Child labour should be completely banned
v. Exploitation of women workers should be checked
vi. Gender bias should be removed in all areas
vii. Women must be empowered to work side by side with men.

**Women and Child Welfare in India**:

The department of Women and Child Development was set up as a part of the Ministry of HumanResources in the year 1985 to give the much-needed encouragement and support to development ofwomen and children. As the national machinery for the advancement of women and children, thisdepartment formulates plans, policies and programmes, enacts legislation, guides and co –ordinates theefforts of both governmental agencies and non-governmental organizations(NGOs) working in the fieldof women and child development. This department prepares and implements programmes, such asnutrition and healthcare, primary school education, training for employment and the empowerment ofwomen, creating awareness among women in their due rights, etc

**Population explosion:**
Population explosion means the tremendous increase in the number of people. It is a known fact that the increase of population is playing vital role of all environmental damage. Most of our natural resources are under threat because of the population growth. If the exploitation of resource is going on in this trend, the resources will be exhaust shortly. Population explosion increase disease, economic inequity and environmental abuse. Therefore we need population stabilization to achieve good health, education and prosperity.

**Reason for population explosion:**

1. Increase in birth rate in developed countries due to illiteracy
2. Invention of modern medical facilities reduces mortality rate.
8. Merit of universal education and child labour prevention is of much less importance than his struggle for existence
9. Developed and developing country givesimportance.

**Meaning of population explosion:**
**Population Explosion may be defined as very high increase in the growth of population in a specific**
**area at a given time.**
**Population explosion or Over-population in India:**
India is one of the most densely populated countries of the world. India’s population is the second largest in the world, next only to China. Though the total land area of the country of the countryis only 2.4% of the total land area of the world, its population is about 17% of the world’s population. Not only is the population of India is very large, but

it has also been growing at a very high rate. In India, about 30 babies are born every minute, 55,000 babies are born every day and about 13 million babies are born every year. It has been rightly remarked that India adds one Australia (i.e., the population of Australia) to its population every year. The yearly increase in population as per the 2001census is 1.95%.

**Is India Over-Populated?**

A country is said to be over-populated, when the present stage of its economic development cannot maintain the population with a reasonable degree of standard of living. On an examination of India's population, its present stage of economic development and the standard of lining of the masses, it is quite clear that the present economic development of India cannot maintain the existing population with a reasonable degree of standard of living. Further, though the density of population on India is much less than those of countries like Britain, Belgium, etc the present density of population is definitely very high for an agricultural economy like India. So, the logical conclusion can be that the population of India is far in excess of what the country can support. In other words**, India is definitely over-populated**. There has been population explosion in India

**Checking the Growth of Population:**

**Need for checking the Growth of Population:**

One of the most serious problems which India is facing today is the rapid growth of population.

The rapid growth of population is seriously threatening the economic progress of the country. So, the growth of population should be checked.The growth of population should be checked for many reasons. The reasons that emphasize the controlled growth of population (i.e., for controlling the growth of population) are:

i. If the growth of population is not checked, the fruits of economic development cannot be enjoyed by the common man.

ii. If the population explosion is not held in check, the existing problem of unemployment and the under-employment becomes unmanageable.

iii. If the rapid growth of population is not controlled. Not only the expenditure on the provision of fair amount of housing, medical and education facilities to the society will increase, but it will also become impossible for the Government to provide such facilities.

iv. The quality of our population is low. So it should be improved through general ans technical education, training and the better living and working conditions.