

SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES, CHITTOOR
(AUTONOMOUS)

Approved by AICTE, New Delhi, Affiliated to JNTUA, Ananthapuramu.



LECTURE NOTES

Subject Name : Environmental Science

Year / Branch : II B.Tech. / Common to all branches

Regulation : R26

Prepared By : Dr. T. Rekha & K. Ramya

Course Code	ENVIRONMENTAL SCIENCE	L	T	Pr	P	Credits
	Common to All Branches	2	0	0	0	0

Prerequisites: No specific prerequisites; open to all engineering branches.

COURSE OBJECTIVES

1. Create awareness about environmental issues, natural resource management and the need for sustainable development.
2. Explain the structure and function of various ecosystems and the significance of biodiversity and its conservation.
3. Describe causes, effects and control of various types of pollution and principles of solid waste management.
4. Examine social, ethical and legislative issues related to environment and sustainable development in India.
5. Understand human population dynamics, environmental health linkages and the role of IT and AI tools in environmental monitoring.

UNIT I: Multidisciplinary Nature of Environmental Studies and Natural Resources (9 Hrs)

Multidisciplinary nature of environmental studies: Definition, scope and importance; need for public awareness.

Natural resources: renewable and non-renewable resources; natural resources and associated problems; forest resources – use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and other effects on forest and tribal people; water resources – use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems; mineral resources – use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources – world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources – use and exploitation of conventional and non-conventional energy sources, case studies.

UNIT II: Ecosystems and Biodiversity and its Conservation (9 Hrs)

Ecosystems: Concept of an ecosystem; structure and function of an ecosystem; producers, consumers and decomposers; energy flow in the ecosystem; ecological succession; food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and its conservation: Introduction and definition – genetic, species and ecosystem diversity; bio-geographical classification of India; value of biodiversity – consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels; India as a mega-diversity nation; hot-spots of biodiversity; threats to biodiversity – habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity – in-situ and ex-situ conservation.

UNIT III: Environmental Pollution and Solid Waste Management (9 Hrs)

Environmental pollution: Definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards.

Solid waste management: Causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; pollution case studies; disaster management – floods, earthquake, cyclone and landslides.

UNIT IV: Social Issues and the Environment (9 Hrs)

Social issues and the environment: From unsustainable to sustainable development; urban problems related to energy; water conservation, rain water harvesting, watershed management; resettlement and rehabilitation of people – its problems and concerns, case studies; environmental ethics – issues and possible solutions; climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies; wasteland reclamation; consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; issues involved in enforcement of environmental legislation; public awareness.

UNIT V: Human Population and the Environment (9 Hrs)

Human population and the environment: Population growth, variation among nations; population explosion; family welfare programmes; environment and human health; human rights; value education; HIV/AIDS; women and child welfare; role of Information Technology in environment and human health; case studies.

Field work: Visit to a local area to document environmental assets – river/forest/grassland/hill/mountain; visit to a local polluted site – urban/rural/industrial/agricultural; study of common plants, insects and birds – river, hill slopes, etc.

COURSE OUTCOMES (COS)

CO	Course Outcome Statement	Bloom's Level
CO1	Recall and explain the multidisciplinary nature of environmental studies, define key concepts of scope and public awareness, and describe the uses, over-exploitation and associated environmental problems of forest, water, mineral, food and energy resources with reference to Indian and global case studies.	L1–L2
CO2	Describe the structure and function of different ecosystem types, explain ecological succession, food chains and ecological pyramids, and outline the concept and classification of biodiversity, its value, threats and conservation strategies (in-situ and ex-situ) including India's status as a mega-diversity nation.	L2–L3
CO3	Identify causes, effects and control measures of air, water, soil, marine, noise, thermal and nuclear pollution; apply principles of solid waste management for urban and industrial wastes; analyze pollution case studies and evaluate disaster management strategies for floods, earthquakes, cyclones and landslides.	L3–L4
CO4	Analyze social issues related to unsustainable development; evaluate the impacts of climate change, global warming, acid rain and ozone layer depletion; examine Indian environmental legislation (EPA, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act) and assess their enforcement challenges.	L4–L5
CO5	Describe population growth trends and their environmental impacts; identify links between environment and human health; demonstrate the	L2–L3

	role of information technology and AI-based tools in environmental monitoring, public health surveillance and field data collection; apply digital tools (QGIS, Python, iNaturalist) for environmental documentation.	
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CO–PO / PSO ARTICULATION MATRIX

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L1-L2	2	1	–	–	1	3	3	2	–	2	–	2	2	1
CO2	L2-L3	2	2	–	1	2	3	3	2	1	2	–	2	2	2
CO3	L3-L4	2	2	2	2	2	3	3	3	1	2	1	2	2	2
CO4	L4-L5	2	2	2	2	2	3	3	3	1	2	1	3	2	2
CO5	L2-L3	1	1	–	1	3	3	3	2	1	2	–	3	1	2

CO–PO Correlation Highlights: Environmental Science demonstrates its strongest correlation with PO6 (Engineer & Society), PO7 (Environment & Sustainability) and PO8 (Ethics) across all five COs, reflecting the direct societal and environmental focus of the course. PO12 (Lifelong Learning) is well addressed through all COs as the course creates lasting environmental awareness. CO4 and CO5 address PO5 (Modern Tools) through AI/GIS-based environmental monitoring tools. As an audit course, the PSO correlations are secondary, though CO3 and CO4 contribute to PSO1 through pollution engineering and environmental management content relevant to civil infrastructure projects.

Multidisciplinary Nature of Environmental Studies (UNIT – I)

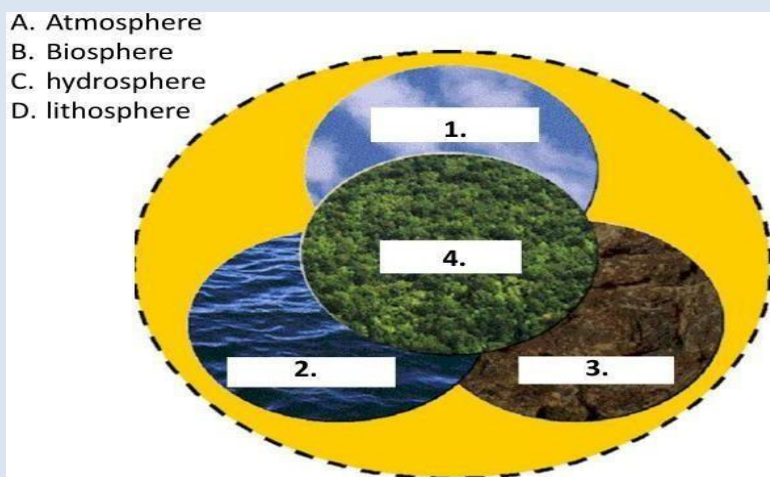
* **Environment:** It is a sum total of all biotic and abiotic factors that surround and potentially influence on organisms is called environment.

* **Environmental studies:** The study of the basic components of our surroundings and their interactions is called environmental studies.

*** Basic Components of the Environment/Segments/parts of the environment**

Environment consists of all living (Biotic) and non-living things (abiotic) which surround us. Therefore, the basic components of the environment are:

1. Atmosphere or the air
2. Hydrosphere or the water
3. Lithosphere or the rocks and soil
4. The living component of the environment or the biosphere



1) Atmosphere

The gaseous envelope of the earth is called atmosphere. It is present around the earth. It consists of gases, some solid and liquid particles suspended in it.

The important function of the atmosphere is, it maintains the heat balance of the earth and energy budget of the earth.

2) Hydrosphere:

The combined mass of water on, above and below the surface of the earth is called hydrosphere.

The important function of the hydrosphere is, it is a part of the living organisms, act as a habitat, regulates climate and usable to humans in a number of ways.

3) Lithosphere:

The solid component of the earth is called lithosphere.

The important function of the lithosphere is, it acts as a substratum for living organisms, store house of wealth in its own, regulates water flow, stores water flow, provide minerals, nutrients to plants, regulates nutrient cycles etc.,

4) Biosphere:

The biological environment where living organisms can live and interact with physical environment (air, water and soil) is called biosphere.

Biosphere, relatively thin life-supporting stratum of Earth's surface, extending from a few kilometres into the atmosphere to the deep-sea of the ocean. The biosphere is a global ecosystem composed of living organisms (biota) and the abiotic (nonliving) factors from which they derive energy and nutrients.

*** Structure of the atmosphere**

Atmosphere consists of a complex mixture of a number of gases, water vapour and a variety of fine particulate material. The gaseous mantle which surrounds the globe is constituted by about 5.15×10^{15} metric tons of gas which exerts a pressure of about 1 kg per sq.cm. on earth's crust. Most of these gases are compressed in the lowermost layer. Pressure decreases as we move upward.

The atmosphere is divided into the following five layers on the basis of vertical distribution of temperature.

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere
5. Exosphere

1. Troposphere:

The lowest layer of the atmosphere, in which the temperature decreases with increasing altitudes is called troposphere. Clouds are formed and carried by winds in this layer. It extends from 6 to 8 km at the poles and to about 17 km at the equator. It contains 90% of the air of the atmosphere. Seasonal variations are so common.

2. Stratosphere:

The layer of atmosphere above the troposphere, in which the temperature increases with increasing altitudes is called stratosphere. It extends to a height of 50 km. Here the air is much thinner. Long distance air crafts fly in the lower part of the stratosphere. The top of this layer contains ozone.

3. Mesosphere:

Mesosphere lies above 50 km upto 100 km It is characterized by decrease of temperature.

4. Thermosphere:

It lies beyond the mesosphere. Here the temperature rises sharply attaining 1000⁰ C. It extends to a height of 400 km.

5. Exosphere:

It lies above thermosphere beyond 400 Km. The increase in temperature ceases at this layer. The density of the atmosphere is very low here.

*** Scope and Importance of environmental studies**

*** Scope of environmental studies:**

The scope of environmental studies is so wide that it is related to every science and scientific aspects in general and biology in particular. The scope of environmental studies in numerous fields is given below.

- 1) Conservation and management of natural resources (like forest resources, water resources etc.,)
- 2) Conservation of biodiversity
- 3) Control of environmental pollution
- 4) Control of human population
- 5) Control of environmental problems
- 6) Control of social issues related to environment
- 7) Replacement of development (like green revolution, urbanisation), economic growth, (industrialisation, etc.,) with sustainable development.

*** Importance of environmental studies:**

The importance of environmental studies are the following.

1. To clarify modern environmental concept like how to conserve biodiversity.
2. To know the more sustainable way of living.
3. To use natural resources more efficiently.
4. To know the behaviour of organism under natural conditions.

5. To know the interrelationship between organisms in populations and communities.
6. To aware and educate people regarding environmental issues and problems at local, national and international levels.
7. It helps in the maintenance of healthy life. Through improved health of people, economic productivity gets increased.

*** Need for public awareness about environment:**

To get rid of environmental problems, environmental awareness is necessary. It ensures that everyone knows about consequences of his/her activities on nature. To protect global environment for sustainable development, we should be aware about environment. Important aspects related to environment in which public awareness should be developed.

- 1) They should be taught to grow plants.
- 2) They should be made aware of the importance of green plants and not to cut the trees.
- 3) They should be given training in the importance of soil.
- 4) They should be advised to use minimum quantities of chemicals.
- 5) They should be made to know about awareness of use of fertilizers and pesticides.
- 6) They should be made to known about clean surroundings.
- 7) They should be made to known clearly about sewage disposal.
- 8) They should be made to know about waste material management.
- 9) They should be taught about environmental pollution.
- 10) They should know about the cause of various diseases.
- 11) They should be made to known about basic principles of personal and environmental hygiene and health.
- 12) They should be taught about water management.
- 13) They should be made to known about the need to conserve biodiversity.

Natural resources

* **Natural resources:** Natural resources are the sources which are useful to man or can be transformed into useful products.

Based on their availability or how human activities affect them, natural resources are classified into two types.

1) Renewable resources

2) Non-renewable resources

1) Renewable resources: These resources are capable of being regenerated by ecological process within a reasonable time period.

Eg: Soil, Water, Air, Wild life, Natural vegetation.

2) Non-renewable resources: These resources are not capable of being regenerated by ecological process.

Eg: Coal, Oil, Natural gas, Minerals.

*** Natural resources and associated problems:**

Human population is growing day-by-day. Continuous increase in population caused an increasing demand for natural resources. Due to urban expansion, electricity need and industrialization, man started utilising natural resources at a much larger scale. This over utilisation creates many problems. The following are the problems associated with natural resources.

● Forest resources and associated problems

1. Use and over-exploitation.
2. Deforestation.
3. Timber extraction.
4. Mining and its effects on forest.
5. Dams and their effects on forests and tribal people.

● Water resources and associated problems

1. Use and overutilization of water.
2. Floods, droughts etc.
3. Conflicts over water.
4. Dams and problems.

- **Mineral resource and associated problems**

1. Use and exploitation.
2. Environmental effects of extracting and using minerals.

- **Food resources and associated problems**

1. World food problems.
2. Changes caused by agriculture and over grazing.
3. Effects of modern agriculture.
4. Fertilizer-pesticide problems.
5. Water logging and salinity.

- **Energy resources and associated problems**

1. Growing energy needs.

- **Land resources and associated problems**

1. Land degradation.
2. Man-induced landslides.
3. Soil erosion and desertification.

Forest resources

*** Forest resources-Uses:**

Beneficial functions of forests are the following.

a) Ecological uses (or) Ecosystem services:

- 1) **Influence on climate:** The crowns of the trees hold the moisture in because the forest of the wind is broken. It makes the forest cool in the summer and warm in the winter.
- 2) **Control runoff:** Leaves and branches of trees break the impact of rain, causing it to drip rather than have a strong force. Rain is absorbed by the ground, reducing surface run-off.
- 3) **Flood control:** Forested watersheds help in avoiding extremes of water flow and so help in flood prevention.
- 4) **Wildlife habitat provision:** Wildlife uses the products of trees and forests as food and shelter respectively.

- 5) **Prevention of soil erosion:** Water moves slowly through forested soils and stays free of sediments.
- 6) **Reduction of wind erosion:** Trees are used as windbreaks and slow down the force of wind.
- 7) **Removal of pollutants:** The roots of trees absorb soil and water pollutants. Thus forests aid in the cleansing of air, water and soil.
- 8) **Noise abatement:** Trees acts as a sound barrier.
- 9) **Recycling of nutrients:** Forests help in nutrient recycling.
- 10) **Provisions for healthy survival of local communities and mankind:** Forest provide employment and income, aesthetic pleasure and spiritual solace.

b) Commercial uses of forest: Forest provide us a large number of commercial goods such as fuel wood, pulp, board, timber, gums, resins, dyes, medicines, drugs, honey, ivory, hides etc.,

*** Over exploitation of forests:**

Our forests contribute substantially to the national economy. Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and overgrazing have together led to over exploitation of our forests leading to their rapid degradation.

*** Deforestation**

Definition: Deforestation is the process of removal or elimination of forest resources due to many natural or manmade activities. In general deforestation means destruction of forest.

Causes of deforestation:

The following are the causes of deforestation.

1) Developmental projects: Developmental projects cause deforestation in two ways.

- i) Through submergence of forest area underwater.
- ii) Destruction of forest area.

Examples: Big dams, hydroelectric projects, road constructions.

Hence, there is a need to discourage the undertaking of any development works in the forest area.

2) Mining operations: Mining have a serious impact on forest areas. Mining operation reduces the forest area.

Examples: Mica, coal, manganese, limestone etc.,

3) Raw materials for industries: Wood is the important raw material for so many purposes.

Examples: For making boxes, furnitures, plywood, match-boxes, pulp etc.,

4) Fuel requirements: Rural and tribal population dependent on the forest for meeting their daily need of fuel wood which leads to the pressure on forest ultimately to deforestation.

5) Shifting cultivation: The replacement of natural forest ecosystem for monospecific tree plantation can lead to disappearance of number of plant and animal species.

6) Forest fires: Forest fires are one of the causes for deforestation.

Effects of deforestation:

The ill-effects of deforestation are summarized below.

1) Soil erosion: Soil is exposed to wind, sunlight, and evaporation due to deforestation. Soil fertility goes down due to soil erosion and rapid leaching of essential mineral nutrients.

2) Harm to fisheries: As the soil is eroded, it accelerates siltation in dams, rivers, and the coastal zone. The increased sedimentation harms downstream fisheries.

3) More floods and droughts: Because of deforestation, there is no regulation of the flow into rivers. As a result, floods and droughts alternate in the affected areas.

4) Habitat loss of wildlife: Many birds and animals suffer due to the loss of their habitat.

5) Extinction of some species: Many species are affected and some become extinct.

6) Local and global climate changes: The rain fall pattern is affected as the forest is cut down. Local and global climate changes may result from deforestation.

7) Global warming: If the trees are burned, the carbon is released immediately as carbon dioxide which leads to global warming.

8) Danger for the survival of local communities: Communities loss their source of food, fuel, construction materials and areas for livestock grazing by deforestation.

Preventive measures (or) avoid of deforestation:

The following are the strategies to prevent or avoid deforestation.

1) Steps should be taken by the government to discourage the migration of people into islands from mainland.

2) To counter the depletion of forest areas, tree plantation programmes have been started.

3) Education and awareness programmes must be conducted.

4) Strict implementation of law of forest conservation act.

- 5) Prevention of fire
- 6) Protection form fire
- 7) Involve local communities to protect forest.

*** Dams and their effects on forest and tribal people:**

Dam is an artificial barrier usually constructed across a river/stream channel to impound water for many beneficial purposes. However, these dams are also responsible for the destruction of vast areas of forest and displacement of local people.

Impacts of dam on forest:

The major effects of dams on forests are summarized below.

- 1) **Loss of forest land:** Construction of dam reduces the forest area considerably.
- 2) **Loss of productivity from forest:** Dam construction causes inundation of the upstream side and degrades the productivity of trees and vegetations.
- 3) **Loss of economy:** It leads to destruction of economic trees.
- 4) **Loss of habitat:** Habitat of flora and fauna species in the forests are affected by the construction of dams.
- 5) **Loss of land due to construction activities:** The forest land is destroyed not only for the construction of dam, but also for construction of workers quarters and approach roads.

Impacts of dams on tribal people:

Forest submergence would greatly affect the tribal people by the way of submerging their dwellings and agricultural lands. The lifestyle of tribals is webbed with the forests. But when the forests are destroyed, their livelihood is greatly affected.

- 1) **Reduced fuel wood:** Wide destruction of forests has reduced the availability and collection of fuel wood to the tribal people.
- 2) **Reduced agricultural activities:** Inundation of their land causes reduced agricultural activities and their altered pattern of living.
- 3) **Loss of income and economy:** The tribal people depend on forests for each and every thing. Loss of forest leads to loss of income and economy due to destruction of economically important tress and vegetation.
- 4) **Loss of livelihood:** Construction of dams affects the tribal people in many ways and it totally affects their livelihood.

Water resources

*** Water resources-Uses:**

Water resources are sources of water that are useful or potentially useful to humans.

It is important because it is needed for life to exist.

- 1) Life originated in water (Sea). So water is the mother of life.
- 2) Plants use water for survival. Without water the plants dry and die.
- 3) Animal drink water. Without water the animals die.
- 4) Water is the house for aquatic plants and animals.
- 5) It is the universal solvent. Many compounds dissolve in it.
- 6) Water is used for irrigation in agriculture.
- 7) Water is used in industries.
- 8) Many uses water for drinking, cooking, bathing, recreational and environmental activities.

*** OVER-UTILIZATION OF SURFACE & GROUND WATER:**

The rapid increase in population and industrial growth led to severe demand on water resources. After using all available surface water resources to the maximum, human beings began using groundwater to meet their needs.

1. The increased extraction of groundwater far in excess of the natural recharge led to decreased groundwater level. The erratic and inadequate rainfall caused reduction in storage of water in reservoirs. This also led to decrease of groundwater.
2. Building construction activities seal permeable soil zone and reduce the area for percolation of rainwater thereby increasing surface runoff.
3. If groundwater withdrawal rate is higher than recharge rate, sediments in aquifers get compacted resulting in sinking of overlaying land surface. This is called land subsidence which leads to structural damage in buildings, fracture in pipes and reverses the flow of canals leading to tidal flooding.
4. Over-utilization of groundwater in arid and semi-arid regions for agriculture disturbs equilibrium of reservoir in the region causing problems like lowering of water table and decreased pressure in aquifers coupled with changes in speed and direction of water flow.
5. Over utilization of groundwater in coastal areas leads to rapid intrusion of salt water from the sea thereby rendering it unusable for drinking and agriculture.
6. Over-utilization of groundwater leads to decrease in water level thereby causing earthquake, landslides and famine.

7. Over-utilization of groundwater leads to drying-up of dug wells as well as bore wells.
8. Due to excess use of groundwater near agricultural fields, agricultural water that contains nitrogen as a fertilizer percolate rapidly and pollutes the groundwater thereby rendering the water unfit for potable use by infants. (Nitrate concentration exceeding 45 mg/L).

*** Floods**

A flood is an overflow of water, whenever the magnitude of flow of water exceeds the carrying capacity of the channel within its bank.

Causes of floods:

The following are the causes of floods.

- 1) Heavy rainfall, melting of snow (ice), sudden release of water from dams, often causes floods in the low-lying coastal area.
- 2) Prolonged downpour can also cause the overflowing of lakes and rivers resulting into floods.
- 3) Reduction in the carrying capacity of the channel, due to accumulation of sediments or obstructions built on flood ways.
- 4) Deforestation, overgrazing, mining increases the runoff from rains and hence the level of flood raises.
- 5) The removal of dense and uniform forest cover over the hilly zones leads to occurrence of floods.

Effects of floods:

The following are the effects of floods.

- 1) Due to flood, water spreads in the surrounding areas and submerges them.
- 2) Due to floods the plain surface have become eroded and silted with mud and sand, thus the cultivable land area gets affected.
- 3) Extinction of civilization in some coastal areas also occurs.
- 4) Floods can damage any type of structure resulting in physical damage to canals, bridges, sewerage systems, roadways, cars, buildings etc.,
- 5) Floods can also cause casualties through epidemics and water-borne diseases.
- 6) The entire harvest can be lost due to floods leading to shortage of food.
- 7) Clear drinking water becomes scarce because of contamination of water due to floods.
- 8) Floods can lead to suffocation and death of some non-tolerant tree species.

Flood management:

Floods can be managed by following strategies.

- 1) Flood can be controlled by constructing dams or reservoirs.
- 2) Channel management and embankments also control the floods.
- 3) Encroachment of flood ways should be banned.
- 4) Flood hazard may also be reduced by forecasting or flood warning.
- 5) Flood may also be reduced by reduction of runoff by increasing infiltration through appropriate afforestation in the catchment area.

*** Drought:**

The lack water for the normal needs of agriculture, livestock, industry or human population may be termed as a drought.

Types of drought:

Droughts are classified into four types.

- 1) Meteorological drought
- 2) Hydrological drought
- 3) Agricultural drought
- 4) Socio-economic drought

1) Meteorological drought: It occurs when the total amount of rainfall is less than 75% of the normal rainfall. This drought will be severe if the rainfall is less than 50% of the normal rainfall.

2) Hydrological drought: It occurs when the total amount of rainfall is less than the average rainfall. It is generally associated with reduction of statistical average of water reserves available in source such as aquifers, lakes and reservoirs.

3) Agricultural drought: This occurs due to the shortage as well as the timing of overall rainfall, which inturn reduce the ground water and reservoir levels, soil moisture. Agriculture drought affects cropped plants.

4) Socio-economic Drought: It occurs due to reduction in the availability of food and social security of the people in the affected areas. Socio-economic drought leads to famine.

Causes of drought:

The following are the causes of drought.

- 1) When rainfall is below normal and less than evaporation, drought is created.
- 2) High population is also another cause for drought.
- 3) Intensive cropping pattern and over exploitation of scarce water resources.
- 4) Deforestation leads to desertification and drought too.

Effects of drought (or) Consequences of drought:

The following are the effects of drought.

- 1) Drought causes hunger, malnutrition and scarcity of drinking water and also changes the quality of water.
- 2) Drought causes widespread crop failures leading to acute shortage of food and adversely affects human and livestock populations.
- 3) The drought indicates the worst situation and initiation of desertification.
- 4) Drought retards the industrial and commercial growth.
- 5) It also accelerates degradation of natural resources.
- 6) Drought leads to large migration of people and urbanization.

Drought management:

Society's vulnerability to drought is minimized through the following actions.

- 1) An artificial technique of cloud seeding helps in inducing rainfall.
- 2) For consumption or irrigation, desalination of sea water can be done in times of scarcity.
- 3) Carefully planned crop rotation can help to minimize soil erosion. This also allow farmers to plant less water dependent crops in drier years.
- 4) Collection and storage of rain water through rain water harvesting is very useful.
- 5) Regulating the use of water in irrigation activities.
- 6) Redirecting rivers for irrigation in drought-prone areas.
- 7) Treatment and purification of sewage waste water for reuse.
- 8) Continuous observation of rainfall levels and comparisons with current usage levels can help prevent man-made drought.

*** Water conflict:**

Water is essential for our existence and is fast becoming a scarce resource. Freshwater is considered to be the most environmental issue of this century. Nearly 1.2 billion people do not have access to safe drinking water.

Thus due to increase in population and decrease in water resources, conflicts over water starts.

Causes for water conflicts:

1) Conflict through use: Unequal distribution of water has been led to interstate or international disputes.

Example:

a) International water conflicts:

- ❖ Indian and Pakistan fight over the rights of water from the Indus.
- ❖ Mexico and USA fight over the rights of water from the Colorado river.
- ❖ Iran and Iraq fight over the rights of water from the Shat-al-Arab water.
- ❖ India and Bangladesh are fighting for Bhramaputra river.

b) National water conflicts:

- ❖ Sharing of Cauvery water between Karnataka and Tamilnadu.
- ❖ Sharing of Siruveni water between Tamilnadu and Kerala.

2) Construction of Dams (or) Power stations:

For hydroelectric power generation, dams are built across the rivers, which initiates conflict between the states.

3) Conflict through pollution:

Not only they act as reservoirs for the supply of fresh water but also as a means of disposing of waste water and industrial rubbish. With the increasing decline in the quality of the water crossing borders, the problem of cleaning the water takes on an international dimension (conflict).

Management of water conflicts:

1. Concerted efforts are required to enforce laws that check these practices to control water pollution.
2. In order to overcome the problem of sharing river water in a country, the concept of interlinking of rivers has been suggested.

3. Rivers should be nationalized, the National Water Authority and River Basin Authority should be given powers to ensure equitable distribution of basin water.

National water conflict:

Example: 1) Sharing of Kaveri water between Karnataka and Tamilnadu:

Kaveri is a south Indian river that originates in western ghats in Karnataka and flow through Karnataka and Tamilnadu where many fields are irrigated. It is said that Karnataka is not releasing enough water necessary for irrigation of fields in the state of Tamilnadu which is a lower state. There was some confrontation between the two states and the central government played an intermediary role to make the government of Karnataka to release some amount of water so as to release the anguish of Tamilnadu ryots.

2) The SYL conflict: The conflict is between states of Punjab and Haryana. Inter linking of Sutlaj river and Yamuna river through a canal. The dispute arose between Punjab and Haryana over the use of water of the inter linking canal.

Mineral resources

*** Uses of minerals:**

Minerals are used in a large number of ways in everyday us, in domestic, agricultural, industrial and commercial sectors.

The important uses of minerals are as follows.

1. Development of industrial plant and machinery.

Example: Iron, aluminium, copper etc.,

2. Construction, housing and settlements.

Example: Iron, aluminium, copper etc.,

3. Generation of energy.

Example: Coal, crude oil, natural gas, uranium, thorium etc.,

4. Designing defence equipments, weapons, ornaments.

Example: Iron, aluminium, copper etc.,

- 5 Agricultural purposes, as fertilizers, seed dressings and pesticides.

Example: Zineb – containing zinc, maneb – containing manganese etc.,

6. Jewellery purposes.

Example: Gold, silver, platinum and diamond etc.,

7. Making of alloys for various purposes.

Example: Brass, bronze, steel etc.,

8. Communication and electricity purposes.

Example: Iron, aluminium, copper etc.

9. Medicinal purposes particularly in ayurvedic system.

Example: Sulphur pyrites, iron, calcium, zinc and copper etc.,

*** Exploitation of mineral resources:**

The exploitation of mineral resources is the use of mineral resources for economic growth, sometimes with a negative connotation of accompanying environmental degradation.

Environmental effects of extracting and using mineral resources:

The environmental effects caused by extracting and using mineral resources are as follows.

1. Deforestation including the loss of flora and fauna.
2. Degradation of land due to excavations.
3. Occupational health hazards such as black lung disease.
4. Pollution of ground and surface water resources due to accidental or periodic discharge of pollutants.
5. Damage to local ecological functions, nutrient cycling and biodiversity due to alterations in water availability or quality.
6. Problem in rehabilitation of affected population.
7. Pollution of air due to emission of dust and poisonous gases during mining and processing stages. Problems in providing living environment and clean water, air etc., for the survival of large number of workers who have migrated nearby mine sites.
8. Problems in the safe disposal of tremendous amounts of solid waste generated during mining.
9. Rapid depletion of mineral deposit.
10. Extraction of mineral resources causes environmental pollution.
11. Extraction needs energy requirements when energy is used more causes environmental damage.
12. Subsidence of land results in cracks in houses, tilting of buildings, bending of rail tracks etc.,

*** Management of mineral resources:**

The following steps are very useful for the management (conservation) of mineral resources.

1. The efficient use and protection of mineral resources.
2. Modernization of the mining industry.
3. Search for new deposits.
4. Encourage Re-use and Re-cycling of the metals.
5. The low grade ores can be better utilized by microbial leaching techniques.
6. Encourage use of improved technologies so as to reduce waste generation.
7. Regulate the use of mineral resources.
8. Reduce the purchase of unwanted products made from mineral resources.
9. Encourage research for providing suitable eco-friendly alternatives for fossil fuels, metals etc.,
10. Implementation of strict laws to manage mineral resources.
11. Public awareness regarding mineral resources importance.

Food resources

*** Overgrazing:**

Overgrazing is a process of eating away the forest vegetation without giving it a chance to regenerate.

Intensive grazing thus causes the plant residual matter to decline and further contributes to numerous negative consequences to both the animals and the land. Consequently, overgrazing signifies a serious environmental challenge in maintaining the natural balance of livestock on grazing lands, which reduces the productivity, usefulness, and biodiversity of the land.

Causes of overgrazing:

The following are the causes of overgrazing

1. Lack of proper animal/wildlife management
2. Drought or decline in precipitation

3. Improper land use
4. Overstocking
5. Poor irrigation methods in arid and semi-arid areas

Effects of overgrazing:

1. Soil erosion: The continued trampling of numerous animals in an average forage land will act to accelerate the death of plants and vegetation cover. This is because the animals will graze even on the slightest shoots of new growth. Without the plants or vegetation cover, the soil is left bare and exposed to harsh weather such as heavy downpour and high temperatures which disintegrates the rocks and carries the top soil away. Animals also prefer gathering at specific areas, like next to water sources, and such areas can get eroded.

2. Land degradation: The acts of compaction and erosion as a result of overgrazing can cause tremendous land degradation.

3. Loss of useful species: The natural composition of plant population and their regeneration capacity is significantly affected by overgrazing. The original pasture crops are composed of high quality pastures and herbs with great nutritional value. When animals intensively graze on such pastures, even the root stocks which contain the reserve food or regeneration capacity get ruined.

4. Food shortage/famine: As earlier stated, overgrazing is a primary contributor to desertification because it converts arable or pasture land into unproductive piece land. The resultant soil is thus not suited for growing food since it loses its essential nutrients.

5. Death of people and livestock: The long term effects of overgrazing are food shortage which can make people and cattle die of starvation.

Control measures to control overgrazing:

1. Avoiding the act of grazing too early, you can have the stockpiled in the rainy season (spring) so that there is enough grass in the dry periods (summer)
2. The use of a grazing chart can assist in planning out how to implement rotational grazing
3. Monitoring rainfall patterns and the growth of pasture
4. Maintaining and managing proper pasture residuals in the grazing area
5. Making sustainable pasture management decisions in dry weather conditions, this can be achieved by leaning more and more about sustainable pasture practices
6. Proper land use management practices

*** Traditional agriculture:**

Traditional Agriculture can be defined as a primitive style of farming that involves the intensive use of indigenous knowledge, traditional tools, natural resources, organic fertilizer and cultural beliefs of the farmers. It is noteworthy that it is still used by about 50% of the world population.

Characteristics of traditional agriculture:

1. Extensive farming with indigenous knowledge and tools
2. Indigenous tools like axe, hoe, and stick
3. Method: Slash & Burn, and Shifting Cultivation
4. Cattle raising helps to create fallow land
5. Absence of accountability and responsibility to the Environment
6. Lacked by surplus production

Impact of traditional agriculture on Environment:

The impacts of traditional agriculture on Environment are discussed below:

1. Depletion of Nutrients

The primitive style of farming like slash and burn decreases the organic matter from the soil and within the short period of time the nutrient content of the soil taken up by the crops. This makes the farmers to move to another place for farming.

2. Deforestation

It is the process of the removal of a forest or stand of trees where the land for the conversion of forestland to farms, ranches, or urban use. The most concentrated deforestation occurs in tropical rainforests. The slash & burn, and shifting cultivation required massive cutting down of the forest which leads to the situation of deforestation.

3. Soil Erosion

It is a process of the removal of topsoil by the natural physical forces of water and wind or through forces associated with farming activities such as tillage. The roots of the plant and trees firmly hold the soil, but the deforestation exposed the soil to get eroded by the weathering forces like rain, wind and storms which causes the loss of top fertile soil.

Hence, we can say, it is our duty to deal with the most mundane problems of life where each individual matters, like dealing with safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and sustainable development.

A few advantages would include:

1. It requires less monetary input, involves a small plot, simple tools, surface water, organic fertilizers and a mix of crops.
2. It requires less skill and technological knowhow,
3. The quality of produce is better and could also reduce risk of cancer,
4. The soil (for arable farming) is more balanced in nutrient distribution and texture, while (in livestock farming) milk, meat and eggs have better quality,
5. Aesthetic benefits,
6. Traditional farming grew many different crops per acre, which replenished the soil, and prevented a reliance on one type of 'staple' crop.

*** Modern agriculture:**

Modern agriculture is an evolving approach to agricultural innovations and farming practices that helps farmers increase efficiency and reduce the amount of natural resources—water, land, and energy—necessary to meet the world's food, fuel, and fiber needs.

Advantages:

- Simpler system for growing one species of crop or one species of animal
- Larger equipment covers more area, therefore should get work done faster
- More advanced technology makes production more efficient and less labour-intensive
- Larger farms create more area to grow more crops to get more money to pay for more machinery (or try to reduce debt in having to get more modernized machinery)
- Less manual labour required because system is more mechanized

- Advances in fertilizers and pesticides generate greater expected yields and reduce weed issues
- Less workers needed.

Disadvantages:

The following are the disadvantages of modern agriculture.

1. Impact of high yielding varieties:

High yielding varieties crops need a lot of fertilisers and pesticides to grow which increases the pollution. It require more reliable source of water for irrigation which inturn create problems.

2. Problem using fertilizers:

The following are the impacts of using fertilizers.

a) Micronutrient imbalance: Most of the chemical fertilizers used in modern agriculture contain nitrogen, phosphorous, and potassium (N, P, K) which are macronutrients. When excess of the fertilizers are used in the fields, it causes micronutrient imbalance.

b) Blue baby syndrome (Nitrite pollution): When the nitrogenous fertilizers are applied in the fields, they leach deep in to the soil and contaminate the ground water. The nitrate concentration in the water gets increased. When the nitrate concentration exceeds 25 mg/lit, they cause serious health problem called ‘‘blue baby syndrome’’. This disease affects infants and leads even to death.

c) Eutrophication: A large proportion of N and P fertilizers used in crop fields are washed off by the runoff water and reaches the water bodies causing over nourishment of the lakes. This process is known as eutrophication.

3) Problems in using pesticides:

The following are the problems of using pesticides.

a) Death of non-target species: Many pesticides not only kill the target species but also kill the several non-target species, which are useful to us.

b) Producing new pests: Some pest species usually survive even after the pesticide spray, which generates highly resistant generations They are immune to all type of pesticides and are called superpests.

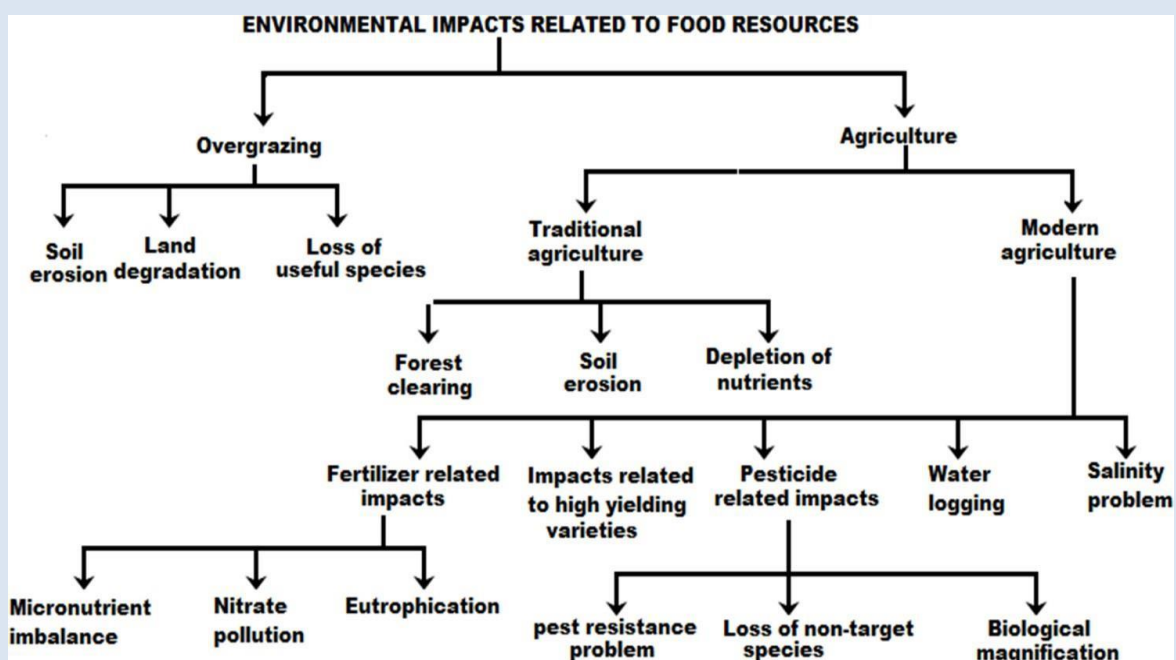
c) Bio-magnification: Many of the pesticides are non-biodegradable and keep on concentrating in the food chain. This process is called bio-magnification. This pesticide in a bio-magnified form is harmful to the human beings.

4) Water logging: Water logging is the land where water stand for most of the year.

Problem in water logging: During water logged conditions, pore-voids in the soil get filled with water and the soil-air gets depleted. In such a condition the roots of the plants do not get adequate air for respiration. So, mechanical strength of the soil decreases and crop yield falls.

5) Salinity: The water not absorbed by the soil, undergo evaporation leaving behind a thin layer of dissolved salts in the top soil. This process of accumulation of salts is called salinity of the soil.

Problems in salinity: Under dry climates, the water gets evaporated leaving behind the salt in the upper portion of the soil. Due to salinity, the soil becomes alkaline and crop yield decreases.



Land resources

Land is regarded as a natural resource because it is essential for the functioning of organisms, populations and ecosystems and constitutes an important entity as a source of all materials essential to man and all other organisms.

* Uses of Land resources:

The following are the uses of land resources.

- 1) Land provides food, wood, minerals etc., for us.
- 2) Land nurtures the plants and animals that provide our food and shelter.
- 3) Land is used as watershed or reservoir.

- 4) Land acts as a dust bin for most of the wastes, created by the modern society.
- 5) Land is the physical space for settlements, industry and recreation.
- 6) Land is store of wealth in its own.
- 7) Land helps in the production of food, fibre, fuel wood etc.,
- 8) Land is the biological habitat for many plants, animals and microorganisms.
- 9) Land regulates flow of surface and stores groundwater.
- 10) Land enables movement of people and animals between one place to another.
- 11) Land is buffer, filter or modifier for chemical pollutants.
- 12) Land is a co-determinant in the global energy balance and global hydrological cycle, which provides both a source and sink for greenhouse gases.

*** Land degradation:**

Definition: The process of deterioration of soil (or) loss of fertility of the soil is called land degradation.

Causes of land degradation:

The causes of land degradation can be grouped into two types as:

1. Natural causes and
2. Man-made activities

1. Natural causes of land degradation

The following are the natural causes of land degradation.

- ❖ Flood
- ❖ Drought
- ❖ Landslides
- ❖ Wind

2. Man-made causes of land degradation

The following are the man-made causes of land degradation.

- ❖ Unsustainable agricultural land use,
- ❖ Poor soil management practices
- ❖ Poor management practices
- ❖ Deforestation
- ❖ Removal of natural vegetation over the soil

- ❖ Frequent use of heavy machineries
- ❖ Overgrazing of animals
- ❖ Improper crop rotation
- ❖ Poor irrigation practices
- ❖ Disposal of industrial effluents
- ❖ Mining and industrial activities

Harmful effects of land degradation:

The following are the harmful effects of land degradation.

- 1) The soil texture and soil structure are deteriorated.
- 2) Loss of soil fertility, due to loss of invaluable nutrients.
- 3) Increase in water logging, salinity, alkalinity and acidity problems.
- 4) Loss of economic, social and biodiversity.
- 5) Land degradation often destroys or reduces the natural beauty of landscapes.
- 6) Loss of flora and fauna
- 7) Loss of tree regeneration capacity
- 8) Vegetation decline and degradation
- 9) Accelerates soil erosion
- 10) Loss of its ability to hold water and sediment.

*** Soil erosion:**

The removal of top layer of the soil from its original place by water, wind and glaciers is called soil erosion.

Types of soil erosion:

Based on the rate at which soil loss takes place, there are two types of soil erosion.

- 1) Normal and geological erosion and
- 2) Accelerated erosion

1) Normal and geological erosion:

Normal and geological erosion includes soil forming as well as eroding processes, thus maintains soil balance, suitable for the growth of plants. It occurs under normal natural condition by itself, without any interference of man.

2) Accelerated erosion:

It is mainly caused by man-made activities. The rate of erosion is much faster than the rate of formation of soil.

Causes of Soil erosion:

The following are the causes of soil erosion.

- 1) Water:** Water affects soil erosion in the form of rain, run off, rapid flow, wave action.
- 2) Wind:** Wind is the important climatic agent, which carry away the fine particles of soil and create soil erosion.
- 3) Biotic agents:** Overgrazing, mining and deforestation are the major biotic agents, cause soil erosion.
- 4) Landslide:** It also causes soil erosion.
- 5) Construction:** Construction of dams, buildings, roads removes the protective vegetal cover and leads to soil erosion.

Control of soil erosion (or) soil conservation methods:

In order to control soil erosion and conserve the soil, the following conservation practices are applied.

- 1) Conservational till farming (or) No-till-farming:** In traditional method, the land is ploughed and soil is broken up and levelled to make a planting surface. This disturbs the soil and makes it susceptible to erosion. However, no-till farming causes minimum disturbance to the top soil. Here the tilling machines make slits in the unploughed soil and inject seeds, fertilizers and water in the slit. So the seed germinates and the crop grows.
- 2) Counter farming:** It involves planting crops in rows across the counter of gently sloped land. Each row acts as a small dam to hold soil and to slow water runoff.
- 3) Terracing:** It involves conversion of steep slopes into a series of broad terraces, which run across the counter. This retains water for crops and reduces soil erosion by controlling runoff.
- 4) Alley cropping (or) Agro forestry:** It involves planting crops in strips or alleys between rows of trees or shrubs that can provide fruits and fuel wood. Even when the crop is harvested, the soil will not be eroded because trees and shrubs still remain on the soil and hold the soil particles.
- 5) Wind breaks or shelter belts:** The trees are planted in long rows along the boundary of cultivated lands, which block the wind and reduce soil erosion. Wind breaks help in retaining soil moisture, supply of some wood for fuel and provide habitats for birds.

Energy resources

*** Renewable and Non-renewable energy resources:**

Based on continual utility, energy resources can be classified into two types.

- 1) Renewable energy resources
- 2) Non-renewable energy resources

1) Renewable energy resources:

These are natural resources which can be regenerated continuously and are inexhaustible. They can be used again and again in an endless manner.

Examples: Solar energy, wind energy, biomass energy, biogas, tidal energy, wave energy etc.

2) Non-renewable energy resources:

These are natural resources which cannot be regenerated once they are exhausted. They cannot be used again.

Examples: Coal, crude oil, natural gas, nuclear fuels etc., (thermal energy, nuclear energy)

*** Difference between conventional and nonconventional sources of energy (OR) Difference between renewable and non-renewable energy resources.**

Conventional sources of energy	Non-conventional sources of energy
Conventionally non-renewable energy resources are using.	Non-conventionally renewable energy resources are using.
They are fully developed	They are not fully developed
Inexpensive technology	Expensive technology
Require established technology	Require new technologies which are still under research and development
Available in limited quantity	Available in plenty
Emit pollutants from the combustion of coal, crude oil, natural gas, uranium etc., and pollutes environment	Free from pollution problems
Ecologically not safe to use	Ecologically safe to use.
Example: Coal, crude oil, natural gas, uranium etc.,	Example: Solar energy, Wind energy etc.,

*** Use of alternate energy resources (Why alternate (renewable) energy resources are required?)**

The following are represents the alternate energy resources and their need to use to generate energy.

- 1) The importance of solar energy can be emphasized in view of the fact that fossil fuels and other conventional sources are not free from pollution problems.
- 2) Energy sources which have least pollution, safety and security snags and are universally available have to be used to get energy.
- 3) Radioactive pollutants released from nuclear power plants are chronically hazardous. Hence better to use renewable energy resources to get energy.
- 4) The burning of coal, oil, wood, dung cakes and petroleum products have well debated environmental problems. Thus the renewable energy resources are needed to generate energy.
- 5) The disposal of ash requires large ash ponds and may pose a severe problem considering the limited availability of land. Thus non-conventional energy sources are needed.
- 6) **Petro plants:** Hydrocarbons present in plants can be converted into petroleum hydrocarbons.

Examples: Euphorbiaceae, Asclepiodaceae, Apocyanaceae, Sapotaceae, 385 species screened for hydrocarbon content and can be used to get energy.
- 7) **Dendrothermal energy (energy plantation):** They provide fuel wood, charcoal that can be used for generating energy.
- 8) **Energy from urban waste:** Sewage and waste in cities used for generating gas and electricity.
- 9) **Bagasse-based plants:** Sugar mills generate bagasse that can be used to generate electricity.

Ecosystem (Unit-2)

Ecology: The study of the basic relationship of organisms and with their environment is called Ecology.

The word ecosystem was coined by A.G.Tansley in 1935. This term is derived from two words namely eco and system. Eco refers to environment and system refers to a complex co-ordinated unit.

An ecosystem is a basic functional unit of the ecology. It consists of living organisms (Biotic factors) and nonliving substances (Abiotic factors).

It is an interacting system where the biotic and abiotic factors interact to produce an exchange of materials between the living and non-living factors.

* **Definition of ecosystem:** An ecosystem is a functional unit of the biosphere in which members of the community interact among themselves and with the surrounding environment.

Biotic components of an ecosystem are broadly classified in to three types.

- 1) Producers
- 2) Consumers
- 3) Decomposers

1) Producers (Autotrophs): Producers synthesize their food themselves through photosynthesis.

Ex: All plants.

Photosynthesis: The green pigments called chlorophyll, present in the leaves of plants convert CO_2 and H_2O in the presence of sunlight in to carbohydrates.



This process is called photosynthesis.

2) Consumers (Heterotrophs): Consumers are organisms which cannot prepare their own food and depend directly or indirectly on the producers.

Ex: **Plant eating species:** Insects, rabbit, goat, deer, cow etc.,

Animal eating species: Fish, lions, tigers etc.,

Consumer are broadly classified in to three types.

a) **Primary consumers (Herbivores or Plant eaters):** Primary consumers are also called herbivores, they directly depend on the plants for their food. So they are called plant eaters.

Ex: Insects, goat, deer, cow, horse etc.,

b) **Secondary consumers (Primary carnivores or meat eaters):** Secondary consumers are primary carnivores, they feed on primary consumers. They directly depend on the herbivores for their food.

Ex: Frog, cat, snake, foxes etc.,

c) **Tertiary consumers (Secondary carnivores or meat eaters):** Tertiary consumers are secondary carnivores, they feed on secondary consumers. They directly depend on the primary carnivores for their food.

Ex: Tigers, lions etc.,

3) Decomposers: Decomposers attack the dead bodies of producers and consumers and decompose them in to simpler compounds. During the decomposition inorganic nutrients are released. These inorganic nutrients together with other organic substances are then utilized by the producers for the synthesis of their own food.

Ex: Microorganisms like bacteria, fungi, algae etc.,

*** Food chain:**

The sequence of eating being eaten in an ecosystem is known as food chain.

The biotic factors of the ecosystem are linked together by food. For example, the producers form food for the herbivores. The herbivores form food for the carnivores.

The various steps through which food energy passes in an ecosystem is called as trophic levels.

Owing to repeated eating being eaten, the energy is transferred from one trophic level to another trophic level. This transfer of energy from one trophic level to another is called energy flow.

A typical food chain can be seen in a pond ecosystem. The algae and phytoplankton are eaten by the zooplankton. The zooplankton is eaten by fishes. The fishes are eaten by snakes.

Ex: Phytoplankton → Zooplankton → Fish → Snake

The food chains are of two types, namely 1. Grazing food chain and 2. Detritus food chain.

1. Grazing food chain:

This food chain starts from green plants, goes through herbivores and ends in carnivores.

This type of food chain depends on the autotrophs which capture the energy from solar radiation. A few chains are given below:

Grass → Rat → Snake → Eagle

Grass → Grasshopper → Frog → Snake → Eagle

Grass → Deer → Tiger

2. Detritus food chain:

It starts from dead organic matter and ends in inorganic compounds. There are certain groups of organisms which feed exclusively on the dead bodies of animals and plants. These organisms are called detritivores.

The detritivores include algae, bacteria, fungi, insects, ducks etc.. These organisms ingest and digest the dead organic materials.

Some amount of energy is trapped and the remainder is excreted in the form of simple organic compounds. These are again used by another set of detritivores until the organic compounds are converted in to inorganic compounds.

Ex: Dead organic matter → Decomposer → Inorganic matter

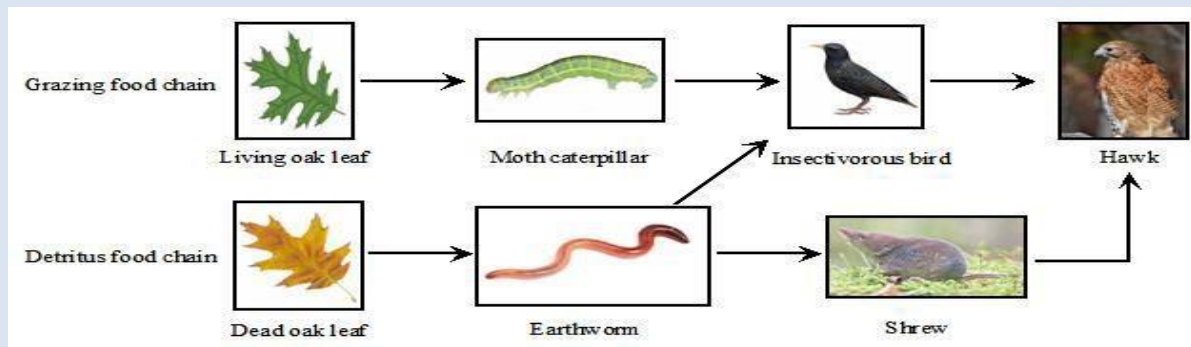
Linking of Grazing and Detritus food chain:

The two main food chains cannot operate independently. They are interconnected at various levels.

According to Wilson and Bossert, the stability of the ecosystem is directly proportional to the number of such links.

The detritus feeders obtain energy from the dead bodies of animals and plants which are components of the grazing food chain.

Again some of the detritus feeders are eaten by the consumers of the grazing food chain. For example, in a pond ecosystem earthworms belonging to the detritus food chain are eaten by fishes belonging to the grazing food chain.



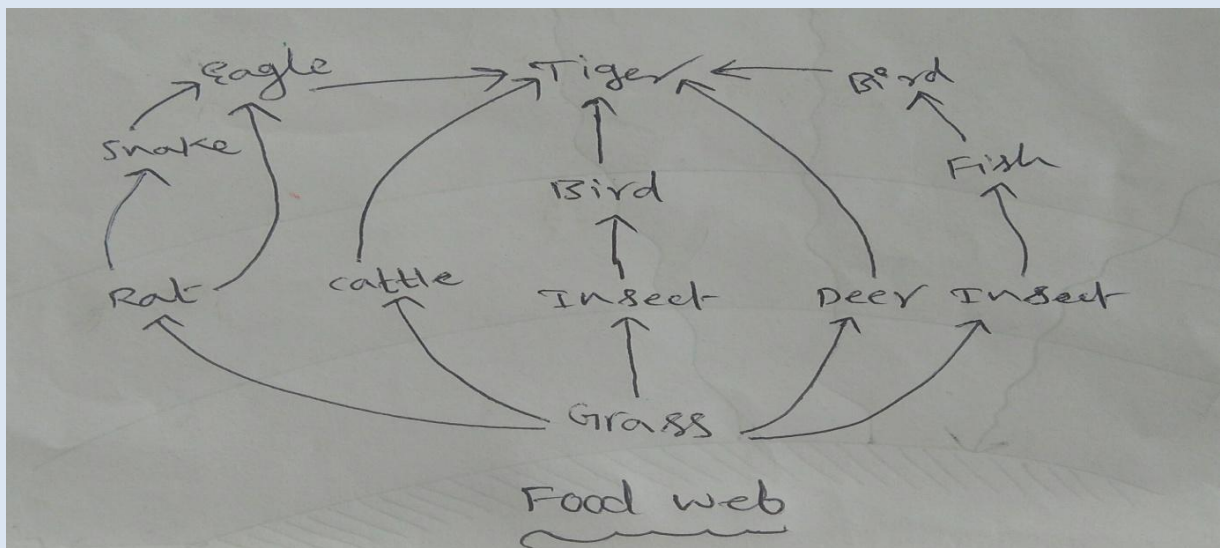
Linking of Grazing and Detritus food chain

*** Food web:**

The interlocking of many food chains is called food web.

In a food web many food chains are interconnected, where different types of organisms are connected at different trophic levels, so that there is a number of opportunities of eating and being eaten at each trophic level.

For example: In a grassland ecosystem, grass is eaten by insect, cattle, deer and rat. Insect is eaten by fish, bird which is eaten by tiger. Cattle, deer and eagle is eaten by tiger. Rat is eaten by eagle. Rat is eaten by snake which is eaten by eagle. In addition, eagle also directly eats rat. Thus five linear food chains which are interconnected to form a food web.



This is a very simple food web. But in any ecosystem the food web is more complex. For example, in the grassland ecosystem itself, in addition to eagle, there are many other carnivores such as vulture, crow, wolf, fox, man etc.....

Difference between Food chain and Food web:

In a linear food chains, if one species get affected (or) becomes extinct, then the species in the subsequent trophic levels are also affected.

But, in a food web, if one species gets affected, it does not affect other trophic levels so seriously. There are number of options available at each trophic level.

Significance of Food chains and Food webs:

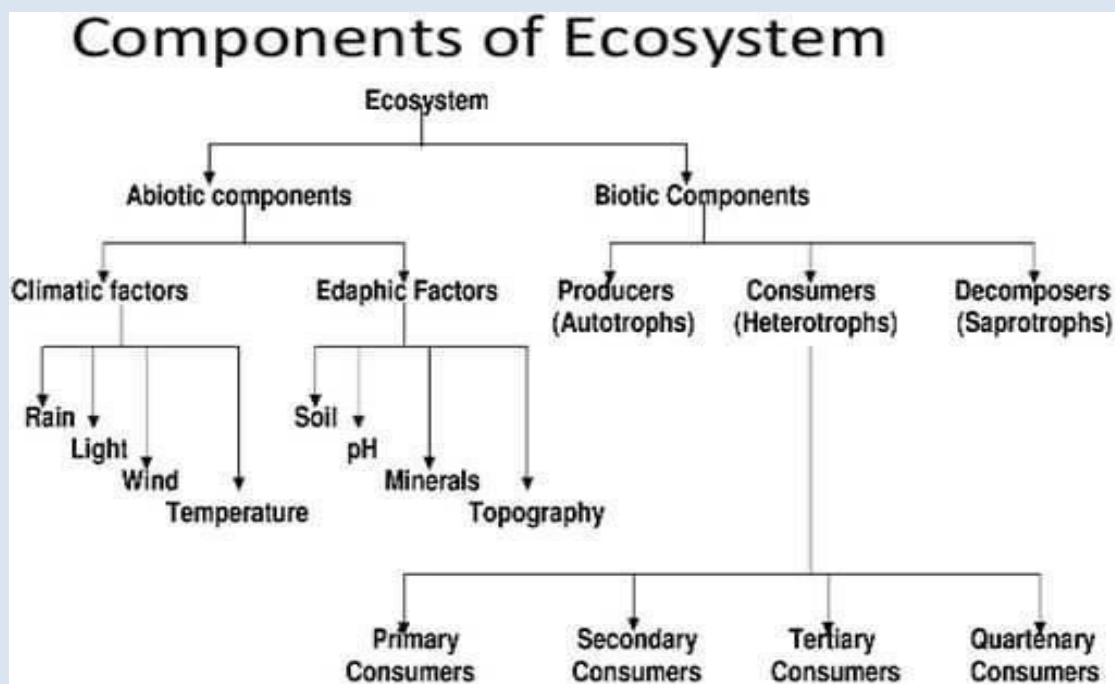
- 1) Food chains and Food webs play a very important role in the ecosystem. Energy flow and nutrient cycling takes place through them.
- 2) They maintain and regulate the population size of different trophic levels, and thus help in maintain ecological balance.

* Structure or Components of an ecosystem

The term structure refers to the various components. So the structure of an ecosystem explains the relation between the abiotic (non-living) and the biotic (living) components.

An ecosystem has two components.

- 1) Biotic (living) components.
- 2) Abiotic (non-living) components.



A) Biotic components:

The living organisms in an ecosystem collectively form its community called biotic components (or) biotic community.

Example: Producers, Consumers and Decomposers

Biotic components of an ecosystem are broadly classified in to three types.

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Ex: Microorganisms like bacteria, fungi, algae etc.,

B) Abiotic components:

The non-living components (physical and chemical) of an ecosystem collectively form a community called abiotic components (or) abiotic community.

Examples: Climate, soil, water, air, energy, nutrients etc.,

i) **Physical components:** They include the energy, climate, raw materials and living space that the biological community needs. They are useful for the growth and maintenance of its member.

Example: Air, water, soil, sunlight etc..

ii) **Chemical components:** They are the sources of essential nutrients.

❖ **Organic substances:** Proteins, lipids, carbohydrates etc.

❖ **Inorganic substances:** All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, P, K) and few other elements.

* Function of an ecosystem

To understand clearly the nature of an ecosystem, its functioning should be thoroughly understood. The function of an ecosystem is to allow flow of energy and cycling of nutrients.

Types of Functions:

Function of an ecosystem are of three types.

i) **Primary function:** The primary function of all ecosystems is manufacture of starch (Photosynthesis).

ii) **Secondary function:** The secondary function of all ecosystems is distributing energy in the form of food to all consumers.

iii) **Tertiary function:** All living systems die at a particular stage. These dead systems are decomposed to initiate the third function of ecosystems namely cycling of nutrients.

The functioning of an ecosystem may be understood by studying the following terms.

- a) Flow of energy
- b) Cycling of nutrients
- c) Food chains
- d) Food webs
- e) Food pyramids (or) Ecological pyramids

* Ecological Pyramid/Food Pyramid

- The pyramidal representation of trophic levels of different organisms based on their ecological position (producer to final consumer) is called as an ecological pyramid.
- Each of the bars that make up the pyramid represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy. Energy moves up the pyramid, starting with the producers, or autotrophs, such as plants and algae at the very bottom, followed by the primary consumers, which feed on these plants, then secondary consumers, which feed on the primary consumers, and so on. The height of the bars should all be the same, but the width of each bar is based on the quantity of the aspect being measured.

The ecological pyramids are of three categories.

1. **Pyramid of numbers,**
2. **Pyramid of biomass,** and
3. **Pyramid of energy**

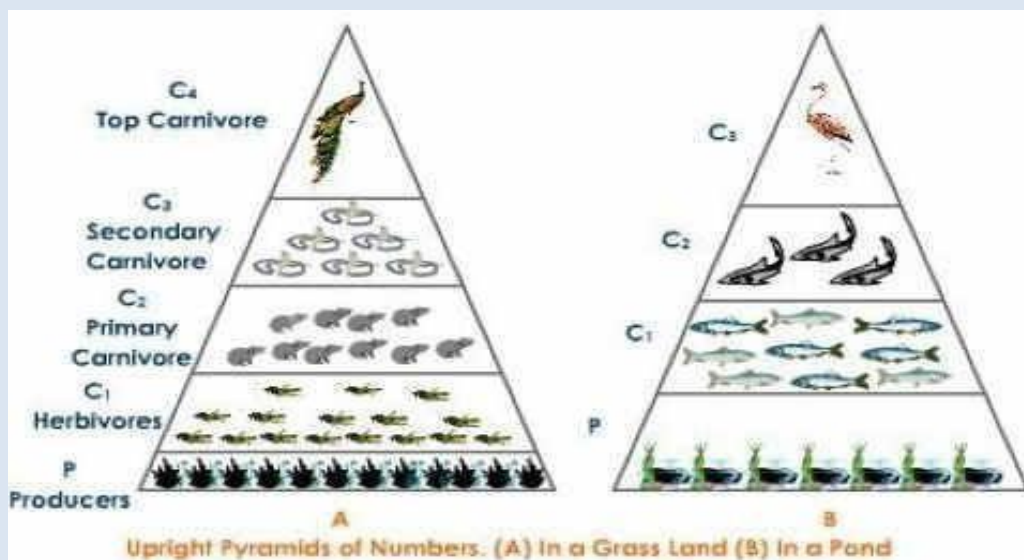
1. Pyramid of number: Pyramid of number represents the **total number of individuals of different species** (population) at each trophic level.

Depending upon the size, the pyramid of numbers may not always be upright, and may even be completely inverted.

It is very difficult to count all the organisms, in a pyramid of numbers and so the pyramid of number *does not completely define the trophic structure for an ecosystem.*

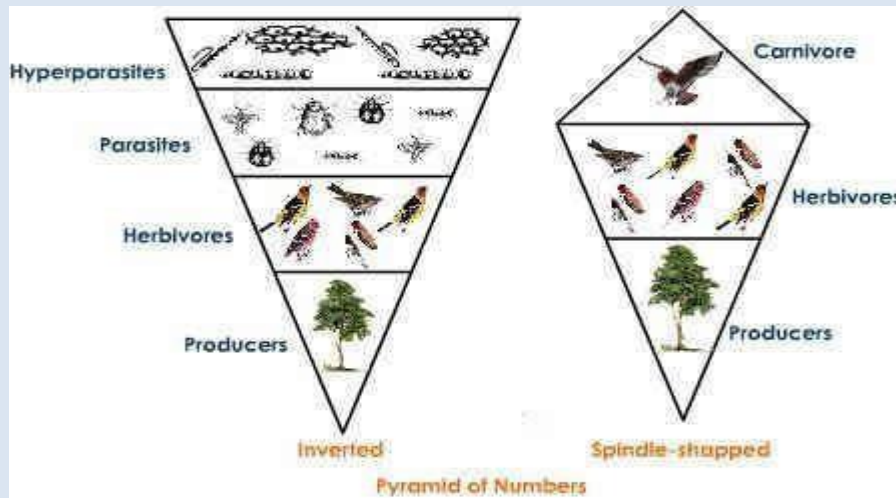
Pyramid of numbers – upright

- In this pyramid, the number of individuals is decreased from lower level to higher trophic level. Eg: Grassland ecosystem.



Pyramid of numbers – inverted

- In this pyramid, the number of individuals is increased from lower level to higher trophic level. E.g. Tree ecosystem.



Pyramid of Biomass:

It represents the total amount of biomass (mass or weight of biological material or organism) present in each trophic level.

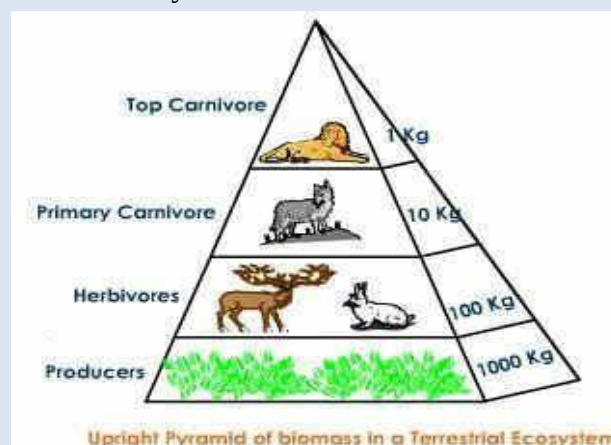
Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their **dry weight**.

The biomass of a species is expressed in terms of fresh or dry weight. Measurement of biomass in terms of dry weight is more accurate.

Pyramid of Biomass – Upright (Eg: Forest ecosystem)

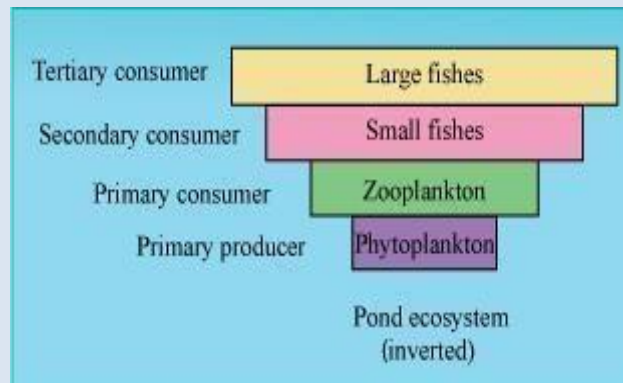
For most ecosystems on land, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top.

The biomass of producers (autotrophs) is at the maximum. The biomass of next trophic level i.e. primary consumers is less than the producers. The biomass of next higher trophic level i.e. secondary consumers is less than the primary consumers. The top, high trophic level has very less amount of biomass.



Pyramid of Biomass – Inverted (Eg: Pond ecosystem)

In contrast, in many **aquatic ecosystems**, the pyramid of biomass may assume an inverted form.

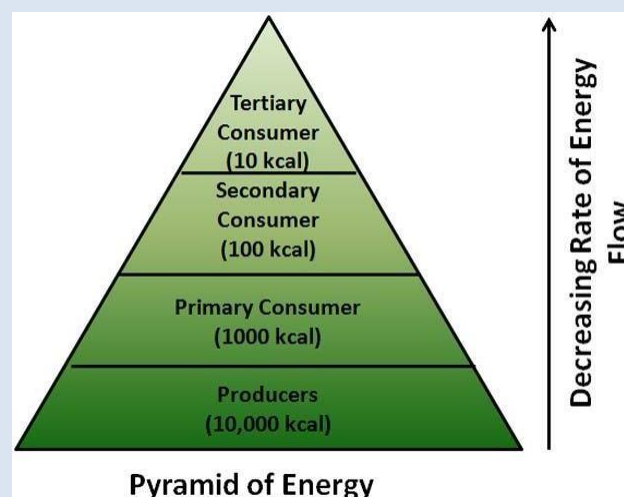


Pyramid of Energy:

An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level. Hence the pyramid is always upright, with a large energy base at the bottom.

To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is most suitable.

At every successive trophic level, there is a heavy loss of energy (about 90%) in the form of heat. Thus at each next trophic level only 10% of the energy is transferred. Hence, there is a sharp decrease in energy at each and every successive trophic level as we move from producers to top carnivores.



* Forest Ecosystem

Introduction:

A forest ecosystem is one in which a tall and dense trees grow, that support many animals. The forests are found in undisturbed areas receiving moderate to high rainfall. The forest occupies nearly 40% of the world's land area. In India it occupies only 21% of its total land area.

Types of Forest Ecosystem:

Depending up on the climatic conditions forests are broadly classified in to following types.

- 1) Tropical forests: They are found near the equator. They are characterised by high temperature, high humidity, high rainfall and climate is constant throughout the year. The trees have broad leaves.
- 2) Temperate forests: They are found in areas with adequate rain fall. Seasonal climate is found in temperate forests. Monsoons play important role in temperate forests. They have broad leaves. They shed leaves during winter season.
- 3) Alpine forests or Taiga: They have needle like leaves. They are also called coniferous forests. They contain pine trees and are evergreen. They occur in low rainfall areas.

Characteristics of Forest Ecosystems:

- 1) Forests are characterised by warm temperature and adequate rainfall, which make generation of number of ponds, lakes etc.
- 2) The forest maintains climate and rainfall.
- 3) The forest support many wild animals and protect biodiversity.
- 4) The soil is rich in organic matter and nutrients, which support the growth of trees.
- 5) Since penetration of light is so poor, the conversion of organic matter in to nutrients is very fast.

Structure and Function of Forest Ecosystem:

- 1) **Abiotic components**: The minerals present in the forest and all organic (litter, debris) and inorganic substances present in the soil and the atmosphere constitute the abiotic components.

Eg. Nutrients, minerals, climatic factors (temperature, light, rainfall).

- 2) **Biotic components**: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the forest.

- a) **Producers**: The plants absorb sunlight and produce food through photosynthesis.

Eg; Trees, shrubs, herbs and ground vegetation.

b) Consumers:

i) Primary consumers (Herbivores-Plant eaters): They directly depend on the producers for their food.

Eg. Insects, mice, deer, rabbit etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the herbivores for their food.

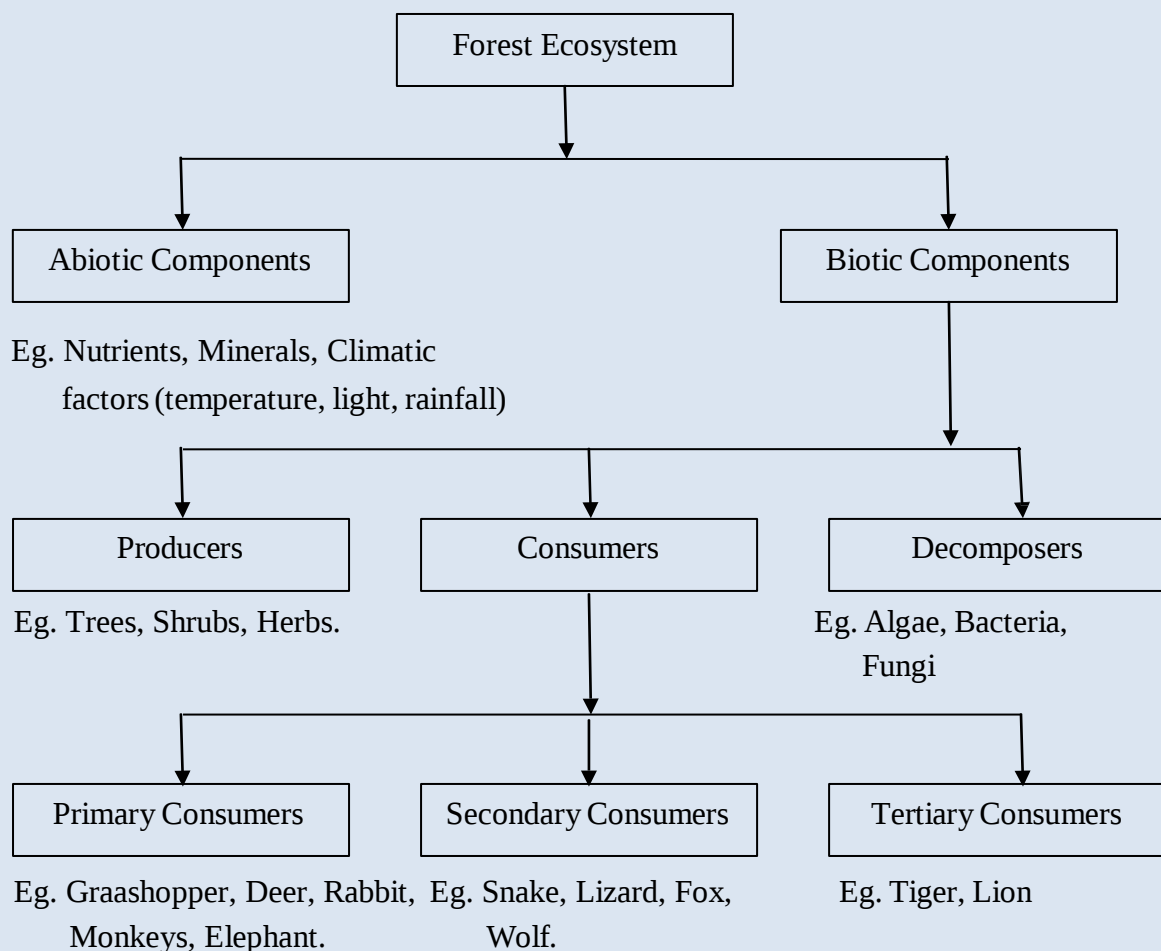
Eg. Snakes, birds, fox, wolf etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Tiger, lion etc.

c) **Decomposers:** They decompose the dead plant and animal matter. During the decomposition inorganic nutrients are released in to the soil which is again used by the producers.

Eg. Bacteria, fungi, earthworms etc.



Structure and Function of Forest Ecosystem

*** Grassland Ecosystem**

Introduction:

Grasslands are areas where the vegetation is dominated by grasses. In addition to grass species some trees and shrubs are also present in grasslands. Grasslands occupy about 20% of the earth's surface. They have enough average rainfall for growing of grass. Grasses grow where there is not enough moisture to support trees, where rainfall is from 10-30 inches a year.

Types of Grassland Ecosystems:

Depending up on the climatic conditions grasslands are broadly classified in to following types.

- 1) Tropical grasslands: They are found near the borders of tropical rain forests. They are characterized by high temperature and moderate rainfall. It is also known as Savanna type. They have tall grasses with scattered shrubs and stunted trees and animals like zebras, giraffes, antelopes etc.
- 2) Temperate grasslands: They are usually found in the centres of continents, on flat, slopped hills. They are characterized by very cold winters and hot summers. Intense grazing and summer fires do not allow shrubs or trees to grow.
- 3) Polar grasslands: They are found in arctic Polar regions. They are characterized by severe cold and strong winds along with ice and snow. In summers several small annual plants grow. They have animals like arctic wolf, weasel, arctic fox etc.

Characteristics of Grassland ecosystems:

- 1) Grassland ecosystem is a plain land occupied by grasses.
- 2) Soil is very rich in nutrients and organic matter.
- 3) Since it has tall grass, it is ideal place for grazing animals.
- 4) It is characterized by low or uneven rainfall.

Structure and Function of Grassland Ecosystem:

- 1) Abiotic components: The minerals present in the grassland and all organic (litter, debris) and inorganic substances present in the soil and the atmosphere constitute the abiotic components.

Eg. Nutrients, minerals, climatic factors (temperature, light, rainfall).

- 2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the grassland.

- a) Producers: The plants absorb sunlight and produce food through photosynthesis.

Eg; Grasses, trees, shrubs.

b) Consumers:

i) Primary consumers (Herbivores-Plant eaters): They directly depend on the producers for their food.

Eg. Insects, cows, buffaloes, deer, sheep etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the herbivores for their food.

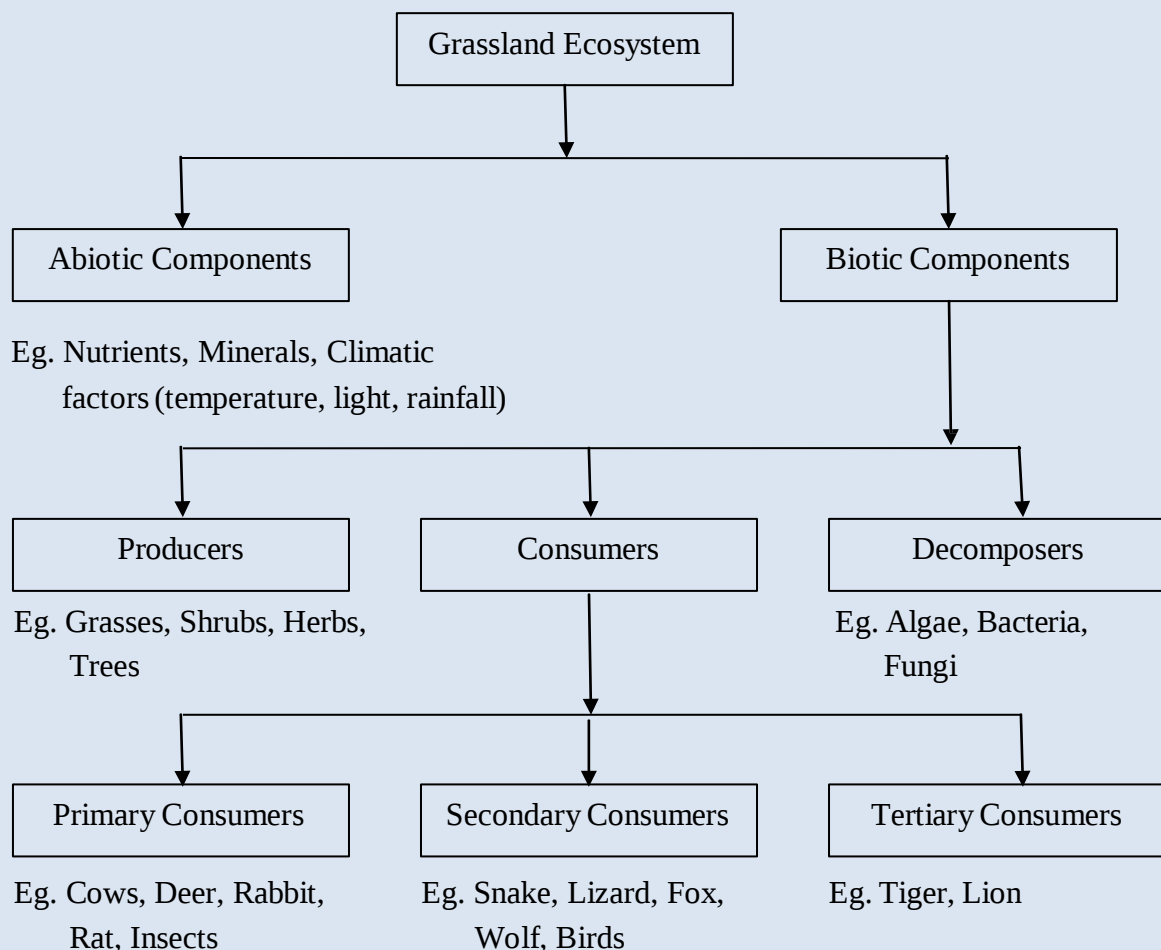
Eg. Snakes, birds, fox, wolf etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Tiger, lion etc.

c) Decomposers: They decompose the dead plant and animal matter. During the decomposition inorganic nutrients are released in to the soil which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Desert Ecosystem

*** Desert Ecosystem**

Introduction:

Desert occupies about 17% of the land. It is characterized by less than 25 cm rainfall. The atmosphere is dry and hence it is poor insulator. Due to scarcity of water and high temperature, the biota is poorly present in desert ecosystem.

Types of Desert Ecosystems:

Depending up on the climatic conditions deserts are broadly classified in to following types.

1) Tropical deserts: They are characterized by only few species, windblown and sand dunes are very common.

Eg. Sahara desert, Thar desert etc.

2) Temperate deserts: They are characterized by very cool winters and very hot summers.

Eg. Mojave desert in Southern California.

3) Cold deserts: They are characterized by cold winters and warm summers.

Eg. Gobi desert in china.

Characteristics of Desert Ecosystems:

1) The desert air is dry and the climate is hot.

2) Annual rainfall is less than 25 cm.

3) The soil is very poor in nutrients and organic matter.

4) Vegetation is poor.

Structure and Function of Desert Ecosystem:

1) Abiotic components: The temperature is very high and rainfall is very low. The nutrient cycling is also very low.

Eg. Temperature, light, rainfall, water.

2) Biotic components: All living organisms, viz. Producers, consumers and decomposers constitute the biotic components of the desert.

a) Producers: Producers are mainly shrubs, bushes, some grasses and a few trees.

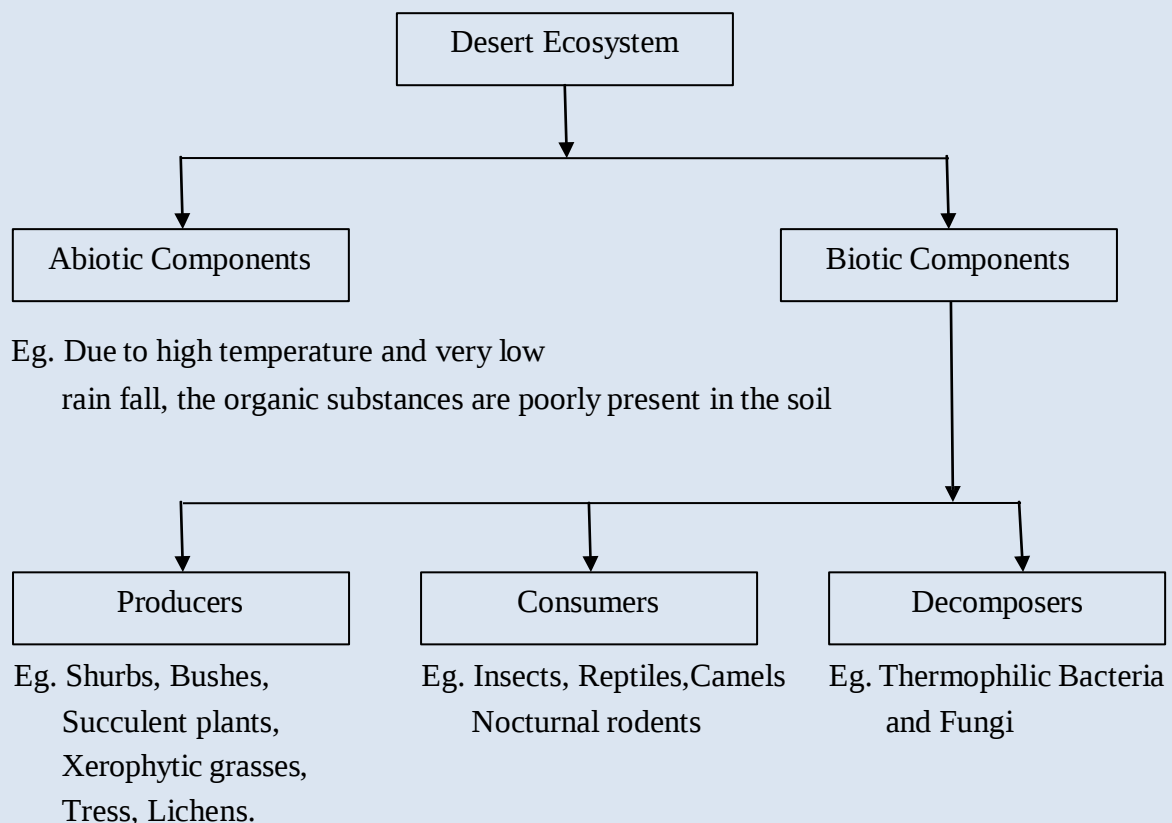
Eg; Succulent plants, Xerophytic plants, shrubs, bushes.

b) Consumers: They include animals which are capable of living in xeric conditions.

Eg. Insects, reptiles, nocturnal rodents, birds etc.

c) Decomposers: In a desert ecosystem, decomposers are very few due to less vegetation and very low amount of dead organic matter.

Eg. Thermophilic Bacteria, fungi etc.



Structure and Function of Lake Ecosystem

*** Lake Ecosystem**

Introduction:

Lakes are large natural shallow fresh water bodies. Lakes are used for various purposes. Lakes are supplied with water from rainfall, melting snow and streams.

Types of Lake Ecosystems: Some important types of lakes are,

- 1) Oligotrophic lakes: They have low nutrient concentrations.
- 2) Eutrophic lakes: They are overnourished by nutrients like N and P.
- 3) Dystrophic lakes: They have low pH, high humic acid content and brown waters.
- 4) Volcanic lakes: They receive water from magma after volcanic eruption.

- 5) Meromictic lakes: They rich in salts.
- 6) Artificial lakes: They are created due to construction of dams.

Characteristics of Lake Ecosystem:

- 1) Lake is a shallow fresh water body.
- 2) It is a permanent water body with large water resources.
- 3) It helps in irrigation and drinking purpose.

Zones of lake

Depending upon their depth and distance from the shore, lakes consists of four distinct zones.

- 1) Littoral Zone: It is top layer of the lake. It has a shallow water.
- 2) Limnetic Zone: Next to the littoral zone is limnetic zone, where effective penetration of solar light takes place.
- 3) Profundal zone: The deep open water, where it is too dark.
- 4) Benthic zone: This zone is found at the bottom of the lake.

Structure and Function of Lake Ecosystem:

- 1) Abiotic components: Minerals, Inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of a lake ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

- 2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the lake.

- a) Producers: They are green plants, submerged, free floating and amphibious plants.

Eg; Phytoplanktons, algae etc.

- b) Consumers:

- i) Primary consumers (Zooplanktons-Plant eaters): They directly depend on the phytoplanktons for their food.

Eg. Protozoans, copepod etc.

- ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the primary consumers for their food.

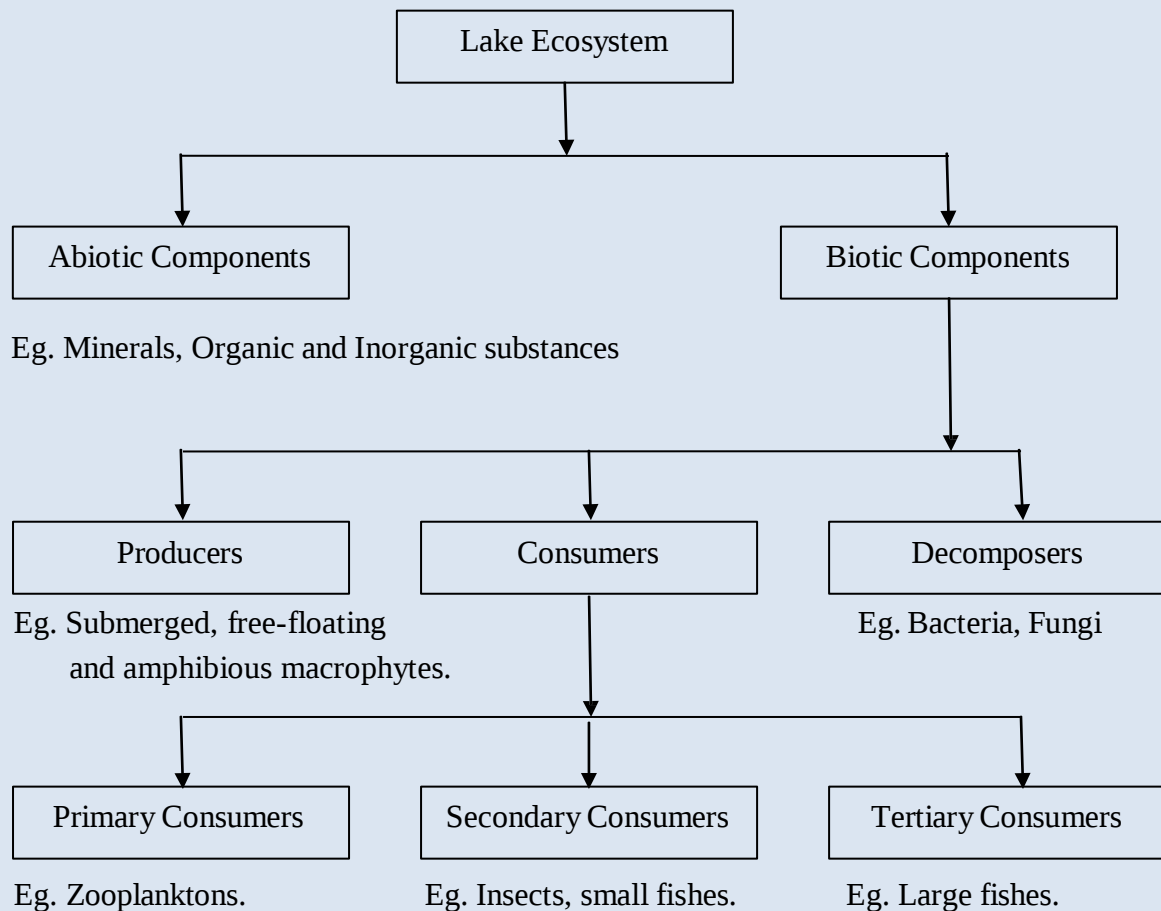
Eg. Small fishes etc.

- iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Large fishes etc.

- c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of River Ecosystem

*** River Ecosystem**

Introduction:

The running water of a river is usually well oxygenated, because it absorbs oxygen from the air. The number animals are low in river.

Characteristics of River Ecosystem:

- 1) It is a fresh water and free flowing water system.
- 2) Due to mixing of water, dissolved oxygen content is more.
- 3) River deposits large amount of nutrients.

Structure and Function of River Ecosystem:

- 1) **Abiotic components:** Minerals, inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of a river ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the lake.

a) Producers: They are green plants, submerged, free floating and amphibious plants.

Eg; Phytoplanktons, algae etc.

b) Consumers:

i) Primary consumers (Zooplanktons-Plant eaters): They directly depend on the phytoplanktons for their food.

Eg. Protozoans, copepod etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the primary consumers for their food.

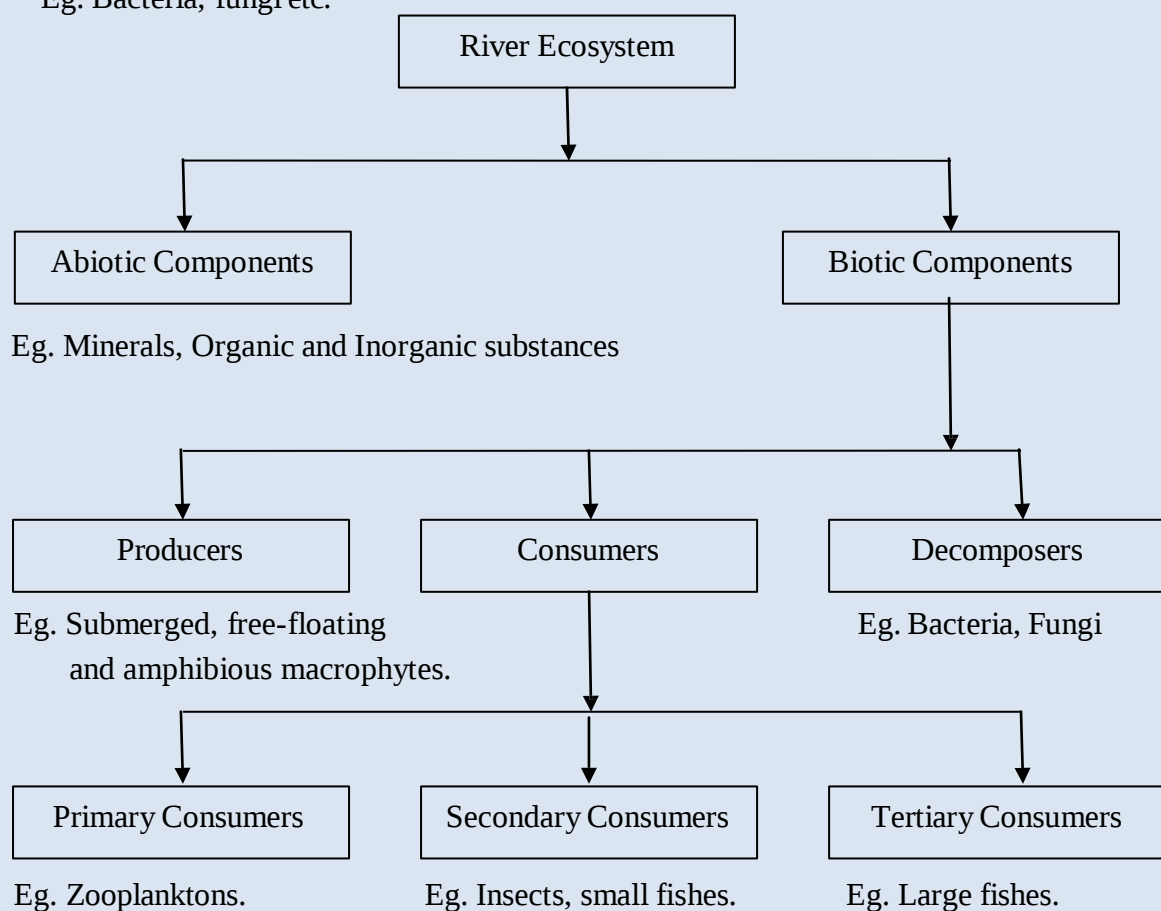
Eg. Small fishes etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Large fishes etc.

c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Ocean Ecosystem

** Ocean Ecosystem*

Introduction:

Ocean cover more than two third of the earth's surface. The Ocean environment is characterized by its high concentration of salts and minerals. It supplies huge variety of sea products and drugs. It also provides us iron, magnesium, phosphorus, natural gas.

Characteristics of Ocean Ecosystems:

- 1) It occupies a large surface area with saline water.
- 2) Since ship, submarines can sail in ocean, commercial activities may be carried out.
- 3) It is rich in biodiversity.
- 4) It moderates temperature of the earth.

Zones of Oceans

The Ocean have two major zones,

- 1) Coastal Zone: It is relatively warm, nutrient rich shallow water. It is the zone of high primary productivity because of high nutrients and sunlight.
- 2) Open Sea: It is the deeper part of the ocean. It is vertically divided in to three regions.
 - i) Euphotic zone: It receives abundant light and shows high primary productivity. (0 to 200 meters)
 - ii) Bathyal zone: It receives dim light and is usually geologically active. (200 to 2000 meters)
 - iii) Abyssal zone: It is the dark zone and is very deep. (2000 to 5000 meters)

Structure and Function of Ocean Ecosystem:

- 1) Abiotic components: Minerals, inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of Ocean ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

- 2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the ocean.

- a) Producers: The plants absorb sunlight and produce food through photosynthesis.

Eg; Phytoplanktons, sea weeds etc.

- b) Consumers:

- i) Primary consumers (Zooplanktons-Plant eaters): They directly depend on the phytoplanktons for their food.

Eg. Crustaceans, molluscs etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the primary consumers for their food.

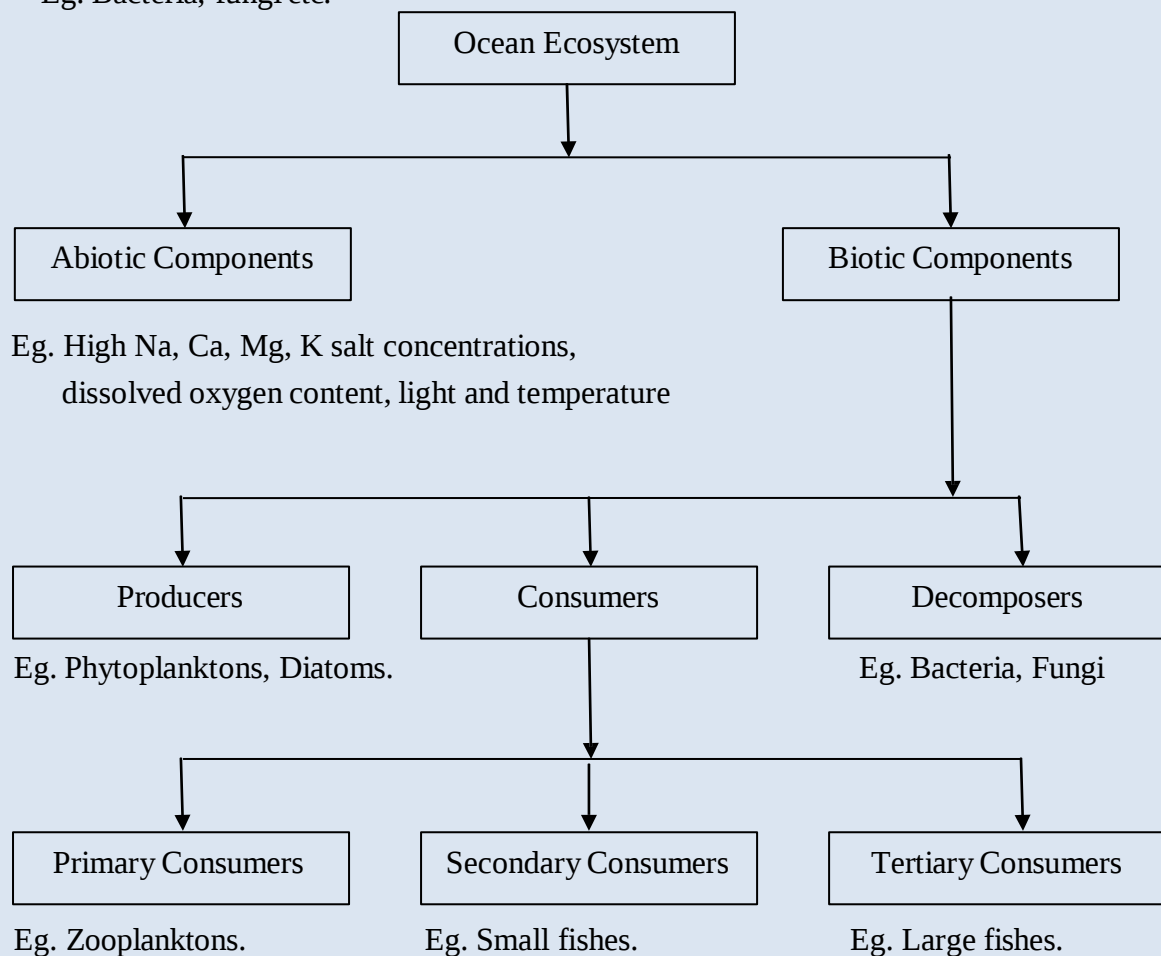
Eg. Small fishes etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Large fishes etc.

c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Estuarine Ecosystem

*** Estuarine Ecosystem**

Introduction:

An estuary is a partially enclosed coastal area at the mouth of a river, where sea water mixes with fresh water. It is strongly affected by tidal action. Estuaries are generally abundant of nutrients. Estuaries are useful to human beings due to their high

food potential.

Characteristics of Estuarine ecosystem:

- 1) Estuaries are transition zones which are strongly affected by tides of the sea.
- 2) Water characteristics are periodically changed.
- 3) The living organism in estuarine ecosystems have wide tolerance.
- 4) Salinity remains highest during the summer and lowest during the winter.

Structure and Function of Estuarine Ecosystem:

- 1) Abiotic components: A mixture of fresh and marine ecosystems.

Eg. Nutrients, minerals, temperature, light, pH etc.

- 2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the ocean.

- a) Producers: The plants absorb sunlight and produce food through photosynthesis.

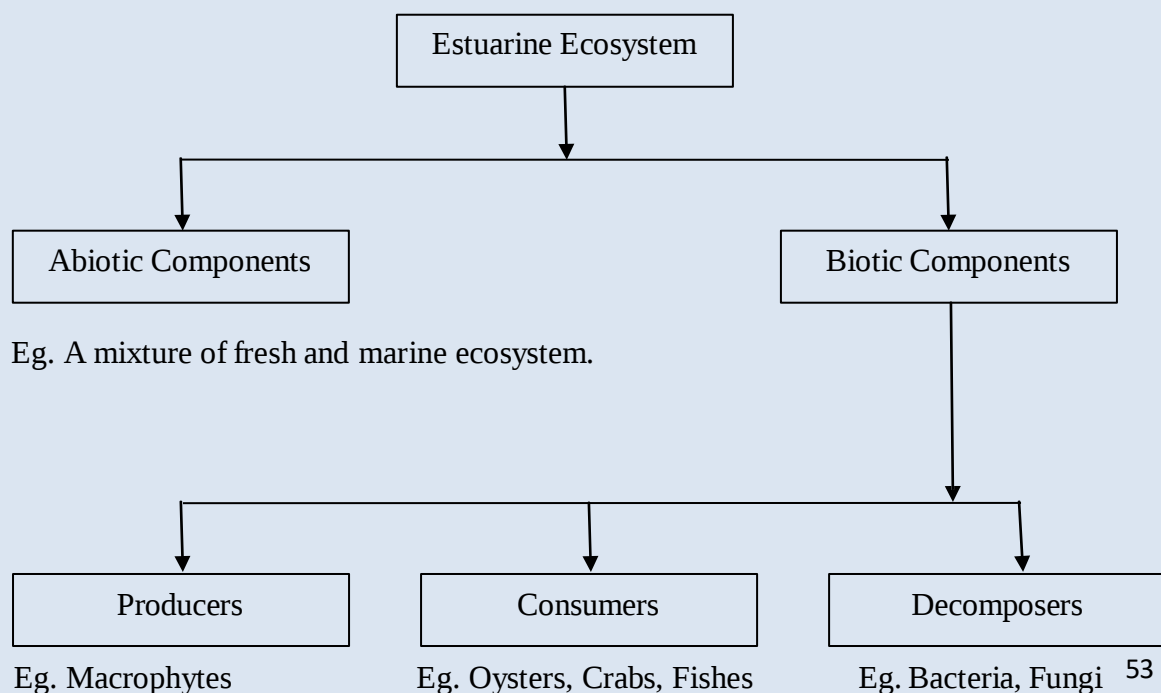
Eg; Phytoplanktons, sea weeds etc.

- b) Consumers: They include animals which are capable of living under wide fluctuations.

Eg. Oysters, Crabs, Fishes, Prawns etc.

- c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



(grasses, Seaweeds, Prawns.
Sea grasses, benthic algae)

*** Pond Ecosystem**

Pond is a freshwater aquatic ecosystem where water is stagnant. It receives enough water during rainy season. It contains several types of algae, aquatic plants, insects, fish and birds.

1. Pond is only seasonal
2. It is a stagnant freshwater body
3. Ponds get polluted easily due to limited amount of water

STRUCTURE AND FUNCTION OF POND ECOSYSTEM

Abiotic components

The non living components of the ecosystem collectively called abiotic components.

Ex: Temperature, light, water, organic and inorganic components

Biotic components

The living components of the ecosystem collectively called biotic components. They are producers, consumers and decomposers.

1. **Producers:** They are green photosynthetic organisms and are of two types. phytoplanktons are microscopic aquatic plants that freely float on the surface of water. Ex: Algae, small floating plants like volvox, pandorina, anabena and cosmarium. Microphytes are large floating plants and submerged plants. Ex: Hydrilla, Jussiaea, wolfina and demna.
2. **Consumers:** Primary consumers are microscopic animals that freely float on the surface of water. They are called zooplanktons and they feed on phytoplanktons. Ex: Protozoa, very small fish, ciliates, flagellates and protozoans. Secondary consumers feed on zooplanktons. Ex: Insects like water beetles and small fish. Tertiary consumers feed on small fish. Ex: Large fish.
3. **Decomposers:** They decompose the dead plant and animal matter thereby releasing the nutrients to be reused by green plants. Ex: Fungi, Bacteria and flagellates.

*** Stream ecosystem**

Running water in a stream is usually well oxygenated as it absorbs oxygen from the air. Stream is full of life with aquatic life.

CHARACTERISTICS:

1. It is fresh and freely flowing water system
2. Due to constant mixing of water during the flow of water in a river, the dissolved oxygen content is high
3. Rivers deposit large amount of nutrients.

STRUCTURE AND FUNCTION:

1. **Abiotic components** Temperature, light, pH, nutrients, organic and inorganic compounds
2. **Biotic components**
 1. Producers: Phytoplankton, algae, water grass, aquatic mass and other amphibious plants
 2. Consumers: Primary consumers feed on phytoplankton. Ex: Water insects, Snails, Fish.

Secondary consumers feed on primary consumers. Ex: Birds and mammals.
 3. Decomposers: They decompose the dead plants and animals. Ex: Bacteria and Fungi.

Biodiversity and its conservation

* **Biodiversity:** The variety and variability among all groups of living organisms and the ecosystem in which they occur is called Biodiversity.

* Types of Biodiversity/Levels of biodiversity/Classification of Biodiversity:

Biodiversity is generally classified into three types.

i) Genetic diversity

ii) Species diversity

iii) Ecosystem (or) Community diversity

i) Genetic diversity: Within individual species, there are number of varieties, which are slightly different from one another. These differences are due to differences in the combination of genes. Genes are the basic units of hereditary information transmitted from one generation to other.

Examples: Rice varieties, Teak wood varieties etc....

ii) Species diversity: Species diversity is the diversity between differed species. The sum of varieties of all the living organisms at the species level is known as species diversity.

Examples: Apple, mango, grapes, wheat, rice etc...

iii) Ecosystem (or) Community diversity: It is a set of biotic components (plants, animals and microorganisms) interacting with one another and with abiotic components (Soil, air, water etc..).

The diversity at the ecological or habitat level is known as ecosystem diversity. A large region with different ecosystems can be considered as ecosystem diversity.

Examples: River ecosystem, pond ecosystem etc....

*** Biogeographical classification of India**

India has different climate and topography in different parts and hence is termed as a mega diversity country. India occupies 10th place among plant rich countries of the world. It is essential to acquire knowledge about the distribution and environmental interaction of flora and fauna of India.

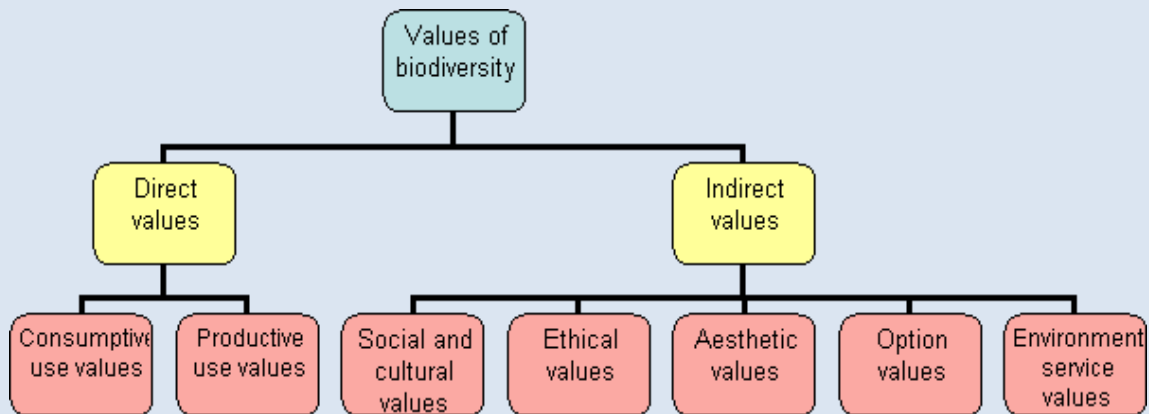
Biogeographers have classified India into ten biogeographic zones with each zone having characteristic climate, soil and biodiversity. These zones are described below:

1. **Trans-Himalayas** The trans-himalayas is an extension to the Tibetan plateau. This region harbors the high-altitude cold desert in Ladakh (Jammu and Kashmir) and Lahaul Spiti (Himachal Pradesh). It accounts for 5.7% of the country's landmass.

2. **Himalayas** The Himalayas are the northern boundaries of India. The entire mountain chain is running from Kashmir in the North-west to Assam in the north-east. The Himalayas comprise of a diverse range of biotic provinces and biomes. The Himalayas cover 7.2% of the country's landmass
3. **Desert** The extremely dry area west of the Aravalli hill range, is comprising both the salty desert of Gujarat and the sandy desert of Rajasthan. Deserts occupy around 6.9% of the country's land mass. The kinds of deserts found in India are:
 1. The desert of western Rajasthan
 2. The desert of Gujarat
 3. The high-altitude cold desert of Jammu & Kashmir and Himachal Pradesh.
 The Indian deserts have more diversified fauna.
4. **Semi-arid** This zone lies between the desert and the Deccan plateau. It includes the Aravalli hill range. It covers approximately 15.6% of the country's landmass.
5. **Western Ghats** The western ghats are a mountain range that runs along the western coast of India. They are a range extending north-south from southern tip of Gujarat in the north to Kanyakumari in the south. The mountains cover an area of about 160,000 sq. km. This ghat section covers an extremely diverse range of biotic provinces and biomes. It covers about 5.8% of the country's landmass.
6. **Deccan plateau** It is a large triangular plateau south of the Narmada valley. Three sides of the plateau are covered by mountains slopes towards east. Satpura mountains cover the north while western ghats cover the west side and eastern ghats cover the eastern side of the plateau. It is the one of largest zones covering the southern and south-central plateau with mostly deciduous trees. It covers 4.3% of the country's land mass.
7. **Gangetic plain** This plain covers the area between the south Himalayas to the tropic of cancer. These plains were formed by the Ganges river system and are relatively homogeneous. This region experiences 600 mm rainfall annually. *Sunderbans* forests are located in this region and it covers 11% of the country's land mass.
8. **North-east India** These are plains and non-himalayan ranges of northeastern India and have a wide variety of vegetation. It covers around 5.2% of the country's land mass.
9. **Islands** The Andaman and Nicobar Islands in the Bay of Bengal has almost 300 big and small islands. Among these, only five islands are inhabited. Only tribes are found in the island of Nicobar. These islands have a highly diverse set of biomes and occupy 0.03% of the country's biomass.
10. **Coasts** India has a large coastline distributed both to the east and west with distinct differences between the two. The Lakshadweep islands are included in this but the area of these islands is negligible.

* Values of Biodiversity

Biodiversity is vital for healthy biosphere. Biodiversity is must for the stability and proper functioning of the biosphere. Definition and estimation of the value of biodiversity is not easy. The value of biodiversity is classified into direct and indirect values as shown in the below diagram.



i) Direct values:

The direct values are of two types (i) Consumptive use value and (ii) Productive use value.

a) Consumptive use value: These are the direct use values where the biodiversity products can be harvested and consumed directly. Example: Food, fuel and drugs. These goods are consumed locally and do not figure in national and international market.

b) Productive use values: These are the direct use values where the product is commercially sold in national and international market. Many industries are dependent upon these values. Example- Textile, leather, silk, paper and pulp industry etc. Although there is an international ban on trade of products from endangered species like tusks of elephants, wool from sheep, fur of many animals etc. These are traded in market and fetch a booming business.

ii) Indirect values

Biodiversity provides indirect benefits to human beings which support the existence of biological life and other benefits which are difficult to quantify. These include social and cultural values, ethical values, aesthetic values, option values and environment service values.

a) Social and cultural value: Many plants and animals are considered holy and sacred in India and are worshipped like Tulsi, peepal, cow, snake etc. In Indian society great cultural value is given to forest and as such tiger, peacock and lotus are named as the national animal, bird and flower respectively.

b) Ethical: These values are related to conservation of biodiversity where ethical issue of 'all life forms must be preserved' is laid down. There is an existence value which is attached to

each species because biodiversity is valuable for the survival of human race. Moreover all species have a moral right to exist independent of our need for them.

c) Aesthetic value: There is a great aesthetic value which is attached to biodiversity. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreational activities like bird watching, photography etc. It promotes eco-tourism which further generates revenue by designing of zoological, botanical gardens, national parks, wild life conservation etc.

d) Option values: The optional values are the potentials of biodiversity that are presently unknown and need to be known. The optional values of biodiversity suggests that any species may be proved to be a valuable species after someday.

e) Environment service values: The most important benefit of biodiversity is maintenance of environment services which includes

- Carbon dioxide fixation through photosynthesis.
- Maintaining of essential nutrients by carbon (C), oxygen (O), Nitrogen (N), Sulphur (S), Phosphorus (P) cycles.
- Maintaining water cycle and recharging of ground water.
- Soil formation and protection from erosion.
- Regulating climate by recycling moisture into the atmosphere.
- Detoxification and decomposition of waste.
- Maintenance of habitats
- Greenhouse gas reduction
- Flood mitigation by vegetation slowing run off

* Hot-spots of biodiversity

Definition: The area which is rich in plant and animal species of which many are endemic and endangered species is called hot-spots of biodiversity.

The concept of identifying biodiversity hotspots was introduced in the year 1988 by British ecologist Norman Myers. These hot-spots were selected on basis of the number of threatened endemic species (Species that are found nowhere else) within them. At the global level, these are the areas of high conservation priority, if these species lost, they can never be replaced (or) regenerated.

Two hotspots are found in India. These are two distinct areas.

1. The Eastern Himalayas
2. The Western Ghats

1. The Eastern Himalayas: Geographically these are comprises Nepal, Bhutan and neighbouring states of Northern India. There are 35,000 plant species found in the Himalayas, of which 30% are endemic.

The Eastern Himalayas are also rich in wild plants of economic value.

Examples: Rice, banana, citrus, ginger, chilli, jute etc.....

- i) The taxol yielding plant is also sparsely distributed in the region.
- ii) 63% mammals are from Eastern Himalayas.
- 2) 60% of the Indian birds are from North East.
- 3) Huge wealth of fungi, insects, mammals, birds have been found in this region.

2. The Western Ghats:

The area comprises Maharastra, Karnataka, Tamilnadu and Kerela. Nearly 1500 endemic, dicotyledones plant species are found from Western ghats. 62% amphibians and 50% lizards are endemic in Western Ghats.

It is reported that only 6.8% of the original forest are existing today while the rest has been deforested or degraded.

* Threats to biodiversity

Definition: The causes for loss of biodiversity is said to be threat to biodiversity.

Any disturbance in an natural ecosystem tend to reduce its biodiversity. Any change in the system leads to a major imbalance and threatens the biodiversity. Causes for loss of biodiversity (or) various threats to biodiversity are

- i) Habitat loss
- ii) Poaching of wildlife
- iii) Man-wildlife conflicts

i) Habitat loss: The loss of species is caused by habitat loss. Habitat loss threatened a wide range of animals and plants.

Factors influencing habitat loss are,

a) Deforestation: The forests are the natural homes of thousands of species, which disintegrate due to loss of their natural habitat (loss of forest).

b) Destruction of wetlands: The wetlands, estuaries and mangroves are destroyed due to draining, filling and pollution, which causes huge biodiversity loss.

c) Habitat fragmentation: Sometimes the habitat is divided into small and scattered patches. This phenomenon is known as habitat fragmentation. Due to this many wild species are vanishing.

d) Raw materials: For the production of hybrid seeds, the wild plants are used as raw materials. As a result many plant species become extinct.

e) Production of drugs: Many pharmaceutical companies collect wild plants for the production of drugs. As a result many plant species become extinct.

f) Illegal trade: Illegal trade on wild life also reduce the biodiversity.

g) Developmental activities: Construction of massive dams in the forest areas, discharge industrial effluents which kill the biodiversity.

ii) Poaching of wild life: poaching means killing of animals (or) commercial hunting. It leads to loss of animal biodiversity.

a) Subsistence poaching: Killing animals to provide enough food for their survival is called subsistence poaching.

b) Commercial poaching: Hunting and killing animals to sell their products is called commercial poaching.

iii) Man-Wildlife conflicts:

Human–wildlife conflict refers to the interaction between wild animals and people and the resultant negative impact on people or their resources, or wild animals or their habitat. It occurs when growing human populations overlap with established wildlife territory, creating reduction of resources or life to some people and/or wild animals.

Significance of the biodiversity:

The following points represent the significance of the biodiversity.

- Increase ecosystem productivity; each species in an ecosystem has a specific niche—a role to play.
- Support a larger number of plant species and, therefore, a greater variety of crops.
- Protect freshwater resources.
- Promote soils formation and protection.
- Provide for nutrient storage and recycling.
- Aid in breaking down pollutants.
- Contribute to climate stability.
- Speed recovery from natural disasters.
- Provide more food resources.
- Provide more medicinal resources and pharmaceutical drugs.
- Offer environments for recreation and tourism.

* Conservation of biodiversity

Definition: The maintenance and preservation of biodiversity is called conservation of biodiversity.

Biodiversity is one of the important tool for sustainable development. The enormous value of biodiversity due to their commercial, medical, genetic, aesthetic and ecological importance emphasizes the need to conserve biodiversity.

There are two types of biodiversity conservation.

- i) In-situ conservation (within habitat, on-site)
- ii) Ex-situ conservation (Outside habitat, off-site)

i) In-situ conservation: It involves protection of different species within its natural habitat, where the species normally occurs is called in-situ conservation.

In-situ conservation methods:

- a) Biosphere reserves
- b) National parks
- c) Wildlife sanctuaries
- d) Gene sanctuary

a) Biosphere reserves:

It covers large area, more than 5000 sq.km. It is used to protect both plant and animal species for long time.

Role of Biosphere reserve:

- It gives long term survival of evolving ecosystem
- It protects endangered species
- It protects maximum number of species and communities
- It serves as site of recreation and tourism
- It is also useful for educational and research purposes.
- It remains and functions as an open system and changes in land use are not allowed.

Restriction: No tourism and explosive activities are permitted in the biosphere reserves.

Examples: Nilgiri: Karnataka, Kerala, Tamilnadu

Gulf of Mannar: Tamil Nadu

Sundarbans: West Bengal

b) National Parks: It is usually a small reserves covering an area of about 100 to 500 sq.kms. within the biosphere reserves, one or more National Parks are also exists.

Role of a National park: It is used to protect, propagate and develop the wildlife. It also used for enjoyment through tourism, without affecting the environment.

Restrictions: Grazing of domestic animals, all private rights and forestry activities are prohibited within a national park.

Examples: Bandipur: Karnataka; Periyar: Kerala, Kaziranga: Assam

c) Wildlife sanctuaries: A wildlife sanctuary is an area, which is reserved for the conservation of animals only.

Role of wildlife sanctuaries: It protects animals only. It allows the operations such as harvesting of timber, collection of forest products, private ownership rights and forestry operations provided, but these activities should not affect the animals adversely.

Restrictions: Killing, hunting, shooting or capturing of wildlife is prohibited except under the control of higher authority.

d) Gene sanctuary: A gene sanctuary is an area, where the plants are conserved.

i) One gene sanctuary for citrus (Lemon family) and

ii) One gene sanctuary for pitcher plant (an insect eating plant)

Examples: In Northern India, two gene sanctuary are found available.

Advantages of In-situ conservation: It is cheap and convenient method. The species gets adjusted to the natural disasters like drought, floods, forest fires.

Disadvantages In-situ conservation: A large surface area of the earth is required to preserve the biodiversity. Maintenance of the habitats is not proper, due to shortage of staff and pollution.

ii) Ex-situ conservation: The protection of different species outside their natural habitats is called Ex-situ conservation.

Role of Ex-situ conservation:

i) It involves maintenance and breeding of endangered plant and animal species under controlled conditions

ii) It identifies those species which are at more risk of extinction.

iii) It prefers the species, which are more important to man in near future among the endangered species.

Important methods of Ex-situ conservation: Botanical gardens, Zoological gardens, seed banks, microbial culture collections, museums etc...

Examples: National Bureau of Plant Genetic Resources – New Delhi.

National Bureau of Animal Genetic Resources – Karnal (Haryana).

Advantages Ex-situ conservation:

- i) Survival of endangered species is increasing due to special care and attention
- ii) In captive breeding animals are assured food, shelter, water and also security and hence longer life span.
- iii) It is carried out in cases of endangered species, which do not have any chances of survival, in the wild.

Disadvantages Ex-situ conservation:

- i) It is expensive method.
- ii) The freedom of wildlife is lost.
- iii) The animals cannot survive in natural environment.

* Factors affecting Biodiversity:

- i) Biodiversity is generally disturbed by human activities such as construction of dams in forest areas, release of Industrial wastes, using pesticides and insecticides in the crop fields, urbanisation etc...
- ii) Poaching of wild animals, over exploitation of natural resources, degradation of habitats affect biodiversity.
- iii) The marine ecosystem is also disturbed due to oil spills and discharge of effluents.
- iv) The climatic factors like global warming, ozone depletion, acid rain also affect the biodiversity.

* Advantages/Need of Biodiversity conservation:

- i) Drugs, herbs, food, and other important raw materials can be derived from plants and animals.
- ii) It provides immediate benefits to the society such as recreation and tourism.
- iii) It also preserves the genetic diversity of plants and animals.
- iv) Ensures the sustainable utilization life supporting systems on earth.
- v) It leads to conservation of essential ecological diversity and life supporting systems.
- vi) Since the biodiversity loss results in ecological and environmental deterioration, it is essential to conserve the biodiversity.

Environmental pollution (UNIT-3)

*** Environmental pollution/Pollution:** Any undesirable change caused in the physical, chemical or biological characteristics of any component of the environment (air, water, soil) which can cause harmful effects on various forms of life (or) property is called Environmental pollution.

*** Pollutant:** The substance released in to the environment and which effect the environment is called pollutant.

Ecologically pollutants are classified in to two types. Non-biodegradable pollutants and Biodegradable pollutants.

i) Non-biodegradable pollutants: The pollutants which can not be decomposed are called Non-biodegradable pollutants.

Ex: Plastic, DDT, mercury salts, aluminium cans etc..

ii) Biodegradable pollutants: The pollutants which can not be decomposed by natural process are called biodegradable pollutants.

Ex: Leaves, vegetable waste etc....

On the basis of physical properties, pollutants are classifies in to four categories. They are solid pollutants, liquid pollutants, gaseous pollutants, pollutants without weight (Heat, temperature, noise, heat etc..)

*** Classification of Pollution:**

Pollution can be classified according to the environment (air, water, and soil) in which it occurs or according to the type of pollutant (lead, mercury, carbon dioxide, solid waste, noise, biocide, heat, etc.) by which pollution is caused.

Sometimes, pollution is made to classify into two broad categories:

1. Natural Pollution:

It originates from the natural process.

2. Artificial Pollution:

It originates artificially by the interaction in between humanity and environment.

Different types of pollutions are as follows:

1. Air pollution

2. Water pollution

3. Soil pollution
4. Thermal pollution
5. Marine pollution
6. Noise pollution
7. Radiation pollution

* **Air pollution**

Definition: The undesirable changes occurring in the air which harmfully affects the life activities of living organisms is called air pollution.

Sources of Air pollution

Sources of air pollution are of two types.

Natural sources and Artificial sources

Natural sources: Natural sources of pollution are those that are caused due to natural phenomena. Ex: Volcanic eruptions, Forest fires, Biological decay, Pollen grains, Marshes, Radioactive materials etc...

Artificial sources: Artificial sources are those which are created by man. Ex: Thermal power plants, Vehicular emissions, Fossil fuel burning, agricultural activities etc.

Classification of Air Pollutants:

Depending on the form of pollutants present in the environment, they are classified as:

1. Primary pollutants and
2. Secondary pollutants

1. Primary pollutants: Primary pollutants are those that are directly emitted in the atmosphere in the harmful form
Ex: CO, NO, CO₂, SO₂ etc.

2. Secondary pollutants: Secondary pollutants are those that are formed by reacting with other components or some basic component of the atmosphere to form new pollutants.
Ex: Oxides of Nitrogen (NO₂ or NO₃) react with moisture in the atmosphere to give Nitric acid.

Reasons that cause Air Pollution:

- ❖ Burning of fuels like wood, cow dung cakes, coal and kerosene in homes pollute the air.
- ❖ Exhaust gases emitted by motor vehicles which pollute the air are the major source of air pollution in big cities.
- ❖ Industries pollute air by releasing various types of pollutants such as sulphur dioxide, oxides of carbon, nitrogen oxide, chlorine, asbestos dust and cement dust.
- ❖ Thermal power plants pollute air by emitting sulphur dioxide and fly-ash.
- ❖ Nuclear power plants pollute air by releasing radioactive rays.
- ❖ Use of fertilisers and pesticides in agriculture pollute the air.
- ❖ Mining activities releases particulate matter into the air and pollutes it.
- ❖ Indiscriminate cutting of trees and clearing of forests increases the amount of carbon dioxide in the atmosphere and thereby pollutes it.
- ❖ Use of chlorofluorocarbons in refrigeration, fire extinguishers and aerosol sprayers pollutes air by depleting the ozone layer.
- ❖ Smoking pollutes air by emitting carbon monoxide and nicotine.

Harmful Effects of Air Pollution:

- ❖ Air pollution affects respiratory system causing breathing difficulties and diseases such as bronchitis, asthma, lung cancer, tuberculosis and pneumonia.
- ❖ It affects the central nervous system causing carbon monoxide poisoning. CO has more affinity for haemoglobin than oxygen and thus forms a stable compound carboxy haemoglobin(COHb), which is poisonous and causes suffocation and death.
- ❖ It causes depletion of ozone layer due to which ultraviolet radiations can reach the earth and cause skin cancer, damage to eyes and immune system.
- ❖ It causes acid rain which damages crop plants, trees, buildings, monuments, statues and metal structures and also makes the soil acidic.
- ❖ It causes greenhouse effect and global warming which leads to excessive heating of earth's atmosphere, further leading to weather variability and rise in sea level. The increased temperature may cause melting of ice caps and glaciers, resulting in floods.

- ❖ Air pollution from certain metals, pesticides and fungicides causes serious ailments.
- ❖ Lead pollution causes anaemia, brain damage, convulsions and death.
- ❖ Certain metals cause problem in kidney, liver, circulatory system and nervous system.
- ❖ Fungicides cause nerve damage and death.
- ❖ Pesticides like DDT(Dichloro diphenyl trichloroethane) which are toxic enter into our food chain and gets accumulated in the body causing kidney disorders and problems of brain and circulatory system.

Prevention and Control of Air Pollution:

- ❖ **Methods of controlling gaseous pollutants**-The air pollution caused by gaseous pollutants like hydrocarbons, sulphur dioxide, ammonia, carbon monoxide, etc can be controlled by using three different methods-Combustion, Absorption and Adsorption.
- ❖ **Methods of controlling particulate emissions**-The air pollution caused by particulate matter like dust, soot, ash, etc can be controlled by using fabric filters, wet scrubbers, electrostatic precipitators and certain mechanical devices.
- ❖ Tall chimneys should be installed in factories.
- ❖ Better designed equipment and smokeless fuels should be used in homes and industries.
- ❖ Renewable and non-polluting sources of energy like solar energy, wind energy, etc should be used.
- ❖ Automobiles should be properly maintained and adhere to emission control standards.
- ❖ More trees should be planted along roadsides and houses.
- ❖ Implementing strict laws to prevent and control of air pollution.
- ❖ Public awareness regarding the importance of air.
- ❖ The forest cover should be protected. Adequate forest cover is essential for maintaining the quality of air. Trees absorb carbon-dioxide (CO₂) and release oxygen (O₂).
- ❖ Green belts should be created. Such areas should be developed around densely populated cities. There should be strict restriction for establishment of large buildings and industries along the Green belt areas.

- ❖ Automobile engines should be redesigned in such a way that their emissions cause minimum pollution. Old automobile engines should be replaced by new ones. People should be encouraged to share the vehicle, and to avoid vehicles for short distances.
- ❖ Use of railway steam engine should be stopped. The burning of combustible materials such as coal produces poisonous gases that are released into the air. Electric engines should be used instead of steam or diesel engines.
- ❖ Industrial areas should be located at a safe distance from the residential areas.
- ❖ Newly designed smoke free furnaces should be used.
- ❖ In industries there should be the arrangement for pollution control.
- ❖ Cheap devices for controlling air pollution should be developed.
- ❖ Air pollution can be checked only through the joint efforts of the government, non-government organizations and the general public.

Case studies of air pollution:

*** 1. Bhopal gas tragedy:**

- ❖ The Bhopal gas tragedy occurred in 1984 at Bhopal. On Dec. 3, a dangerous chemical reaction occurred in the plant. As a result, water entered into the tank containing methyl isocyanate gas. This resulted in the increase of temperature and pressure inside the tank. This led to the release of methyl isocyanate gas from the tank.
- ❖ The gas spread within the radius of eight kilometers. The gas caused coughing, breathlessness, stomach pain, burning in the respiratory tract. By the morning, thousand of people had died.
- ❖ Many people who survived this disaster, suffered from various diseases for the rest of their lives. People still suffer from cancer, tuberculosis, gynecological disorders etc as the result of the inhalation of the gas.

2. Chernobyl nuclear disaster:

At 1:23 a.m. on April 26th, 1986, reactor four at the nuclear power plant near Chernobyl, Ukraine exploded, releasing more than a hundred times the radiation of the bombs dropped on Hiroshima and Nagasaki. Thirty-one people died shortly after the explosion and thousands more are expected to die from the long-term effects of radiation. The Chernobyl nuclear disaster dramatically changed the world's opinion about using nuclear reaction for power.

*** Water pollution**

Definition: The undesirable changes occurring in the water which harmfully affects the life activities of living organisms is called water pollution.

Sources of water pollution: There are two types of sources for water pollution.

1) Point sources and

2) Non-point sources of water pollution

1) Point sources: These are pollutants that are discharged at specific locations through pipes, ditches or sewers into bodies of surface waters.

Ex: Factories, sewage treatment plants, abandoned underground mines and oil tankers.

2) Non point sources: These pollutants cannot be traced to a single point of discharge. They are large land areas or air-sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.

Ex: Acid deposition, runoff of chemicals into surface water from croplands, livestock feedlots, logged forests, urban streets, lawns, golf courses and parking lots.

Causes of water pollution:

There are numerous causes of water pollution. The main ones are listed below.

- ❖ **Industrial process:** When manufacturers and factories are simply allowed to pour toxic chemicals into water bodies before treatment, the water becomes polluted. The oxygen levels in the water also decreases. The toxic chemicals include: lead, sulphuric acid, mercury and used oil.
- ❖ **Inorganic Industrial waste:** Inorganic wastes such as acids, mercury, lead and heavy metals can destroy the normal body processes. The presence of these toxic and corrosive substances in water is dangerous to living things. Factories and other industries dump waste products into water at an alarming rate.
- ❖ **Agricultural fertilizers:** By a process known as leaching, agricultural chemicals such as fertilizers and pesticides can wash into rivers and lakes, poisoning them.
- ❖ **Untreated sewage from households:** Dye, lotion, soap, hair oil, shampoo, powder, deodorant, moisturizer and many other such products also contribute in water pollution. These products go to the sewage without any treatment. Untreated sewage from households can contaminate different water bodies in the process. When sewage pipes break, there is a

chance that the wastes will contaminate drinking water. Sometimes, poorly treated sewage is released into water bodies. Domestic cleaning products can be very dangerous pollutants.

- ❖ **Garbage:** Plastics are non-biodegradable. Mass plastics clog water bodies and contaminate water.
- ❖ **Urbanization:** Urbanization is a key factor in increasing the amounts of water pollution.
- ❖ **Dumping solid waste:** Humans often carelessly dump their trash in the sea or near rivers.
- ❖ **Oil spills:** Accidental oil spills have a devastating effect on seas.
- ❖ **Dissolved gases:** Polluting gases in the air can dissolve into salt and fresh water and pollute it.
- ❖ **Boat fuels:** Fossil fuels used in the shipping industry are one of the largest causes of both air and water pollution.
- ❖ **Heated water from power plants:** Some power plants release the heated water into water bodies. This reduces the oxygen content in water. Power plants normally use heated water to cool their machines.

Effects of water pollution:

The following are the effects of the water pollution.

- ❖ **Water becomes dangerous to drink:** Humans have less safe drinking water.
- ❖ **Less clean water for agriculture:** we need unpolluted water to irrigate crops, too.
- ❖ **Economic costs:** When water has been polluted, there is money needed to purify water, remove plastics from water bodies and so on.
- ❖ **Change in water color:** Polluted water becomes visibly different.
- ❖ **Water-borne diseases:** Living near to polluted water can put humans at risk of diseases. Water-borne diseases: When sewage combines with drinking water, there is a likelihood of a breakout of diseases. If people end up drinking this water, they might suffer from diseases such as typhoid, cholera and dysentery.
- ❖ **Treatment plants.** Treatment plants should be set up especially in cities where huge amount of water goes to drain daily. Water flowing through the drainage system should be properly treated and harmful pollutants removed.
- ❖ **Fewer possibilities for leisure:** Swimming, sailing, surfing and other water sports are definitely not advised in polluted water.

❖ **Acidic rain:** When toxic gases and smoke is released from industries, cars and homes, the gases lead to formation of acid rain. Acidic rain is a threat to human health and it also affects the living organisms in soil.

❖ **Genetic mutations:** The genes of marine and freshwater plants and animals mutate

❖ **Acid oceans:** pollution causes the oceans to acidify.

❖ **Algae bloom:** An excess of oxygen in waters due to a change in the chemical composition causes algae to bloom in overabundance and block out the light in pools and river.

❖ **Damage to the ecosystems:** Ecosystem is the interaction of living things, depending on each other for life. When their habits become polluted, marine and freshwater organisms are at risk of extinction. When aquatic life is threatened the entire ecosystem is disturbed.

❖ **Avoid pouring medicine and insecticides in toilets and sinks:** Throw such waste in the bathroom toilet. This is important because if poured in toilets and sinks, these products could combine to form harmful products.

❖ **Use manure instead of fertilizers.** Manure should be used instead of fertilizers because unlike fertilizers, it does not contain harmful chemicals.

Control measures/Solutions to water pollution.

It is in our power to halt water pollution. Some of the key solutions that can be applied are outlined below.

1. **Stop using harmful chemicals at home:** Opt for environmentally friendly household cleaners.

2. **Prevent industrial waste reaching water:** Dispose of industrial waste by burying or neutralizing it instead.

3. **Sewage treatment:** Household water should be properly treated to make it environmentally safe. Raw sewage should never be pumped into water. This may seem like a convenient way of disposing of it but it is highly dangerous for health. Effective sewage treatment processes should be put in place.

4. **Treatment of industrial wastes before discharge:** Factories should treat wastes before discharge and toxic substances should be converted into harmless materials.

5. **Recycle:** Recycle domestic and commercial waste safely rather than dumping it in the sea or near rivers.

6. **Promote a love for waterways:** That way, everyone in the community will be motivated to stop pollution. When we all work together, we can achieve great things.

7. **Go organic:** Organic agriculture uses far fewer chemical pesticides and fertilizers.
8. **Adherence to water laws.** Laws and legislation regarding water pollution should be strictly followed. There should be heavy penalties for those who fail to adhere to the rules.
9. **Avoid using paper bags:** Carry a shopping bag whenever you expect to go shopping. This will minimize the chances of you using a paper bag. You can also buy a portable shopping bag and always have it with you.
10. **Improve oil tanker safety:** Avoiding oil spills would remove a key cause of environmental pollution.
11. **Routine cleaning:** Wells, and lakes should be regularly cleaned and treated to ensure that they remain safe for human use. There should also be system of regularly testing pond and lake water.

*** Soil Pollution**

Definition: The undesirable changes occurring in the soil which harmfully affects the life activities of living organisms is called soil pollution.

Causes of soil pollution:

1. **Soil erosion:** Soil erosion can be defined as the movement of topsoil from one place to another. Soil erosion is a natural process due to wind, flood and due to human activities like- construction, overgrazing, farming and deforestation.
2. **Industrial wastes:** Various pollutants exists in environment from industrial wastes. Discharge from Chemical industries, Fertilizer Company, pharmaceutical companies are highly polluting.
3. **Urban wastes:** Because of modern life style and eating habits the urban wastes are becoming very dangerous to the human beings. Urban wastes include both which is a non-degradable material and harmful to the society in long run.

4. Agricultural practice:

Use of strong fertilizer, pesticides and inorganic chemicals for increasing productivity.

5. **Biological agents:** Human and animal excreta wastes enter the soil pores and decompose pathogenic bacterial present in those wastes spread infection.

Effects of Soil Pollution:

The harmful effects of soil pollution are briefly described below:

- i) Reduction in the fertility of soil.
- (ii) Obstruction in the public passage (road, railway lanes etc.) by solid waste
- (iii) Contamination of underground and surface drinking water.
- (iv) Fluorosis occurs as a result of consumption of fluoride containing maize, jawar crops. The fluoride is absorbed by the crops from the fluoride contaminated soil.
- (v) Emission of toxic gases (from dumped solid wastes on land) is detrimental to health.
- (vi) The unpleasant smell and spread of insects cause inconvenience to people.
- (vii) Poisoning of the ecosystem take place by soil pollution.
- (viii) Soil erosion occurs due to shifting cultivation.

Control measures of soil pollution:

1. Soil erosion can be controlled by a variety of forestry and farm practices.

Ex: Planting trees on barren slopes

Contour cultivation and strip cropping may be practiced instead of shifting cultivation.

Terracing and building diversion channels may be undertaken.

Reducing deforestation and substituting chemical manures by animal wastes also helps arrest soil erosion in the long term.

2. Proper dumping of unwanted materials: Excess wastes by man and animals pose a disposal problem. Open dumping is the most commonly practiced technique. Nowadays, controlled tipping is followed for solid waste disposal. The surface so obtained is used for housing or sports field.

3. Production of natural fertilizers: Bio-pesticides should be used in place of toxic chemical pesticides. Organic fertilizers should be used in place of synthesized chemical fertilizers. Ex: Organic wastes in animal dung may be used to prepare compost manure instead of throwing them wastefully and polluting the soil.

4. Proper hygienic condition: People should be trained regarding sanitary habits.

Ex: Lavatories should be equipped with quick and effective disposal methods.

5. Public awareness: Informal and formal public awareness programs should be imparted to educate people on health hazards by environmental education.

Ex: Mass media, Educational institutions and voluntary agencies can achieve this.

6. Recycling and Reuse of wastes: To minimize soil pollution, the wastes such as paper, plastics, metals, glasses, organics, petroleum products and industrial effluents etc should be recycled and reused.

Ex: Industrial wastes should be properly treated at source. Integrated waste treatment methods should be adopted.

7. Ban on Toxic chemicals: Ban should be imposed on chemicals and pesticides like DDT, BHC, etc which are fatal to plants and animals. Nuclear explosions and improper disposal of radioactive wastes should be banned.

8. Formulation and effective implementation of stringent pollution control legislation also helps in controlling soil pollution.

9. Proper treatment of liquid wastes from industries and mines must be done.

10. Faulty sanitation practices must be improved.

11. Polluted soil can be treated by bioremediation. It uses microorganisms (yeast, fungi or bacteria) to breakdown, or degrades hazardous substances into less toxic or nontoxic substances (such as CO₂ and H₂O).

* Thermal pollution

Defination: The degradation of water quality by any process that changes ambient water temperature is called thermal pollution.

Causes of thermal pollution/Sources of thermal pollution:

The following are the causes for thermal pollution.

- 1. Water as Cooling Agent in Power, Manufacturing and Industrial plants:** Production and Manufacturing plants are biggest source of thermal pollution. These plants draw water from nearby source to keep machines cool and then release back to the source with higher temperature. When heated water returns to the river or ocean, the water temperature rises sharply. When oxygen levels are altered in the water, this can also degrade the quality and longevity of life in wildlife that lives underwater.
- 2. Soil Erosion:** Soil erosion is another major factor that causes thermal pollution. Consistent soil erosion causes water bodies to rise, making them more exposed to sunlight. The high temperature could prove fatal for aquatic biomes as it may give rise to anaerobic conditions.
- 3. Deforestation:** Trees and plants prevent sunlight from falling directly on lakes, ponds or rivers. When deforestation takes place, these water bodies are directly exposed to sunlight, thus absorbing more heat and raising its temperature.
- 4. Runoff from Paved Surfaces:** Urban runoff discharged to surface waters from paved surfaces like roads and parking lots can make water warmer. During summer seasons, the pavement gets quite hot, which creates warm runoff that gets into the sewer systems and water bodies.
- 5. Natural Causes:** Natural causes like volcanoes and geothermal activity under the oceans and seas can trigger warm lava to raise the temperature of water bodies. Lightening can also introduce massive amount of heat into the oceans. This means that the overall temperature of the water source will rise, having significant impacts on the environment.

Effects of Thermal Pollution:

The following are the effects of thermal pollution.

- 1. Decrease in DO (Dissolved Oxygen) Levels:** The warm temperature reduces the levels of DO (Dissolved Oxygen) in water. The warm water holds relatively less oxygen than cold water. The decrease in DO can create suffocation for plants and animals such as fish, amphibians and copepods, which may give rise to anaerobic conditions. Warmer water allows algae to flourish on surface of water and over the long term growing algae can decrease oxygen levels in the water.
- 2. Increase in Toxins:** With the constant flow of high temperature discharge from industries, there is a huge increase in toxins that are being regurgitated into the natural body of water. These toxins may contain chemicals or radiation that may have harsh impact on the local ecology and make them susceptible to various diseases.
- 3. Loss of Biodiversity:** A dent in the biological activity in the water may cause significant loss of biodiversity.
- 4. Ecological Impact:** A sudden thermal shock can result in mass killings of fish, insects, plants or amphibians. Hotter water may prove favorable for some species while it could be lethal for other species. Small water temperature increases the level of activity while higher temperature decreases the level of activity.
- 5. Affects Reproductive Systems:** A significant halt in the reproduction of marine wildlife (although this may be true, reproduction can still occur between fish – but the likelihood of defects in newborns is significantly higher) can happen due to increasing temperatures as reproduction can happen with in certain range of temperature.
- 6. Increases Metabolic Rate:** Thermal pollution increases the metabolic rate of organisms as increasing enzyme activity occurs that causes organisms to consume more food than what is normally required, if their environment were not changed. It disrupts the stability of food chain and alter the balance of species composition.
- 7. Migration:** The warm water can also cause particular species of organisms to migrate to unsuitable environment that would not cater to its requirements for survival.

Control measures of thermal pollution:

The following methods can be adapted to control high temperature caused by thermal discharges:

1. Cooling towers: Use of water from water systems for cooling systems for cooling purposes, with subsequent return to the water way after passage through a condenser, is called cooling process. Cooling towers transfer heat from hot water to the atmosphere by evaporation. Cooling towers are of two types:

(i) **Wet cooling tower:** Hot water coming out from the condenser (reactor) is allowed to spray over baffles. Cool air, with high velocity, is passed from sides, which takes away the heat and cools the water.

(ii) **Dry cooling tower:** Here, hot water is allowed to flow in long spiral pipes. Cool air with the help of a fan is passed over these hot pipes, which cools down hot water. This cool water can be recycled.

2. Cooling ponds: Cooling ponds are the best way to cool thermal discharges. Heated effluents on the surface of the water in cooling ponds maximise dissipation of heat to the atmosphere and minimise the water area and volume. The warm water wedge acts like a cooling pond.

3. Spray ponds: The water coming out from condensers is allowed to pass into the ponds through sprayers. Here water is sprayed through nozzles as fine droplets. Heat from the fine droplets gets dissipated to the atmosphere.

4. Artificial lakes: Artificial lakes are manmade water bodies that offer once-through cooling. The heated effluents can be discharged into the lake at one end and water for cooling purposes may be withdrawn from the other end. The heat is eventually dissipated through evaporation.

*** Marine pollution**

Defination: The undesirable changes occurring in the sea which affects the living organisms is called marine pollution.

Causes/Sources of Marine Pollution

1. Toxic chemicals in water:

Chemical runoff from industry can really endanger marine life. Industrial waste pumped into the sea, household cleaners poured down the sink, and even chemicals in the atmosphere (for instance due to the discharge of industrial wastes through factory chimneys) that dissolve into the sea can pollute our oceans significantly.

2. Oil spillages:

This is usually an accidental form of industrial dumping, whereby leaks in oil tankers cause vast quantities of oil to pour into the ocean. Accidental oil spills can devastate marine life.

3. Small particles:

The tiny plastic beads in exfoliating creams and other small particles that we pour down the drain without thinking wind up polluting the ocean.

4. Plastic, Litter, and human waste:

Plastic bags, aluminum cans, trash and other human waste constitute a major pollutant of the world's oceans. A huge 'island' of trash roughly the size of Texas was recently found in the Pacific ocean for instance, demonstrating the vast scale of this problem.

5. Sewage:

Whether or not it is treated with toxic chemicals, sewage pollutes the clear, clean water of the oceans. This is another type of industrial dumping. Sometimes, sewage is not pumped directly into the sea but into rivers, and then the untreated water of rivers carries it into the sea.

6. The shipping industry:

Gases (which dissolve in the sea), chemicals and sewage from container ships are major pollutants.

7. Dissolved greenhouse gases: Greenhouse gases from human fossil fuel consumption are making the sea more acidic.

Effects of Marine Pollution:

1. Oxygen depletion:

Seawater is full of dissolved oxygen, however decomposing sewage and other biomatter in oceans can result in a condition known as ‘hypoxia’ or oxygen depletion. This makes it hard for oxygen loving marine life – plants, fish and animals – to survive in the oceans.

2. Higher acidity:

Toxic chemicals make our oceans more acidic. Again, this makes them poisonous to marine life and causes harm to fish and marine mammals as well as marine plants and corals.

3. Choking marine life:

Small pieces of plastic and other litter are increasingly being found in the stomach of fish, turtles and other marine animals. These pieces of trash choke marine animals and hamper their digestion, with an often fatal result.

4. Spoiling birds' feathers:

Oil spills coat the feathers of marine birds and strip them of the natural oils that birds use to keep their feathers waterproof and to maintain their own body temperatures. As a result, marine birds can overheat or get too cold, and they find it hard to stay afloat as their feathers get soggy. They will also find it difficult to fly when their feathers are clogged with oil.

5. Blocking out the sunlight:

Pollutants such as oil or litter can block out the sunlight from sea plants which need sunlight for photosynthesis.

6. Dangers to human health:

Human swimmers and water sports lovers can become endangered by swimming in a polluted sea.

Control measures of marine pollution:

The following are the control measures of marine pollution.

1. Introduction of sewage treatment plants to reduce BOD of final product before discharging into sea.
2. Cleaning oil from surface waters and contaminated beaches can be accelerated through the use of chemical dispersants which can be sprayed on the oil.
- 3 Load on top system reduce oil pollution cleaned with high pressures jets of water.
4. Crude oil washing: The clingage is removed by jets of crude oil while the cargo is being unloaded.
5. Skimming off the oil surface with a section device.
6. Spreading a high density powder over the oil spill, so that oil can I be sunk to the bottom.
7. Stop using plastic and littering garbage as they not only choke up the drains but also releases into the oceans.
8. Ensure that chemicals are not used anywhere near the streams of water and try cutting down on the usage of such chemicals.
9. For farmers, they need to switch from chemical fertilizers and pesticides and move towards the usage of organic farming methods.
10. Use public transport and reduce the carbon footprint by taking small and substantial measures that will not help in reducing the pollution from the environment but will ensure a safe and healthy future for the upcoming generations.
11. Prevent from any oil or chemical spill in the oceans and if in case there is an oil or chemical spill near you volunteer and help in cleaning out the ocean water.
12. Volunteer or initiate beach cleanup activities and spread awareness about the same in the nearby vicinity.

*** Noise pollution**

Defination: Noise is defined as, "the unwanted, unpleasant or disagreeable sound that causes discomfort to all living beings".

Sources/Causes of Noise Pollution:

The sources of noise pollution are divided into two categories:

Natural sources:

The natural environment is filled with various sounds – thunderstorms, lightning, tornado, cyclone, volcanic eruptions, earthquakes, landslides, sounds produced by animals, and rapidly falling water.

Human sources:

Rapid industrialization, urbanization, use of modern means of transport, population growth, and increasing scale of human activities are some of the human factors responsible for noise pollution. Both types of noise pollution, affect sleep, listening ability, physical and mental health.

Vehicular Noise: The modern means of traffic including vehicles such as buses, trucks, scooters, cars, motorcycles, trains, aircraft, firecrackers, explosives etc, pollute the atmosphere. Sound of other automated vehicles and horn, excessive use of loudspeakers for religious purposes also generate jarring noise.

Industrial Noise: Industry-businesses, factories and commercial establishments produce a variety of raucous sounds that bump into our ears and disturb our mind. Noise pollution is an integral part of the industrial environment with heavy machines used in the industries; it is on the rise with the increase in industrial urbanization.

Commercialization of residential areas: Even in non-industrial areas, there is noise in the surrounding environment due to printing, dyeing machines, repairing cars, grinding etc.

Domestic Noise: As the houses in the cities are quite adjacent, the amount of domestic noise is increasing. The noise of radio, television, instrumentation and various types of sounds are constantly occurring around us, which cause mental health problems, stress, deafness etc. Other domestic sources include noise in the kitchen, and domestic discord including scolding, shouting, crying, etc.

Construction activities: Unbridled construction is also a reason for noise pollution outside the home. Sound pollution is also caused due to poor urban planning because industrial and residential buildings are quite close by in many cities.

Political Activities: Noise pollution is also generated by dharna, demonstrations, slogans, election propaganda, processions, and rallies frequently organized in cities.

Noisy Hospitals: Noise pollution also occurs in hospitals. Rocking of trolleys, wheelchairs, surgical instruments, oxygen cylinders, sounds from plants, uncontrolled conversations

among patients, relatives, emergency noise and screams, mourning followed by death are some of the sources of noise pollution in medical centres.

Fireworks: Fireworks are another source of pollution. Uncontrolled fireworks in festivals, fairs, or crackers after victory in matches and elections produce unbearable noise.

Other Reasons: Noise pollution inside and outside the house includes car alarms, emergency services siren, machine tools, compressed air horn, equipment, electrical equipment, megaphone etc.

Effects of Noise Pollution/Diseases Caused by Noise Pollution:

- Noise pollution may cause temporary or permanent hearing impairment. The most direct harmful effect of excessive noise falls on the ears. Many times, extreme noise ruptures the ear drums.
- You cannot only be deaf but can also come in the grip of deadly illnesses like impotence and cancer, besides problems such as lack of memory, concentration, and interruption in speech, irritation, irritability, stress and depression.
- The noise not only creates irritability, anger, but also accelerates the heart rate by increasing blood flow in the arteries. The constant noise increases the amount of cholesterol in the blood, which contracts blood vessels, increasing the likelihood of cardiovascular disease.
- Health experts believe that rising noise gives rise to neurological disease, nervous breakdown, hypertension, vision, dizziness, excessive sweating, exhaustion
- As rapid noise hinders sleep, insomnia has adverse effects on human functioning. The person becomes irritable, angry, tired and tense, and he even becomes neurotic or crazy.
- Exposure to the noise of 180 decibels intensity may result in the death of man.
- Due to excessive noise, there is a decrease in the production of digestive juices.
- Noise pollution has a lot of adverse effect on infants and women, sometimes due to loud velocity of sound, women also undergo miscarriage or the foetus's heart stops and the entire behaviour of the infant can change. Children imbibe forgetful tendencies.
- The effect of noise is dangerous for animal life too. Due to continuous noise, their habitat decreases and the threatened creatures reach the brink of extinction. The most notable of the deadly effects of noise pollution is that some species of whale die due to noise.

- Noise pollution has extremely harmful effects on other organisms and vegetation. Due to frequent noise, animals and birds leave their habitat and move away. Animals and birds migrate from the forest areas near the mining areas and high traffic roads. Due to acute sound waves, birds may even stop laying eggs.
- Because of excessive noise, many violent creatures cannot find their prey, while other creatures cannot survive being hunted.
- Many microbes are destroyed by acute sound, which inhibit decomposition of wastes.
- There are adverse effects of pollution on pets such as turbulence, and decrease in their milk content.
- Similarly, due to noise pollution, the growth of the vegetation is hindered; the fruits and flowers of the trees get withered and decayed.
- With excessive sound the walls of windows of the buildings are broken, the roofs rattle and get cracked.
- Due to blasts in the mining areas, or sound of jet aeroplanes sometimes high-rise buildings collapse or cracks develop in them, dams, bridges, etc.
- The sound effects of noise pollution caused by nuclear explosions spread through hundreds of kilometres so that biodiversity is threatened.
- Rocks, snowflakes and landslide incidents rise in snowy and mountainous areas.
- Because of the noise, many creatures also speak loudly, which is called Lombard Vocal Response. Their vocal intensity increases in the presence of noise. It occurs as a response to ambient noise.
- Due to excessive noise, there is a disruption in the studies of children too, as they do not get peaceful environment for study even in their homes.

Measures for Prevention/Control of Noise Pollution:

- Considering the widespread ill-effects of noise pollution, measures need to be taken to control them.
- Increasing noise pollution is very harmful for the health, efficiency and productivity of animals, organisms, flora etc. as well as the adaptation and balance of the environment.
- It has become necessary to control it and also to make people aware of this.
- Factories, which mainly produce noise pollution, should be established far away from settlements, forests, reservoirs and hilly areas.

- Settlements should not be located at least within 20 kilometres from mining areas, and airports.
- Explosives should be not used in mountainous, forest and mining areas.
- With proper maintenance of vehicles, along with the restriction of high sound horns, the use of advanced technology silencer should be used inevitably.
- Use of horn in public places (hospital, teaching institutes etc.) should be banned.
- The sound of musical instruments should be controlled to desirable limits.
- The use of sound amplifiers of high power, DJ, etc should be banned in religious, social, political events.
- There should be control over noise generated from machine and equipment.
- The use of sound absorber acoustic tiles should be encouraged in the construction of multi-storeyed buildings.
- In industrial, commercial and hospital buildings, adequate soundproof systems should be installed.
- Intensive plantation should be made in the entire building complex.
- Planting green trees along the road side reduces the intensity of noise pollution.
- Dense tree cover is very useful in the prevention of noise pollution. Such trees help in absorbing high sound waves, as well as deflecting them into the atmosphere.
- Therefore, cities, highways, industrial settlements should be fully lined with the green belt of trees.
- Protective tools (ear plugs etc.) should be provided for workers.
- Limits should be set on noise and control over noise pollution by legal provisions.
- Adequate health education on pollution should be provided through government agencies and voluntary institutions.

*** Nuclear hazards (Radioactive pollution/Radiation pollution)**

Nuclear hazard is an environmental pollution caused by ionizing radiations. Atom bomb explosion, nuclear power plant accident etc are nuclear hazards.

It is a radioactive pollution. It is caused by radioactive substances called radioactive isotopes or radionuclides. eg. Uranium, Thorium, Plutonium etc.

Radioactive pollution (also radioactive contamination) is the presence of radioactive substances in the environment. These substances are known as pollutants because they can

cause damage to the environment. Animals, plants and humans can all fall ill due to radioactive pollution.

Alternative names for radioactive pollution include ‘radioactive contamination’ and ‘radiological contamination’. These terms all mean the same thing: radioactive matter polluting the environment.

Defination: The undesirable change caused by the release of radiations into the air from radioactive substances is called radioactive pollution.

Sources/Causes of radioactive pollution:

The following are the sources of the radioactive pollution. Sources may be natural or manmade activities.

The natural sources of radiation may be:

1. Radioactive minerals;
2. Cosmic rays;
3. Radio nuclides.

1. Radioactive Minerals:

The minerals containing Uranium- 235 (U^{235}), Uranium-238 (U^{238}), Thorium-232 (Th^{232}), Plutonium- 239 (Pu^{239}) etc. are capable of emitting energetic radiations causing pollution.

2. Cosmic Rays:

The cosmic rays containing highly energetic particles reach the surface of the earth causing pollution. The intensity of cosmic rays depends on latitudes and altitude of the place. The intensity is maximum at the poles and minimum at the equator.

3 .Radio nuclides:

The unstable radio-nuclides in the atmosphere can be splitted up into smaller parts emitting energetic radiation. The smaller radio-nuclides enter into the body of organism along with air during respiration.

The various sources of manmade radiation pollutions may be:

1. Nuclear power plants;
2. Radio-active wastes;

3. Nuclear explosions; and
4. Radio-isotopes.

1. Nuclear Power Plants:

Nuclear power plants emit radiation to a very smaller extent except accidental leaks (Chernobyl accident of undivided USSR).

2. Radio-active Wastes:

The nuclear power plants produce a lot of nuclear radio-active wastes. The disposal of these wastes has become a global problem. Some countries producing large quantity of nuclear wastes dump them in ocean near other countries.

3. Nuclear Explosion:

During nuclear explosion, a large number of radio-nuclides are generated in the atmosphere. The radio nuclides settle down with rain contaminating the soil and water bodies. Finally, these enter into food chain causing serious problem to the living organisms.

4. Radio-isotopes:

Radio-isotopes are also prepared artificially either by nuclear fusion or by nuclear fission. If these radio-isotopes are not properly handled, these emit radiations causing pollution.

5. Television Set:

Television sets produce radiations which can also cause cancer.

Effect of Radiation Pollution:

When radiation passes through different living organisms the following dis-orderness takes place:

1. Radiation splits the molecules of the tissues into ions and free radicals and causes mutation by breaking DNA (Deoxy ribonucleic acid) molecules in the nucleus.
2. Radiation in bone marrow may cause leukemia.
3. Radiation may cause skin burns which may lead to skin cancer.
4. Radiation at pelvic regions of pregnant ladies, cause damage to the foetus.
5. Still birth- Birth of dead babies.

6. congenital deformities – defects in new born babies.
7. Microcephaly – Abnormal small head in babies.
8. Destruction of cities.
9. Destruction of plants and animals
10. It causes radiation sickness.
11. Cumulative radiation damage and death.
12. Cataract in the eye.
13. Reduced fertility.
14. Damage to liver, spleen, thyroid etc.
15. Carcinoma (cancer)
16. Leukemia (blood cancer)
17. General malaise (discomfort)
18. Nausea, vomiting, headache, Anaemia, mental retardation, thyroid cancer, bone cancer,
19. Inhibition of mitosis (Cell division)
20. Inhibition of enzyme secretion.

Control of Radiation Pollution:

Radiation pollution can be controlled in the following ways:

1. Care should be taken to check manmade radiation pollution at source.
2. Nuclear reactor should be perfectly maintained to avoid accidental leakage.
3. Nuclear tests should be banned.
4. **Waste disposal:** Radioactive waste must be stored in underground tanks where they gradually decay in a harmless manner.

5. **Protective garments:** Workers in atomic power plant and industries using radioactive materials should wear protective garments and should be screened from radioactive materials by radiation resistant walls or cases.

6. **Radiation indicators:** The workers should wear radiation indicators to know the total amount of radiation to which they have been exposed.

7. **Exposure to visible light:** Visible light neutralizes UV damage considerably. Therefore exposing the UV radiation affected persons to sunlight can treat him.

8. **Glass spectacles:** Use of glass spectacles will protect the eyes from ultraviolet light because UVL cannot penetrate the glass.

9. Public awareness

10. Implementation of strict laws.

*** Solid waste management**

Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes. It also offers solutions for recycling items that do not belong to garbage or trash. As long as people have been living in settlements and residential areas, garbage or solid waste has been an issue. Waste management is all about how solid waste can be changed and used as a valuable resource.

Types of solid wastes: Depending on the nature of origin, solid wastes are classified into

1. Urban or municipal wastes
2. Industrial wastes and
3. Hazardous wastes

Sources of urban wastes

Urban wastes include the following wastes:

Domestic wastes containing a variety of materials thrown out from homes

Ex: Food waste, Cloth, Waste paper, Glass bottles, Polythene bags, Waste metals, etc.

Commercial wastes: It includes wastes coming out from shops, markets, hotels, offices, institutions, etc.

Ex: Waste paper, packaging material, cans, bottle, polythene bags, etc.

Construction wastes: It includes wastes of construction materials.

Ex: Wood, Concrete, Debris, etc.

Biomedical wastes: It includes mostly waste organic materials

Ex: Anatomical wastes, Infectious wastes, etc.

Classification of urban wastes

Urban wastes are classified into:

Bio-degradable wastes - Those wastes that can be degraded by micro organisms are called bio-degradable wastes

Ex: Food, vegetables, tea leaves, dry leaves, etc.

Non-biodegradable wastes: Urban solid waste materials that cannot be degraded by micro organisms are called non-biodegradable wastes.

Ex: Polythene bags, scrap materials, glass bottles, etc.

Sources of industrial wastes

The main source of industrial wastes are chemical industries, metal and mineral processing industries.

Ex:

Nuclear plants: It generated radioactive wastes

Thermal power plants: It produces fly ash in large quantities

Chemical Industries: It produces large quantities of hazardous and toxic materials.

Other industries: Other industries produce packing materials, rubbish, organic wastes, acid, alkali, scrap metals, rubber, plastic, paper, glass, wood, oils, paints, dyes, etc.

Effect of improper solid waste management

1. Due to improper disposal of municipal solid waste on the roads and immediate surroundings, biodegradable materials undergo decomposition producing foul smell and become a breeding ground for disease vectors.
2. Industrial solid wastes are the source for toxic metals and hazardous wastes that affect soil characteristics and productivity of soils when they are dumped on the soil
3. Toxic substances may percolate into the ground and contaminate the groundwater.

4. Burning of industrial or domestic wastes (cans, pesticides, plastics, radioactive materials and batteries) produce furans, dioxins and polychlorinated biphenyls that are harmful to human beings.
5. Contaminates water and air, resulting into diseases and dysentery in Human beings.
6. Mosquitoes breed in the stagnant water, blocked due to waste choked in the drains.
7. Decomposition of solid waste spreads obnoxious odour in the air, thus polluting it.
8. Garbage dumps and decomposed waste helps many harmful species to breed in them.
9. The infected water supply also leads to large scale epidemics.

Solid waste management involves waste generation, mode of collection, transportation, segregation of wastes and disposal techniques.

Steps involved in solid waste management:

Two important steps involved in solid waste management are:

Reduce, Reuse and Recycle of Raw Materials

Discarding wastes

Reduce - If usage of raw materials is reduced, the generation of waste also gets reduced

Reuse - Refillable containers that are discarded after use can be reused

Rubber rings can be made from discarded cucle tubes and this reduces waste generation during manufacture of rubber bands.

Recycle- Recycling is the reprocessing of discarded materials into new useful products

Ex: Old aluminium cans and glass bottles are melted and recast into new cans and bottles

Preparation of cellulose insulation from paper

Preparation of automobile body and construction material from steel cans

This method (**Reduce, Reuse & Recycle**), i.e, **3R's** help save money, energy, raw materials and reduces pollution.

Discarding wastes:

The following methods are adopted for discarding wastes:

1. Sanitary Landfill
2. Incineration
3. Recovery and recycling
4. Composting
5. Pyrolysis

Sanitary Landfill

This is the most popular solid waste disposal method used today. Garbage is basically spread out in thin layers, compressed and covered with soil or plastic foam. Modern landfills are designed in such a way that the bottom of the landfill is covered with an impervious liner which is usually made of several layers of thick plastic and sand. This liner protects the ground water from being contaminated because of leaching or percolation. When the landfill is full, it is covered with layers of sand, clay, top soil and gravel to prevent seepage of water.

Incineration

This method involves burning of solid wastes at high temperatures until the wastes are turned into ashes. Incinerators are made in such a way that they do not give off extreme amounts of heat when burning solid wastes. This method of solid waste management can be done by individuals, municipalities and even institutions. The good thing about this method is the fact that it reduces the volume of waste up to 20 or 30% of the original volume.

Recovery and Recycling

Recycling or recovery of resources is the process of taking useful but discarded items for next use. Traditionally, these items are processed and cleaned before they are recycled. The process aims at reducing energy loss, consumption of new material and reduction of landfills.

Composting

Due to lack of adequate space for landfills, biodegradable yard waste is allowed to decompose in a medium designed for the purpose. Only biodegradable waste materials are used in composting. Good quality environmentally friendly manure is formed from the compost and can be used for agricultural purposes.

Pyrolysis

This is method of solid waste management whereby solid wastes are chemically decomposed by heat without presence of oxygen. This usually occurs under pressure and at temperatures of up to 430 degrees Celsius. The solid wastes are changed into gasses, solid residue and small quantities of liquid.

In summary, proper solid waste management is an integral part of environmental conservation that should be observed by individuals and companies globally. This will keep the environment clean and reduce health and settlement problems.

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

Environment protection has been burning issue in last half century. In order to tackle the menace of pollution, urgent steps have to be taken at not only global or country level, but also at local level. In fact, the role of individuals in prevention of pollution is of critical importance, because it is the individuals that make a community or country. Effort by each

individual at his or her level can have a significant effect on global level. It has been aptly said “charity begins at home”.

Ways in Which a Individual can Help in Prevention of Pollution

- Individuals should minimize wastage of resources such as electricity. Every unit of electricity saved is equivalent unit of electricity produced as it not only saves the fuel that would be used to produce that electricity, but also help to prevent pollution that is accompanied by burning of that fuel. Therefore, person should always switch off appliances when not in use.
- Individuals should prefer walking or use cycles instead of using motor vehicles, especially when distances to be travelled are small.
- Individuals can make considerable contribution by using mass transport (buses, trains, etc) instead of using personal vehicles.
- When going to workplace, colleagues from nearby localities should pool vehicles instead of going in individual personal vehicles.
- Taking personal vehicles for periodic pollution checks at centres approved by authorities.
- Individuals should reuse items whenever possible.
- Products that are made of recycled material should be given preference.
- Use gunny bags made of jute instead of plastic bags.
- Take part in environment conservation drives such as tree planting drives.
- Use water resources efficiently.
- Use renewable resources by installing equipment such as solar heaters and using solar cookers.
- Dispose potentially harmful products such as cells, batteries, pesticide containers, etc properly.
- Use of refrigerators should be minimised wherever possible as they are main source of CFC, which is responsible for Ozone layer depletion.
- Follow and promote family planning, as more population means more resources utilized and more resources utilized imply more pollution.
- Avoid making noise producing activities such as listening to loud music.
- Use handkerchiefs instead of paper tissues.

Organize drives to clean streets and clean drains with help of other people of locality.

Social Issues and the Environment (UNIT- 4)

*** From unsustainable to sustainable development:**

Sustainable development definition:

Meeting the needs of the present, without compromising the ability of future generations, to meet their own needs.

True sustainable development

Optimum use of natural resources with high degree of reusability, minimum wastage, least generation of toxic by products and maximum productivity.

Dimensions of sustainable development

Multi dimensional concept – derived from interactions between society, economy and environment.

Aspects of sustainable development

i. Inter-generational equity ii. Intra-generational equity

Approaches for sustainable development

- 1) Developing appropriate technology - locally adaptable, eco-friendly, resource efficient and culturally suitable.
- 2) Reduce, reuse, recycle [3R] approach – reduces waste generation and pollution
- 3) Providing environmental education and awareness – changing attitude of the people
- 4) Consumption of renewable resources – attain sustainability
- 5) Conservation of non renewable resources – conserved by recycling and reusing
- 6) Population control

*** WATER CONSERVATION:**

Definition: The process of saving water for future utilization

Water conservation refers to the preservation, control and development of water resources, both surface and groundwater, and prevention of pollution.

*** Rain water harvesting**

The storage of rain water for future use is called rain water harvesting.

The rain water harvesting is carried out in two main methods.

In one method, the rain water is directly collected on vessels and tanks and is used for drinking, cooking, bathing, etc. The water collected and stored can be used for months.

In the second method, the rain water is allowed to percolate into the soil by constructing percolation pits. It increases the underground water table.

Need for rain water harvesting (Use of rain water harvesting):

1. To provide water for domestic purposes.
2. To reduce water scarcity.
3. To increase water resources.
4. To increase water table.
5. To increase the quality of water
6. To reduce intrusion of sea water.
7. To reduce floods.

Methods of rain water harvesting:

There are many methods of rain water harvesting:

1. Collection in ponds
2. Collection in vessels
3. Rain water harvesting in tanks
4. Rain water harvesting in open place
5. Percolation pond
6. Percolation pit (Absorption pit)
7. Percolation well

1. Collection in ponds:

Rain water is harvested in surface water bodies like ponds, lakes, irrigation tanks, temple tanks etc. It is a traditional method.

2. Collection in vessels:

The rain water falling on the sloping roofs of houses fall down along the edge of the roof. This is collected in vessels.

3. Rain water harvesting in tanks:

The rain water collected on flat concrete roof is diverted through a pipe into a cement tank constructed near the house or under the house.

The water is passed through a filter. The filter is made up of a layer of 2'' stones, a net, sand and charcoal.

In this method, the water can be stored in a cement tank or well or a bore well.

4. Rain water harvesting in open place:

In the open places, open polythene bags or asbestos sheets are arranged in a slanting manner.

The rain water, falling on this, is collected into vessels or tanks.

5. Percolation pond:

The rain water falling in the elevated areas is collected in small ponds by constructing dykes. This water percolates through the soil and reach the underground water table. This helps to raise the water table.

6. Percolation well:

Rain water from the terrace is diverted into an open well using PVC pipes through a filter chamber.

7. Percolation pit:

A pit of 1 × 1 meter is made on the ground by the side of the house. It is filled with 2'' stones and sand. The rain water falling on the roof is diverted into the pit through PVC Pipes.

The rain water percolates in to the ground and increases the water table.

*** Environmental ethics**

Environmental ethics is the scientific looking of various issues related to the rights of individuals on the environment.

It is the moral relationship of human beings with the environment. It is concerned with the do's and dont's of the human beings to the environment.

It deals with the ecological rights of all creatures present today as well as those which will come next to live on the earth. Ethical standards are necessary for a long term conservation and maintenance of nature and its resources.

Environmental ethics is maintained by the following methods.

1. Equitable utilization of natural resources.
2. Equity among the Northern and Southern countries.
3. Equity among people of rural and urban areas.
4. Equity for males and females.
5. Conservation of resources for future generations.
6. Environmental rights of animals.
7. Environmental education.
8. Conservation of traditional value systems.
9. Use of ecofriendly items.
10. Prevention of hunting and poaching.
11. Regulation of felling of trees.
12. Respecting animals and plants.

*** Green house effect**

Green house effect is the increased warming of the earth caused by the raise in green house gases of the air.

It is the case of air pollution.

In green house effect, the temperature of the earth increases causing global warming.

Green house is a glass house, where green plants are reared. In a glass house the temperature will be slightly higher than that of the outside.

The glass allows the sunlight to pass into the glass house. The sunlight heats the floor of the green house and the floor reflects infrared radiation.

The glass does not allow the infrared radiation to go out. A part of the radiation is absorbed by the glass and another part is reflected back into the green house. Hence the glass house gets heated.

Certain gases such as CO₂, methane, nitrous oxide, chloro fluoro carbon, water vapour, etc. function as glasses in a glass house. These gases are called green house gases. They form a layer of about 20 km above the earth's surface.

The green house gases allow sunlight to pass through them. The sunlight heats the earth and the earth reflects infrared radiation. The green house gases reflect the infrared radiation back to earth. This process warms up the earth.

The warming increases proportionally to the increase in the concentration of green house gases.

*** Green house gases**

The gases responsible for the warming up of the earth are called green house gases.

The following are the important green house gases.

1. Carbon dioxide
2. Methane
3. Chloro fluoro carbon
4. Nitrous oxide
5. Water vapour
6. Ozone
7. Sulphur dioxide, etc.

Green house gases are produced by automobiles, industries, agricultural products, dairy products etc.

Among the green house gases CO_2 has the most harmful effect. It is produced by burning fossil fuels, such as coal, petroleum, etc. In industries, thermal power plants, automobiles, railways, air crafts, etc. The plants and animals release CO_2 by respiration. Burning of firewood and forest fire also release CO_2 .

The coolants used in refrigerators and air conditioners release chloro fluoro carbons.

Methane is produced by bacteria living in the gut of cattle. It is also produced by the decomposition of dead bodies of plants and animals.

The green house gases form a layer about 20 km above the surface of the earth. They allow the sunlight to pass through. They reflect back, the infrared radiation (heat rays).

The green house gases prevent the escape of the infrared rays. They reflect back a portion of the infrared rays to the earth and absorb the remaining portion. This helps the earth to remain warm at about 15°C .

The green house gases bring about the effects similar to that in a glass house. Hence they are called green house gases.

If the green house gases are not there, the earth will become very cold and the water becomes ice. Hence the green house gases are necessary and they are the blessing to the earth.

When the green house gases exceed the optimum amount, the earth becomes over heated and it leads to undesirable and destructive changes on the earth.

*** Global warming**

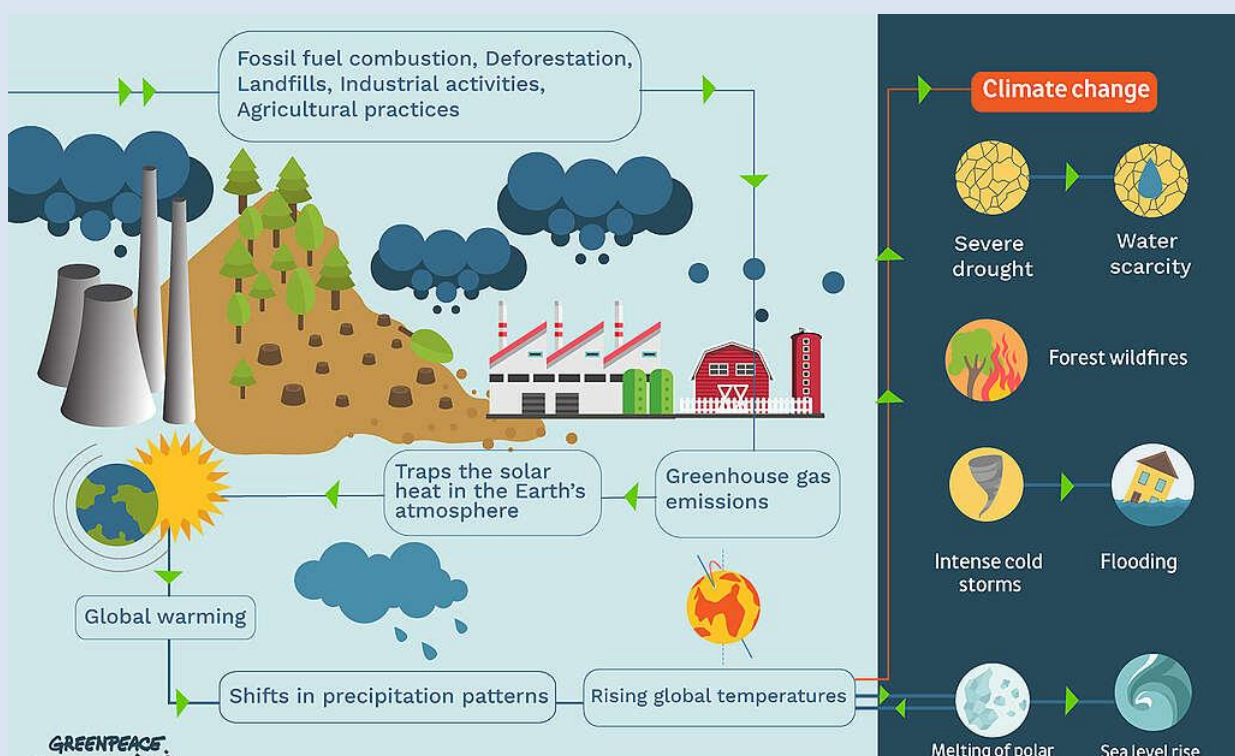
The overheating of the earth by the increased amount of green house gases is called global warming.

The earth is kept warm at an average of 15°C by the green house gases, such as CO_2 , methane, CFC, nitrous oxide, water vapour, ozone, SO_2 , etc.

The green house gases form a layer about 20 km above earth. They trap infrared radiations of the earth and keep the earth warm at an average temperature of 15°C .

The optimum amount of green house gases keeps the earth warm at the optimum level.

But now the industries, automobiles, aircrafts, railways, forest fire and dairy farms release high amount of green house gases. The increased green house gases, reflect back more portion of the infrared rays to the earth and absorb the remaining portion. This leads to increase in the global temperature.



In the last century there was an increase at 0.6°C at the global level. It is estimated that the raising temperature will be 0.5°C for every 10 years. It is estimated that in 2050, the global temperature will increase by 4°C .

Harmful effects of global warming (Harmful effects of green house effect)

Green house effect increases global temperature. The increase in global temperature or global warming produces the following ill effects.

1. The polar ice caps will melt causing an increase in sea level. When the sea level increases, low lying coastal towns and cities will be swallowed by the sea.
2. The drastic changes in the global climate.
3. Melting of ice leads to floods in the river.
4. The rain fall will be affected.
5. Food production will be decreased.
6. The ozone umbrella will be depleted.
7. High temperature may be harmful to the life of man.
8. The agriculture and forestry will be affected.
9. Water resources are also affected
10. It shows effect on human health.
11. It shows effect on both terrestrial and aquatic ecosystems.

Control measures to check global warming:

1. CO₂ emissions can be cut by reducing the use of fossil fuels.
2. Implement energy conservation measures.
3. Utilize renewable resources such as wind, solar, hydro power, etc.
4. Plant more trees
5. Shift from coal to natural gas
6. Adopt sustainable agriculture.
7. Stabilize population growth.
8. Efficiently remove CO₂ from smoke stacks.
9. Remove atmospheric CO₂ by utilizing photosynthetic algae.
10. Public awareness regarding reduction of global warming.
11. Implement strict laws to regulate human activities to control global warming.

*** Acid rain**

Normal rain water is always slightly acidic because of the fact that CO_2 present in the atmosphere gets dissolved in it. Because of the presence of SO_2 and NO_2 gases as pollutants in the atmosphere, the pH of the rain water is further lowered. This type of precipitation of water is called acid rain or acid deposition. (Presence of excess of acid in the rain water is called acid rain. The pH of acid rain is lower than 5.6)

Formation of acid rain:

Acid rain means the presence of excessive acids in the rain water. The thermal power plants, industries and vehicles release nitrogen oxide and sulphur dioxide into atmosphere due to burning of coal and oil. When these gases react with water vapour in the atmosphere, they form acids and descend on to the earth as acid rain through rain water.

Effects of acid rain:

The following are the effects of the acid rain.

1. The acid rain collect in ponds and the ponds becomes acidic. The acidic water kills the fishes in pond. Thus the ponds become fish grave yards. In Sweden there are about 15,000 fishless lakes.
2. The acid rain falling on the earth, leach aluminium. The dissolved aluminium is washed into the pond. In the pond, the aluminium clogs the gills, prevents respiration and caused death of fishes.
3. The bacteria and green algae are killed by acidified water.
4. Acid rain damaged the green leaves and hence the deforests.
5. The acid rain leached the soil nutrients such as calcium, potassium, iron, magnesium, etc. They are washed away from the soil. Hence the plant growth is affected.
6. Photosynthesis is reduced.
7. The yield in crop plants is reduced due to acidification.
8. The activity of nitrogen fixing bacteria present in the root nodules is inhibited and hence the fertility of the soil is reduced.
9. Pine trees are weakened due to acidity.
10. Acid rain damages buildings.
11. Acid rain corrodes monuments, statues, etc.
12. Acid rain causes corrosion of British Parliament Building.
13. Acid rain causes stone leprosy in Taj mahal.

14. Acid rain contaminates potable water and causes abnormality in the nervous system, respiratory system and digestive system.

Control measures of acid rain:

The following are the control measures of acid rain.

1. Improvement in technologies and switching to clear combustion technologies are highly essential in order to monitor the air pollution.
2. Emissions of SO₂ and NO₂ from industries and power plants should be reduced by using pollution control technologies.
3. Coal with low sulphur content is desirable to use in thermal plants. Replacement of coal by natural gas would also reduce the problem.
4. Liming of lakes and soils should be done to correct the adverse effects of acid rain.
5. The real use of cut back on the use of fossil fuels by reducing our dependency on motor vehicles and unnecessary utility of motor vehicles.
6. Prefer to use renewable energy resources for heating and energy purpose
7. Plant more trees to pollutant levels in air.
8. Implement strict laws to regularise human activities to control acid rain.
9. Public awareness regarding reduction of acid rain.

*** Ozone layer depletion**

Ozone is a gas found throughout the atmosphere, but most highly concentrated in the stratosphere between 10 to 50 km above sea level, where it is known as ozone layer.

Importance of ozone layer:

Without the ozone layer, life on the earth's surface would not be possible. It protects us from the damaging ultraviolet radiation of the sun. In particular it filters out UV-B radiations.

Causes for ozone layer depletion:

In 1970, it was found that the ozone layer was attacked by chlorofluoro carbons (CFCs) which are released in to the atmosphere by refrigeration units, air conditioning systems, aerosol sprays and cleaning solvents. chlorofluoro carbons release chlorine which breaks ozone into oxygen.

Each chlorine atom is capable of attacking several ozone molecules. So that a long chain process is involved. A 1% loss of ozone results in a 2% increase in UV rays reaching the earth's surface.

Ozone depleting chemicals:

The ozone depleting chemicals essentially consists of chlorine or bromine atoms which are extremely reactive while they are in the free state. The following gases are accumulated in the atmosphere and are found to be instruments in ozone depletion.

1) Chloro Fluoro Carbon (CFC)

Sources: Refrigerants (Freon) in refrigerators, propellant in aerosol spray cans, blowing agent, foam plastic blowing agent.

2) Hydro Chloro Fluoro Carbon (CFC)

Sources: Refrigerants, blowing agents

3) Bromo Fluoro Carbons (BFC)

Sources: Fire extinguishers

4) Other chemicals

i) Certain halogen compounds are potential ozone destroyers upto ten times more powerful than the CFCs.

ii) Sometimes the atmospheric sulphur dioxide is converted into sulphuric acid which greatly increases the rate of ozone depletion.

Effects of ozone layer depletion:

As the ozone layer gets deteriorated the harmful UV rays will reach the ground and cause various adverse effects.

1) Effect on human health:

a) The UV-rays damage the genetic material in the skin cells which cause skin cancer.

b) For fair skinned people life long exposure to the high level radiation of UV rays increases the risk of non melanoma skin cancer.

c) Prolonged human exposure to UV-rays may lead to slow blindness called actinic keratitis. Enhanced level of UV-rays could lead to more people suffering from cataracts.

d) Human exposure to UV-rays can suppress the immune responses in humans and animals. It also reduces human resistivity leading to a number of diseases such as cancer, allergies and some other infectious diseases.

2) Effect on Aquatic systems:

a) UV-rays directly affect the aquatic forms such as phytoplankton, fish, larval crabs.

b) The phytoplankton consumes large amounts of CO₂.

Decrease in population of phytoplankton could have more amount of CO₂ in the atmosphere which contributes to the global warming.

3) Effect on materials:

Degradation of paints, plastics and other polymeric material will result in economic loss due to effects of UV radiation.

4) Effect on climate:

The ozone depleting chemicals can contribute to the global warming i.e., increasing the average temperature of the earth's surface.

Control measures:

- 1) Replacing CFCs by other materials which are less damaging.
- 2) Use of gases such as methyl bromide which is a crop fumigant should be controlled.
- 3) Manufacturing and using of ozone depleting chemicals should be stopped.
- 4) Implement strict laws to regulate human activities.
- 5) Public awareness regarding the ozone depleting gases.

*** Nuclear Accidents and Holocaust:**

Nuclear accidents can occur at any stage of the nuclear fuel cycle and such accidents are viewed more seriously because the effects of reactor accidents are more drastic. Although the estimated chance of disastrous nuclear accident is very low, but the probability of an accident occurring increases with every reactor put into operation anywhere in the world. Till date following nuclear accidents are most well-known.

1) Three Mile Island Accident: In 1979, on March 28, the most dramatic incident occurred in the U.S. at the Three Mile Island nuclear power plant (Pennsylvania). Radioisotopes as well as intense radiation was released into the environment due to the malfunctioning within one of the nuclear facilities in the nuclear plant. However, the plume emitted into the atmosphere has been estimated quite low for causing toxic effect.

2) The Chernobyl Nuclear Accident: This accident occurred at 28th April, 1986 and resulted in wide spread contamination by radioactive substances. After the incident there were 237 confirmed cases of chronic radiation illness and also 37 deaths.

3) In nuclear holocaust in Japan, 1945, two nuclear bombs were dropped on Hiroshima and Nagasaki cities of Japan. one fission bomb was dropped on Hiroshima. This holocaust (large scale destruction of human lines by fire) killed about 1,00,000 people and destroyed the city. Even after more than 50 years the impacts of the nuclear fallout are still visible.

But the most significant effect of radioactivity is that it causes long range effects affecting the future of man and hence future of our civilization

*** Waste land reclamation**

The conversion of wasteland into land suitable for use of habitation or cultivation is called waste land reclamation.

Waste land. The land which is not in use is called waste land . Waste land is unproductive, unfit for cultivation Grazing etc. 20% of the geographical area of India is waste land.

Types of waste land: 1.Uncultivable waste land .2. Cultivable waste land.

1. Uncultivable waste land: These lands can not be brought under cultivation.

Ex. Barren rocky areas, hilly slopes, sandy deserts, etc.

2. Cultivable waste land: These are cultivable but become waste lands because not cultivated for more than 5 years. Ex Degraded forest land, Gullied lands, water logged and marsh lands , saline lands, etc.

Causes for wasteland formation:

The following are the causes for waste land formation.

1. Over-exploitation of natural resources.
2. By the industrial and sewage wastes.
3. Due to soil erosion, over grazing, deforestation, water logging, salinity etc.
4. Mining activities destroy the forest and cultivable land.
5. The increasing demand for fire-wood and excessive use of pesticides.
6. Developmental activities like construction of dams and power projects have caused considerable damage to land due to water logging.
7. Growing demand for fuel, fodder, wood and food causes degradation and loss of soil productivity.

Objects of waste land reclamation:

1. To prevent soil erosion, flooding and landslides.
2. To avoid over exploitation of natural resources.
3. To improve the physical structure and quality of the soil.
4. To conserve the biological resources and natural ecosystem.
5. To improve the availability of good quality of water for agricultural purposes and industrial operations.

Methods waste land reclamation:

Drainage: Excess water is removed by artificial drainage. This is for water logged soil reclamation.

Leaching: Leaching is a process of removal of salt from the salt affected soil by applying excess amount of water. Leaching is done by dividing the field into small plots. In continuous leaching 0.5 to 1.0 cm water is required to remove 90% of soluble salts.

Irrigation practices: High frequency irrigation with controlled amount of water helps to maintain better availability of water in the land.

Green-manure and biofertilizers: Application of green manure and bio fertilisers improves saline soil.

Application of gypsum: Soil sodality can be reduced with gypsum. Ca of gypsum replaces sodium from the exchangeable sites. This converts clay back into calcium clay.

Social Forestry programmes: These programmes involve strip plantation on road, canal sides, degraded Forest land etc.

Afforestation programmes: These programmes also help to reclaim the waste lands.

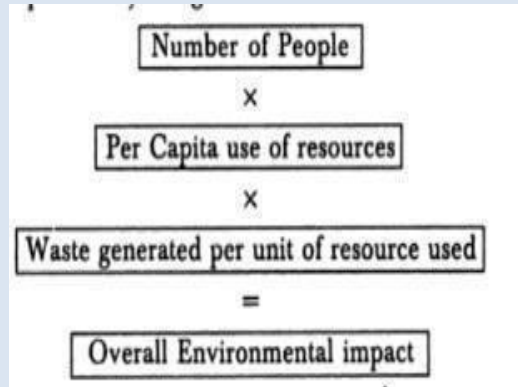
*** Consumerism and waste products:**

Consumerism refers to the consumption of resources by the people. While early human societies used to consume much less resources, with the dawn of industrial era, consumerism has shown an exponential rise it has been related, both to the increase in the population size as well as increases in our demands due to change in life-style. Earlier we used to live a much simpler life and used to have fewer wants. In the modern society our needs have multiplied and so consumerism of resources has also multiplied.

Our population was less than 1 billion for thousands of years ever since we evolved on this earth. Today we have crossed the six billion mark and are likely to reach 11 billion by 2045 as per World Bank estimates. Let us see how these changing population trends influence consumerism of natural resources and generation of wastes. Two types of conditions of population and consumerism exist. These are,

- i) **People over-population:** It occurs when there are more people than available supplies of food, water and other important resources in the area. Excessive population pressure causes degradation of the limited resources and there is absolute poverty, undernourishment and premature death.
This occurs in less developed countries (LDCs). Here due to large number of people, adequate resources are not available for all. So there is less per capita consumption although overall consumption is high.
- ii) **Consumption over-population:** Consumption occurs in the more developed countries (MDCs). Here population size is smaller while resources are in

abundance and due to luxurious life style per capita consumption of resources is very high. More the consumption of resources more is the waste generation and greater is the degradation of the environment. This concept can be explained by using the model of Paul Ehlich and John Holdren (1972)



*** Air (Prevention and control of pollution) act – 1981**

The Parliament enacted the Air (Prevention and Control of Pollution) Act, 1981 to arrest the deterioration in the air quality. The notable points from this act are as follows:

- 1) The central board may lay down the standards for the quality of air.
- 2) The central board coordinates and settle disputes between state boards, in addition to providing technical assistance and guidance to state boards.
- 3) The state boards are empowered to lay down the standards for emissions of air pollutants from industrial units or automobiles or other sources.
- 4) The state boards are to collect and disseminate information related to air pollution and also to function as inspectorates of air pollution.
- 5) The state boards are to examine the manufacturing processes and the control of equipment to verify whether they meet the standards prescribed.
- 6) The directions of the central board are mandatory on state boards.
- 7) The operation of an industrial unit is prohibited in a heavily polluted areas without consent of the central board.
- 8) Violation of law is punishable with imprisonment for a term, which may extend to three months or fine up to rupees ten thousand or both.
- 9) The state board can advise the state government to declare certain heavily polluted areas as pollution control areas and can advise to avoid the burning of waste products which can cause air pollution in such areas.

*** Water (Prevention and control of pollution) act – 1974**

The Water (Prevention and Control of Pollution) Act was enacted (1974) for prevention and control of water pollution and maintaining or restoring of wholesomeness of water. The Central and State Pollution Control Boards have been constituted under section 3 and 4 of the water Act respectively.

Obligation on the part of the industries and local bodies are:

- a) To obtain prior consent to establish and operate industry for new discharge of domestic sewage or trade effluent under section 25 of the Act.
- b) Board within four months will either refuse or grant consent.

Function of Central board:

- a) Subject to the provision of this act, the main function of the Central Board shall be to promote cleanliness of streams and wells in different areas of the country.
- b) Advise the central government on any matter concerning the prevention and control of water pollution.
- c) Co-ordinate the activities of the state boards and resolve dispute among them.
- d) Provide technical assistance and guidance to the state boards, carry out and sponsor investigations and research relating to problems of water pollution and prevention.
- e) The board may establish or recognize a laboratory or laboratories to enable the board to perform its function under this section efficiently, including the analysis of the samples of water from any stream or well or of sample of any sewage or trade effluents.

Power of State board:

- a) To obtain information under section 20.
- b) Carry out any related work under section 30.
- c) Collect and analyze sample of streams/wells or trade effluent.
- d) To give direction for closure/prohibition or regulation of industries.
- e) Enter and inspect any place, examine any plants/records etc. and seize if necessary.

*** Wild life protection act – 1972**

The Wildlife Act was passed in 1972 to protect the wildlife and their habitats. The habitat destruction due to agriculture, industries, urbanisation and other human activities had led to the erosion of the country's wildlife.

The notable points from this act are as follows:

1. It defines the wildlife related terminology.
2. Enactment of an All India Wildlife Protection Act (1972).
3. It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc.
4. Becoming a party to the Convention of International Trade in Endangered Species of Fauna and Flora (CITES, 1976).
5. Launching a “national component of UNESCO’s ‘Man and Biosphere Programme’ (1971).
6. Under the Act, comprehensive listing of endangered wildlife species was done for the first time and prohibition of hunting of the endangered species was mentioned.
7. Protection to some endangered plants.
8. The Act provides for setting up of National Parks, Wildlife Sanctuaries etc.
9. The Act provides for the constitution of Central Zoo Authority.
10. There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.
11. The act imposes a ban on the trade or commerce in scheduled animals.
12. It provides for legal powers to officers and punishment to offenders.

*** Forest conservation act – 1980**

The forest conservation act (1980) covers all types of forests including reserve forests, protected forests or any forested land irrespective of its ownership. The Act has made ample provisions to check deforestation and encourage afforestation of non-forest areas.

The National Forest Policy (1980) prohibits State governments for declaring any portion of forests as non-reserved without approval of Central government. The policy also prohibits State government for allotting any forest land for non-forest purposes.

The amended Act (1988) prohibits lease of forest land to anybody other than the government. It enhances conservation, plantation and increase of forest cover to an average of 30%.

Amended Forest Act, 1992:

1. The Act made provision for allowing some non-forest activities in forests without cutting trees with prior approval of Central government. These activities include setting of transmission lines, seismic surveys, exploration, drilling and hydroelectric projects.

2. Wildlife sanctuaries, National Parks etc. are totally prohibited for any exploration or survey without prior approval of Central government even if no tree felling is involved.
3. Cultivation of tea, coffee, spices, rubber, mulberry for rearing silk worms and cash crops are included under non-forestry activities and are not allowed in reserve forests.
4. Even cultivation of fruit bearing trees, oil yielding plants or medicinal plants in the forest area need to be first approved to maintain the balance in the ecology of the forest.
5. Mining is a non-forestry activity and prior approval of Central government is mandatory.
6. Any proposal sent to Central government for non-forest activity must have a cost benefit analysis and also Environmental Impact Statement (EIS) of the proposed activity.
7. More stringent penal provisions are made against violators of the Act.

*** Environmental protection act – 1986**

This is a general legislation law in order to rectify the gaps and laps in other acts. This act empowers the central government to fix the standards for quality of air, water, soil and noise and to formulate procedures and safe guards for handling of hazard substance.

Important features of the environmental protection act – 1986

- 1) The act further empowers the government to lay down procedures and safe guards for the prevention of accidents which cause pollution and remedial measures if an accident occurs.
- 2) The government has the authority to close or prohibit or regulate any industry or its operation, if the violation of the provisions of the act occurs.
- 3) The penal sections of the act contain more stringent penalties. Any person who fails to comply or who contravenes any provision of the act shall be punishable with imprisonment for a term extending to five years or be punishable with fine upto rupees one lakh or both.
- 4) If the violation continues, an additional fine of rupees five thousands per day may be imposed for the entire period of violation of rules.
- 5) The act fixes the liability of the offence punishable under act on the person who is directly in charge.

Whether he/she is the director or manager or secretary or any other officer,

unless he/she proves that it was committed without his/her knowledge or consent.

6) The act empowers the officers of central government to inspect the site or the plant or the machinery for preventing pollution and to collect samples of air, water, soil or other material from any factory or its premises for testing.

The environmental protection act is the most comprehensive legislation with powers for the central government to directly act, avoiding many regulatory authorities or agencies.

HUMAN POPULATION AND THE ENVIRONMENT (UNIT- 5)

*** Population explosion**

The enormous increase in population due to low death rate (mortality) and high birth rate (natality) is termed as population explosion.

Causes for population explosion:

- **Increase in birth rate:** Lack of awareness in terms of birth control has resulted in a rapid explosion in population.
- **Decrease in mortality rate:** The advanced science and medical technologies have reduced the mortality rate to a large extent.
- **Increase in life expectancy:** Growth and development in terms of living conditions, sanitation and hygiene have ensured greater life expectancy, thus resulting in population explosion.
- **Lack of recreation:** In rural areas, due to lack of recreation, people engage in sexual activities without taking protective measures to control birth.
- **Illiteracy:** Education makes people aware. Illiteracy, on the other hand, results in lack of awareness regarding family planning, female education and their age of marriage. Illiterate people think that more the hands in the family more will be the family income- a concept which is faulty in itself.

Effects of population explosion:

- **Over population:** This is a condition wherein the limited resources are to be shared by a huge population when earlier it was being shared by only a small population. This means that a comfortable living will not be attainable by one and all.
- **Poverty:** Population explosion is directly proportional to poverty. As population grows beyond control, scarcity of resources will be faced, thus resulting in poverty.
- **Unemployment:** Population explosion, again, is directly proportional to unemployment. This means that the economy will not be able to create sufficient employment for an unchecked, sudden growth in population.
- **Poor health and economy:** The demand will be greater than the supply, thus, resources such as proper food, shelter and clothing along with monetary aspects will not be available to every hand of the nation.
- **Pollution:** Population explosion will increase the demand for goods. This means that more raw materials will be extracted from the earth. In turn, this will cause more by-products and waste, thus causing pollution.

Measures to control population explosion:

Control measures must be taken in order to put a stop to population explosion. The government must join hands with every individual of the society to bring about a productive change. This can be done by firstly educating people and creating more awareness regarding population explosion and its repercussions. Secondly, family planning norms must be followed by every single household of India. Thirdly, the minimum age of marriage should be increased, and fourthly, the government should give certain incentives to families who adopt birth control measures.

Population explosion is an urgent issue in India which needs to be resolved in order to ensure every citizen a comfortable, healthy living and at large, a greener and cleaner earth.

***Family welfare and planning programmes**

Family welfare programme:

Family welfare programme was implemented by the government of India as a voluntary programme. It is an integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right.

Objectives of family welfare programmes:

- 1) Slowing down the population explosion by reducing the fertility.
- 2) Pressure on the environment due to over exploitation of natural resources is reduced.

The government are concerned with the enormous increase in births and promulgated some rules and regulations to restrict population growth.

The following are some of the rules to be followed for family welfare.

- 1) The marriage age is 21 for men and 18 for women.
- 2) Use of family planning techniques is recommended when the couple has 2 children.

Family planning methods include:

- 1) Tubectomy for women
- 2) Vasectomy for men
- 3) Use safety during intercourse
- 4) Announcement of incentives for those who observe family planning and undergo tubectomy and vasectomy.
- 5) Giving publicity to family welfare programmes among rural population and illiterate public.

The advantages of family welfare measures are:

- 1) Restriction of human population
- 2) Increase GDP and productivity
- 3) Better utilization of the natural resources
- 4) Economic development of the nation.
- 5) Increase of the average nation income.

*** Environment and human health**

Environment and human health are two inseparable entities. If one gets disturbed other will be automatically disturbed. Generally a physically fit person, not suffering from any disease, is called a healthy person. But, the factors like nutritional, biological, chemical or psychological, which cause harmful changes in the body's conditions are called disease.

Earth surface and the surrounding environment is very important to human health. The environment is polluted due to manmade activities. Millions of people die every year due to illness caused by environmental pollution.

Important hazards and their health effects (or) Deterioration of environment and health effect

1) Physical hazards and their health effects:

S.No.	Physical Hazards	Health effects
1.	Radioactive radiations	a) Affects the cells in the body and the function of glands and organs. b) Suffer from cancer.
2.	UV radiations	Skin cancer
3.	Global warming	Temperature increase causes famine, mortality
4.	Noise	Painful and irreparable damage to human ear.

2) Chemical hazards and their health effects: A large number of chemicals are introduced in the environment by anthropogenic activities.

S.No.	Chemical hazards	Health effects
1.	Combustion of fossil fuels: Liberates SO ₂ , NO ₂ , CO ₂ , and particulate matters.	Asthma, Bronchitis and other lung disease.
2.	Industrial effluents (Toxic)	Kill cells and cause cancer and death.
3.	Pesticides like DDT and Chlorinated pesticides	Affect the food chain
4.	Heavy metals like Hg, Cd, Pb, fluoride and nitrite	Contaminate water cause ill effects

3) Biological hazards and their health effect:

Biological hazards	Health effects
Bacteria, viruses and parasites	Diarrhoea, malaria, parasitic worms, anaemia, respiratory diseases, cholera, etc.

*** Human rights**

Human rights are the fundamental rights, which are possessed by all human beings irrespective of their caste, nationality, sex and language. These rights can not be taken away by any legislature or any government act. As natural rights they are seen as belonging to men and women by their very nature.

Environment is also a part of the universal system. Populations living on this planet earth in different countries are protected by certain human rights. Common human rights are the following:

- ❖ Right to live freely and independently.
- ❖ No other individual should do anything leading to loss of life.
- ❖ Life is linked to productivity of the organisms.
- ❖ No individual should cause any harm to kill others.
- ❖ No life should be subjected to torture by others.
- ❖ Torture free, independent life is a fundamental human right.

1) Right to life: Life is a gift given by God to all living organisms. So this human right called right to life can be applied to plants and animals present in the environment also. So “live and let others also live” should be the maxim that everyone should follow. We should allow all living organisms to lead a normal life.

2) Right against loss of life: No other organism in the environment should think of killing or cutting off various parts of others.

3) Productivity is linked to life: Productivity is a metabolic property observed in all types of living organism. No step should be taken that will hinder the process of natural reproductive methods of plants and animals or human beings. It is also against human rights.

4) Avoid killing others: Some people are fond of hunting animals and birds. That is also killing other living organisms. They are also liable for some deterrent punishment. So gaining should be prohibited. It is equal to murdering others.

5) Law against torture: Apart from killing or murdering, we should not allow torturing of anybody others. No one should be allowed to torture others.

6) Law against, torture free, independent life: Living organisms whether they are animals or plants should be allowed to live a torture free, stressless, independent happy existence as long as they live. They should be subjected to either stress or torture by anybody even by their own kith and kin.

*** Value Education**

Value education is an instrument used to analyse our behaviour and provide proper direction to our youths. It teaches them the distinction between right and wrong, to be compassionate, helpful, loving, generous and tolerant. So that a youth can move towards the sustainable future.

Value-based environmental education: Value-based environmental education provides knowledge about the principle of ecology, fundamentals of environment and biodiversity. It creates a sense of duty to care for the natural resources and to manage them in a sustainable way.

When environment gets degraded it affects our health, well-being and our future. So it is important to know all about the environment and also have a right to safe and clean environment.

An awareness is needed to save the environment, the Earth of man. It is inoculated through environmental value education.

The environmental value education involves the following aspects:

- ❖ Teaching the importance of Earth.
- ❖ Knowledge on environment..
- ❖ Understanding the natural resources.

- ❖ Appreciating the environmental assets.
- ❖ Understanding the balance of nature.
- ❖ Experience the problems caused due to our destruction of our environment.
- ❖ The problems created by the technology and economic growth.
- ❖ Regulated use of natural resources.
- ❖ To keep our environment neat and clean.
- ❖ To use less fertilizers and pesticides.
- ❖ To conserve water and energy.
- ❖ To separate the garbage into degradable and non-degradable items.
- ❖ Effects of consumerism and pollution
- ❖ Ill effects of deforestation.
- ❖ Impacts of global warming.
- ❖ Causes and impacts of acid rain.
- ❖ To understand the ill effects of atom bomb explosion.

*** AIDS/HIV**

AIDS is the abbreviated form of Acquired Immuno Deficiency Syndrome caused by a virus called HIV (Human Immune Deficiency virus). Many myths have been spread about AIDS and it is very important for everyone to know the facts about HIV/AIDS.

Factors influencing modes of transmission of HIV:

HIV is spreading due to the following activities.

- 1) HIV from infected person can pass to a normal person through blood contact, generally during unprotected sex with infected person.
- 2) Using needles of syringes, contaminated with small quantities of blood from HIV positive person, also transmit HIV to others.
- 3) HIV can also pass from infected mothers to their babies during pregnancy, delivery or breast feeding.
- 4) Blood transfusion from the infected person, at the time of accidents or pregnancy also results in HIV/AIDS.
- 5) Women are more vulnerable to HIV, biologically the male to female transmission of HIV is 2 to 4 time more efficient than female to male transmission.
- 6) Women around 18-20 years are at more risk, since their cervical tissue is more vulnerable to invading HIV.

7) Since the majority of HIV infections occur in women of child-bearing age, transmission of HIV to their new born babies happen easily.

Factors not influencing transmission of HIV:

HIV is not spreading by the following activities.

Tears, food and air, cough, handshake, mosquito, flies, insect bites, urine, saliva, sharing of utensils, clothes, toilet, bathroom, etc.

Symptoms for HIV/AIDS:

Many people have no symptoms, when they are infected with HIV. But some people get fever, headache, fatigue. During this time HIV is present in large amounts in semen and vaginal fluids and it is very easy to pass the infection to another person.

HIV is very active inside a person's body. The virus multiplies and kills more and more T-cells of the immune system.

Consumption of alcohol increases the susceptibility to infection and progress of AIDS.

Minor symptoms:

- 1) Persistent cough for more than one month.
- 2) General skin disease
- 3) Viral infection
- 4) Fungus infection in mouth and throat.
- 5) Frequent fever, headache, fatigue

Major symptoms:

- 1) Fever for more than one month.
- 2) Diarrhoea for more than one month
- 3) Cough and TB for more than six month.
- 4) Fall of hairs from the head.
- 5) 10% of body weight get reduced within a short period.

Control and prevention measures of AIDS:

Once a person is infected with HIV the person remain infected for life. There is neither a cure nor a vaccine but can be prevented.

The basic approaches to control AIDS are.

1) Education: Health education enables people to avoid indiscriminate sex and encourages the use of safety. One should avoid the use of sharing razors, needles and syringes.

2) Prevention of blood borne HIV transmission: People in highrisk groups should not donate blood. Blood should be screened for HIV before transmission and strict sterilization practices should be followed in hospitals.

3) Primary health care: AIDS awareness programmes should be encouraged. Voluntary health agencies should participate in large. Training programmes to doctors and paramedical workers should be conducted.

4) Counselling services: Counselling services should be provided either in person or through telephone.

5) Drug treatment: Testing HIV treatment does not mean the end. They can still stay healthy leading productive lives for many years. Seeking early medical care and staying active are very vital in managing HIV. The immune system has to be kept boosted by taking nutritious diet and maintaining a stress-free mid.

Effects of HIV/AIDS:

- 1) Large number of deaths occur, which affect environment and natural resources.
- 2) Due to large number of deaths, there is loss of labour and level of production decreases.
- 3) More water is required for maintaining hygiene in AIDS affected locality.
- 4) The people affected by HIV, can not perform work well due lack of energy and frequent fever and sweating.

*** Women and Child Welfare**

Women and Child welfare Schemes

Women and children are very important identities of human society. The adult women are the creators of next generation, and children are the hopes of future. Therefore they should be cared to utmost degree. No doubt, their welfare is being looked after by societies and families. However, this is just not sufficient. In this regard, Governments also devise and implement various welfare measures for them. Some of the women and child welfare measures are listed below.

- 1) Sarwa Siksha Abhiyan
- 2) Balika Samridhi Yojana
- 3) Indira Mahila Yojana
- 4) Programme of Development of women and Children in Rural areas
- 5) Mahila Samridhi Yojana
- 6) Integrated Child Development Services
- 7) Employment and Income Generating Training-cum-Production centers

- 8) Rashtriya Mahila Kosh
- 9) Short Stay Home for Women and Girls

Problems affecting Women and Child Welfare

The major problems faced by Women and Children are:-

- 1) Under nourishment
- 2) Malnutrition
- 3) Limited education
- 4) Lower socio-economic status

A brief discussion of these issues is given below:-

(i) Under nourishment

Under nourishment means the lack of sufficient calories in food. The lack of energy and nutrients make them prone to infectious diseases. It causes weakness and sickness also. Mainly the poor women and children are severely influenced by it. They are generally subjected to following ill-effects.

- 1) weakness and giddiness
- 2) lower working efficiency due to weakness
- 3) sickness at increased frequency
- 4) poor growth of children
- 5) social and mental disorders
- 6) mental retardation

(ii) Malnutrition

Malnutrition means lack of specific ingredients such as vitamins, proteins, minerals, etc. in the food. Pregnant women, nourishing mothers and children are more susceptible to malnutrition. It causes the following ill effects in women and children.

- 1) Illness like anemia, goiter, pellagra, etc.
- 2) Less weight of child at birth.
- 3) High rate of child mortality.
- 4) Miscarriages, maternal depletion, toxemia of pregnancy in pregnant women.

According to demographic data and estimates, the projections in the year 2002 for India are as follows;

Infant mortality rate = 68.

Life expectancy at birth (total life) = 63.3.

(iii) Limited education

The number of school going children is still far from satisfactory. Less than 50% reach to primary school. Also a substantial number of them than drop out at elementary level. The drop-out rate of girls is much higher than those of the boys. It is probably because the girls have to perform many household works also. The literacy rate of women and children to given below reveals more facts in this regard.

Literacy in the year 2001 at national level=65.38%

- a. The literacy rate in males = 75.85%
- b. the literacy rate in female =54.16%

(iv) Lower socio-economic status

The socio-economic status of women is generally lower than man in under-developed countries. This can be understood well by the fact that the number of school going boys at all levels of education is generally more than the number of girls. Also the grown up and adult women are depend in respect of social and economical decisions. The lower socio-economic status of women and children can also be understood by the following status

- a. Women labour force in the year 2001 = 90 million
- b. Child labour force in the year 2001 = 11.28 million

*** Role of information Technology in environment and human health**

Information technology has tremendous potential in the field of environment education and health as in any other field like business, economics, politics or culture. Development of internet facilities, Geographic Information System (GIS) and information through satellites has generated a wealth of up-to- date information on various aspects of environment and health.

A number of software have been developed for environment and health studies which are used friendly and can help an early learner in knowing and understanding the subject.

Database on Environment System:

Database is the collection of interrelated data on various subjects. It is usually in computerized form and can be retrieved whenever required. In the computer the information of database and can be very quickly retrieved. The comprehensive database includes wildlife database, conservation database, forest cover database etc. database is also available for diseases like HIV/AIDS, Malaria, Fluorosis, etc.

(a) National Management Information System (NMIS):

NMIS of the Department of Science and Technology has compiled a database on Research and Development Projects along with information about research scientists and personnel involved.

(b) Environmental Information System (ENVIS):

The Ministry of Environment and Forests, Government of India has created an information System called Environmental Information System (ENVIS). With its headquarters in Delhi, it functions in 25 different centres all over the country.

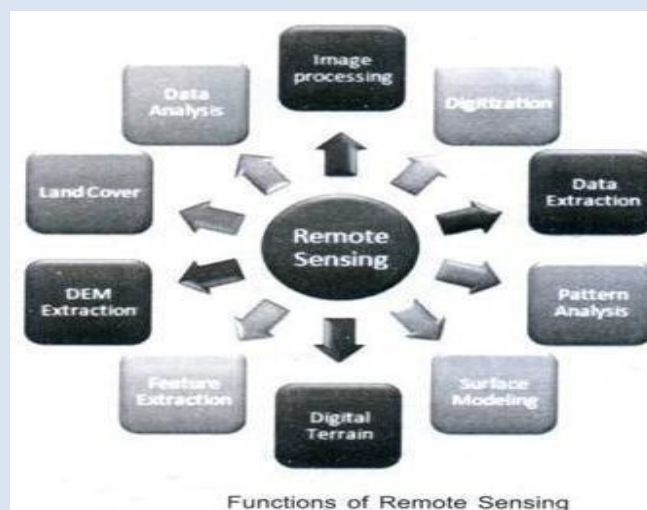
The ENVIS centres work for generating a network of database in areas like pollution control, clean technologies, remote sensing, coastal ecology, biodiversity, western Ghats and eastern environmental management, media related to environment, renewable energy, desertification, mangroves, wildlife, Himalayan ecology, mining etc.

(c) Remote Sensing and Geographical Information System (GIS):

Satellite imageries provide us actual information about various physical and biological resources and also to some extent about their state of degradation in a digital form through remote sensing.

Satellite imageries provide us actual information about various physical and biological resources and also to some extent about their state of degradation in a digital form through remote sensing.

We are able to gather digital information on environment aspects like water logging, desertification, deforestation, urban sprawl, river and canal network, mineral and energy reserves and so on.



(d) Geographical Information System (GIS):

GIS has proved to be a very effective tool in environmental management.

GIS is a technique of superimposing various thematic maps using digital data on a large number of inter-related or inter dependent aspects. Several useful soft-wares have been developed for working in the field of GIS.

Different thematic maps containing digital information on a number of aspects like water resources, industrial growth, human settlements, road network, soil type, forest land, crop land or grassland etc. are superimposed in a layered form in computer using software.

There are several Distribution Information Centres (DICs) in our country that are linked with each other and with the central information network having access to international database.



They also provide information of atmospheric phenomena like approach of monsoon, ozone layer depletion, inversion phenomena, smog etc. We are able to discover many new reserves of oils, minerals etc. with the help of information generated by remote sensing satellites. Thus remote sensing and GIS play a key role in resource mapping, environmental conservation, management, and planning and environmental impact assessment.



(e) The World Wide Web:

With resources material on every aspect, class-room activities, and digital files of photos, power-point lecture presentations, animations, web-exercises and quiz has proved to be extremely useful both for the students and the teachers of environmental studies.

TEXTBOOKS

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson Education.
3. S. Azeem Unnisa, "Environmental Studies", Academic Publishing Company.
4. K. Raghavan Nambiar, "Text Book of Environmental Studies for Undergraduate Courses as per UGC Model Syllabus", Scitech Publications (India) Pvt. Ltd.

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1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M. Anji Reddy, "Text Book of Environmental Sciences and Technology", BS Publications.
3. J. P. Sharma, "Comprehensive Environmental Studies", Laxmi Publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private Limited.
5. G. R. Chatwal, "A Text Book of Environmental Studies", Himalaya Publishing House.
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", Prentice Hall of India Private Limited.

WEB RESOURCES & NPTEL / ONLINE LINKS

- NPTEL: Environmental Science – <https://nptel.ac.in/courses/124107002>
- Google Earth Engine (free cloud geospatial platform) – <https://earthengine.google.com>
- Global Forest Watch (free deforestation monitoring) – <https://www.globalforestwatch.org>
- OpenAQ (free global air quality open data) – <https://openaq.org>
- iNaturalist (free citizen science biodiversity app) – <https://www.inaturalist.org>
- QGIS (free, open-source GIS) – <https://qgis.org>
- India Meteorological Department (free data) – <https://mausam.imd.gov.in>
- Central Pollution Control Board (CPCB) data portal (free) – <https://cpcb.nic.in>

"The greatest threat to our planet is the belief that someone else will save it."